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Appropriation et authenticité : une didactique des expériences d'apprentissage d'étudiants engagés "jeu sérieux" en Epidémiologie et Biostatistique

Celso André de Souza Barros Goncalves

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THÈSE

Pour obtenir le grade de

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Spécialité : **Ingénierie de la Cognition, de l'interaction, de l'Apprentissage et de la création**

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préparée au sein du **Laboratoire d'Informatique de Grenoble - UMR 5217, Equipe MeTAH**
dans l'**École Doctorale EDISCE**

Appropriation et Authenticité, Une étude didactique des expériences d'apprentissage d'étudiants engagés dans un "jeu sérieux" en Epidémiologie et Biostatistique

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*Speciality Engineering for the Cognition, Interaction, Learning and
Creation*

Appropriation & Authenticity

A didactic study of the learning

experience of students engaged in a

serious game on Epidemiology and Biostatistics

Celso André DE SOUZA BARROS GONÇALVES

Dedication

Along the path to completion of a professional project such as a thesis, personal experiences are important. I trod some of this way without any institutional support; I had to be obstinate to achieve my goals. Therefore, I dedicate this work to those who supported, helped, and inspired me, while widening my mind and spirit, and who offered or facilitated important job opportunities and my early scientific work.

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My thesis did not emerge as a complete document, but was rather formed from various layers of written and unwritten co-operative discourse and oral exchange, and unpublished and published papers. Every time I presented a rough sketch of my ideas, this was polished and enriched by many generous contributions, comments, observations, and suggestions. I thus thank Jerry ANDERSEEN at Twente University, Michael BAKER at Telecom Paris Tech, Sten R. LUDVIGSEN at the University of Oslo, and Thomas MOHER at the University of Illinois. I wish to thank colleagues from the Themis team at the TIMClab, especially Claudine SCHWARTZ, Sandra DAVID-TCHOUDA, and my thesis co-Director Jean-Luc

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No matter how much effort a young researcher may invest in a scientific field, the horizon may appear closer than is in fact the case because of a lack of experience; such experience is essential for appropriate development of research. This is why PhD candidates need supervisors; these individuals are usually experienced senior researchers who take a broad view of a field. Not only do they recognize connections between various scientific concepts but they can also identify and respect the importance of an embryonic idea that may in fact evolve to become useful. I am honoured and humbled to have had the opportunity to work with Nicolas BALACHEFF and Muriel NEY. I want to thank them for their conceptual support; for every meeting they had with me; and for every clarification they made. Finally, I cannot end without expressing my eternal gratitude to my thesis director Muriel NEY for her presence, and the support and assistance provided during the past five years. She has guided me not just into a research field but also into a professional life. Thank you for doing this with such dignity.

Foreword

When I look back over the fifteen-year path that led to my present work, I can identify my reasons. As a researcher, my motivation to engage in scientific studies had its roots in my undergraduate days. During work for my degree in Psychology at the *Universidade Federal de Uberlândia*, I was lucky to meet teachers who were committed to the conduct of fieldwork and who were involved in projects dedicated to the local community. I volunteered to work as a research assistant and I became a member of various teams and projects during three of the five years I spent at that university. While taking these first steps into research, I often encountered problems with data collection, observation methods, or interaction, within class or work situations. I always tried to capture the moment in a genuine observation. I developed questionnaires; created observational situations; took notes in the field; interacted with and interviewed students, teachers, and workers; and video-recorded situations of interest. The findings of these field projects were published in the Proceedings of local and national Brazilian conferences on Psychology.

I became concerned about the genuineness of observations. I found the first elements of an answer at the *Université Lyon II*, during my Master's studies in Organizational Psychology (*Travail Coopératif et Travail en Réseaux*). I was introduced to the field of Information and Communication Technology and, especially, the analysis of human interaction. I also became a member of a local/regional community of researchers committed to interaction analysis in various fields. These people worked in the ICAR laboratory of the *Ecole Normal Supérieur de Lyon*, where I also worked temporarily as research assistant during the year after I finished my Master's. During this time I became familiar with software specifically designed to analyse interaction as revealed by audio-video recordings and computer trails. Indeed, the use of technology to analyse human interaction provided answers to the research issues that I found important and I became fascinated with the opportunities thus afforded.

The prospect of commencing PhD studies on how technology could enhance learning was most welcome. I applied for a research position that would allow me to observe learning situations using these new technologies. The program focus was on the micro-didactics and proposed implementation of a didactic situation via conduct of a *serious game* in Biostatistics within a medical school. I thought that this offered a very interesting opportunity to study interaction analysis in a didactic situation. What a rich corpus of work would be produced! On the one hand, I would have access to the totality of the didactic engineering that underlay the project (the didactic programming and analysis of interactions from an *a priori* perspective); I would also be introduced to a new field, the French school of Didactics of Mathematics. On the other hand, I would be able to analyse human interactions *in situ* within a *serious gaming* scenario. My research questions emerged when I considered *Appropriation Phenomena*; the process was natural. The first questions were triggered by my interest in investigating the learning process under the planned experimental conditions.

Résumé

Cette thèse s'intéresse à la relation sujet-objet – l'expérience d'apprentissage vécu par des étudiants universitaires dans le cadre du *jeu sérieux Laboratorium of Epidemiology (LOE)*. Elle porte essentiellement sur la modélisation de phénomènes d'apprentissage – Appropriation et Authenticité – et se veut multidisciplinaire en rassemblant Psychologie de l'Education, Didactique des Mathématiques et Environnements Informatiques pour l'Apprentissage Humain.

Le terrain d'expérimentation de cette thèse se place dans le cadre d'un module de Biostatistique dans lequel le jeu sérieux LOE a été implémenté de manière écologique et pérenne. La problématique de recherche porte sur les phénomènes d'appropriation et d'authenticité qui sont formalisés et illustrés, en s'appuyant sur la Théorie des Situations Didactiques (TSD) de Brousseau.

Des traces d'activité, des interactions verbales et des entretiens directs ont été analysés au cours de trois années d'utilisation du jeu LOE. Ce travail a permis la construction de concepts tels que « l'appropriation de rôle » par des étudiants dans le contexte d'un jeu sérieux, « l'appropriation de problèmes » par les étudiants que ce soit à travers leurs interactions individuelles avec l'objet (le jeu) ou dans la recherche collaborative de solution aux problèmes, et enfin « la perception de l'authenticité » du jeu.

Ainsi, cette thèse montre comment appropriation et authenticité découlent de l'interaction individu-objet. L'appropriation est un élément de l'expérience d'apprentissage à partir duquel l'individu fait sien un objet d'apprentissage dans un processus actif de développement transformationnel dans lequel l'individu reconstruit l'objet qu'il s'approprie à sa manière. Dans le modèle proposé, le processus s'établit par des catégories non nécessairement consécutives : accepter, tester, faire des choix, anticiper et maîtriser. La perception de l'authenticité d'un jeu sérieux par un individu est favorisée par des attributs de l'environnement informatique en raison de l'impact qu'ils produisent chez l'individu. L'authenticité d'un environnement informatique est définie comme un compromis entre trois dimensions élémentaires : réalisme, cohérence interne et pertinence didactique.

Une meilleure compréhension de ces phénomènes à la base du processus d'apprentissage contribuera aux études futures sur la qualité de l'enseignement et sur la conception de nouveaux outils, en particulier ceux basés sur le jeu de rôle et l'immersion.

Mots-clés : Théorie de Situations Didactiques, Appropriation, Authenticité, Jeu sérieux

Abstract

This thesis focuses on the relation between a subject and an object. Specifically, it deals with the learning experience of university students for the serious game *Laboratorium of Epidemiology (LOE)*. It basically concerns the modelling of learning phenomena in the didactics of mathematics—appropriation and authenticity. This study will be a multidisciplinary one that covers the fields of psychology of education, didactics of mathematics, and technology-enhanced learning.

As a part of this thesis, a field experiment was conducted in a class of biostatistics, in which LOE was implemented in an ecological and permanent manner. The research problem concerns the phenomena of appropriation and authenticity, which are formalized and illustrated and supported by Brousseau's Theory Didactical of the Situations.

The tracks of activity, verbal interactions, and direct interviews were analysed over a three-year period during which the LOE game was used. This study allowed the construction of concepts such as 'role appropriation' by students in the context of a serious game; 'appropriation of problems' by students, whether individually through interactions with the object (game) or by collaboratively seeking a solution to the problems; and 'the perception of the authenticity' of the game.

Through this approach, this thesis shows how appropriation and authenticity ensues from the interaction between individuals and objects. Appropriation is an element of the learning experience from which individuals make their own learning objects in an active process of transformational development, in which individuals reconstruct an object that they appropriate in their own way. In the proposed model, the process is established using categories that are not necessarily consecutive: accept, make choices, anticipate, and master. The perception of the authenticity of a serious game by an individual is favoured by the attributes of an information technology environment owing to the impact such attributes have on individuals. The authenticity of an IT environment is defined as a compromise among three elementary dimensions: realism, internal coherence, and didactic relevance.

A better understanding of these phenomena on the basis of the learning process will contribute to future studies on the quality of teaching and on the design of new tools, especially those based on role-playing and immersion.

Keywords: Theory of Didactic Situations, Appropriation, Authenticity, Serious Games

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Résumé en Français

Les sociétés modernes trouvent leurs fondements dans le développement de leurs systèmes éducatifs. Des paradigmes, tels que le constructivisme, ont influencé la formation de certains de ces systèmes éducatifs et des concepts qui les structurent. Parmi ces théories se trouve celle des « situations didactiques » (Brousseau, 1997) qui permet une compréhension des interactions entre apprenants, enseignant et connaissance. Parallèlement, l'arrivée des nouvelles technologies a attiré l'intérêt des communautés scientifiques pour l'éducation et donna lieu à la création de nouvelles stratégies d'apprentissage tel que l'apprentissage investigateur basé sur ordinateur (de Jong, 2006), l'apprentissage collaboratif basé sur ordinateur (Stahl, Koschmann et Suthers, 2006) et bien d'autres encore. La rencontre des nouvelles technologies avec les stratégies d'apprentissage a déclenché une série d'innovations aboutissant à des stratégies novatrices pour la conception et l'amélioration des situations d'apprentissage. Un des concepts innovants qui mérite une attention spéciale est celui des phénomènes embarqués (Moher, en 2006).

La combinaison de ce concept avec des stratégies d'apprentissage tel que l'apprentissage basé sur des projets, la découverte ou sur des jeux, etc., est une intéressante initiative. Parmi les différents enseignements supérieurs, l'entraînement médical constituant un terrain essentiel pour l'étude de la combinaison des technologies novatrices et des stratégies d'apprentissage, la présente thèse se développe dans ce contexte. Selon les études traditionnelles en didactique des disciplines (Jonnaert et Laurin, 2001), le présent travail s'inscrit dans le cadre de la psychologie et de la didactique. La thèse se développe dans le contexte du projet « Laboratoire of Epidemiology » (LOE). Ce projet s'inspire du concept des phénomènes embarqués (Moher, 2006) et cherche à répondre à des besoins spécifiques du système d'enseignement en associant nouvelles technologies, nouvelles stratégies d'apprentissage et cadres théoriques. La présente thèse porte sur ces besoins ainsi que sur l'apparition d'innovations notables dans le cadre de l'enseignement de l'épidémiologie et de la biostatistique dans une école de médecine.

Dans le cadre du cursus de l'école de médecine, les étudiants doivent acquérir des compétences en « lecture critique d'articles scientifiques ». Il s'avère que les étudiants ont du mal à comprendre l'utilité de l'outil de biostatistique dans leur formation pendant les premières années et, plus tard, lorsque le besoin d'utiliser ces outils se fait enfin sentir, les acquis ne sont plus disponibles. Ainsi, le projet LOE est une initiative pour contextualiser les disciplines de la biostatistique et de l'épidémiologie dans une situation réaliste et authentique en vue de procurer aux étudiants les bases nécessaires pour établir une réflexion critique. Nos questions de recherche concernent trois points essentiels : (i) comment les étudiants jouent

le jeu (ii), comment ils apprennent en s'appropriant un problème et (iii) comment ils perçoivent l'authenticité de la situation simulée. La présente thèse explore des propositions théoriques plus qu'elle ne priorise des validations expérimentales. La qualité même de l'apprentissage des étudiants n'est pas l'objet de notre étude ; notre intérêt s'est en effet surtout porté sur le processus par lequel l'apprentissage a lieu dans des environnements fictionnels, mais néanmoins réalistes.

La thèse se structure en trois parties. Dans la première, nous présentons la théorie des situations didactiques, une théorie qui soutient le modèle que nous proposons pour « l'appropriation de problèmes par des étudiants ».

Dans le Chapitre 1, les phénomènes d'appropriation sont développés et expliqués dans le cadre d'une étude étymologique puis dans une étude généalogique sur l'origine du concept d'appropriation et les différentes formes qu'il acquiert avant d'être appliqué dans le domaine de la didactique des mathématiques. Ensuite, un modèle conceptuel pour l'appropriation de problèmes par l'apprenant dans le cadre de la théorie des situations didactiques (Brousseau) sera proposé.

Pour conclure, le Chapitre 2 présente le LOE et une étude didactique qui lui est associée. Les objectifs d'apprentissage appartiennent en effet au domaine de l'épidémiologie qui s'applique essentiellement à la discipline de biostatistique. L'environnement informatique et la discipline de travaux pratiques dans lesquels le LOE a été implémenté seront passés en revue et le problème que les étudiants sont censés s'approprier sera décrit.

Nos questions de recherche concernent les phénomènes d'appropriation et nous nous sommes particulièrement investis dans une investigation sur le processus d'apprentissage des étudiants dans le cadre d'un jeu sérieux. L'objectif du jeu est de proposer une situation dans laquelle les étudiants peuvent s'immerger entièrement. Un autre but est d'offrir une situation par laquelle la connaissance cible est la solution optimale du problème proposé (Brousseau, 1997). Les enseignants et concepteurs de cette activité ne veulent en effet pas seulement que les étudiants jouent, mais aussi qu'ils entrent dans un processus de résolution de problèmes spécialement conçus pour les aider à acquérir une connaissance cible. Le jeu, dans ce contexte, ajoute du réalisme au problème que les étudiants doivent résoudre, pouvant rendre la situation d'apprentissage plus complexe tout en étant éducative. Le risque est toutefois que les étudiants s'engagent dans la résolution d'un problème différent de celui proposé par les enseignants et concepteurs du LOE.

C'est ici que notre intérêt pour les phénomènes d'appropriation se fait jour. L'appropriation est un processus par lequel l'apprenant peut s'approprier le problème cible proposé au cours d'une situation d'apprentissage, et ce processus est à ce titre pertinent dans un environnement qui favorise la pratique. C'est en effet au fil du temps, que se développe le processus d'apprentissage. Dans notre

enquête sur les moyens par lesquelles l'apprentissage prend place, voici les questions qui ont animé nos réflexions :

- Les étudiants jouent-ils le jeu ?
- Apprennent-ils par le biais de ce jeu ?

Ces questions en appellent d'autres :

- Les étudiants s'approprient-ils le jeu ?

Le jeu propose un jeu de rôle, ce qui nous mène à la question suivante :

- Les étudiants s'approprient-ils un rôle en jouant le jeu (Question 1) ?

Dans une situation didactique (Section 0.2, Chapitre 0), les étudiants sont confrontés à un objet d'apprentissage, un jeu sérieux dans lequel un problème est posé et dont le chemin qui mène à sa résolution est effacé.

- Les étudiants s'approprient-ils le problème (Question 2) ?

Le jeu LOE, caractérisé en tant que phénomène embarqué, est supposé procurer une expérience authentique d'apprentissage. Le jeu simule l'activité du médecin épidémiologiste ; les étudiants jouent ce rôle en conduisant une enquête épidémiologique. Il y a simulation des conséquences de l'apparition d'une maladie spécifique dans des hôpitaux publics et les étudiants sont chargés par une commission de santé publique d'examiner l'apparition de cette maladie. Ceci conduit à une troisième question :

- Perçoivent-ils la situation d'apprentissage proposée comme étant une situation authentique (Question 3) ?

Dans la deuxième partie de ce travail, nous répondons aux trois questions ci-dessus, en nous appuyant sur trois études distinctes et indépendantes que nous avons réalisées.

Le Chapitre 3 concerne le processus à partir duquel nous avons formulé la première question, notre but étant de découvrir si, en jouant le jeu, les étudiants s'approprient un rôle (1). Nous nous sommes intéressés aux critères qui permettent de considérer si un étudiant s'est approprié le rôle (1.1) et aux indicateurs qui peuvent être collectés en observant des étudiants jouant le jeu (1.2). Pour répondre aux questions de recherche, nous avons analysé les interactions des étudiants avec des personnages du jeu, parce que ces moments offrent des occasions aux étudiants pour jouer un rôle.

Le chapitre 4 répond à la deuxième question. Comme il s'agit d'une situation didactique, ce jeu sérieux présente aux étudiants un problème. Dans une approche de pédagogie active, le problème n'est pas explicite, les étudiants doivent le découvrir. Il est alors question de savoir si les étudiants s'approprient le problème (2). Les étudiants travaillent en équipes. L'examen de la façon dont ils s'approprient le problème implique de prendre en considération leur capacité à résoudre le problème posé et la manière dont, individuellement et collectivement, ils se le sont appropriés. Nous appliquerons le modèle « d'appropriation de problèmes par des étudiants », introduit au Chapitre 1, pour illustrer comment les étudiants s'approprient un problème dans le cadre d'un travail en équipes. Cela

permettra de dresser une analyse de cette appropriation tant individuelle que collective par des étudiants.

Dans le Chapitre 5, nous analysons la conception même du jeu, qui est destiné à procurer une expérience authentique d'apprentissage, et doit nous permettre de cerner la question de la perception de l'authenticité de l'environnement par les étudiants (3). La littérature traitant du réalisme perçu dans les contenus télévisuels et sur Internet suggère de questionner le jugement des sujets plutôt que le réalisme de l'objet. Nous avons ainsi étudié les perceptions de cette authenticité dans les jugements des étudiants immédiatement après une séance de biostatistique, en passant également au crible les indices, dans l'environnement du jeu, qui permettent aux étudiants de poser ces jugements d'authenticité.

L'obtention d'une meilleure compréhension des phénomènes étant à la base du processus d'apprentissage, elle contribuera non seulement aux études futures portant sur la qualité de l'enseignement mais aussi à la conception de nouveaux outils pouvant être introduits dans le système éducatif. Une conclusion suivra qui reliera les trois études placées dans la perspective d'un sujet apprenant, de son appropriation d'un objet d'apprentissage ainsi que de ses perceptions d'authenticité manifestées à partir des jugements émis lors de ses interactions pendant le jeu.

Dans le chapitre suivant, nous présenterons brièvement les concepts principaux de la théorie des situations didactiques, ce qui nous permettra de poser les jalons de l'étude des phénomènes d'appropriation.

Introduction

The foundation of modern societies is developed by educational systems. Such educational system serves as the societies' decorator, as it incorporates individuals into the relevant institutions. Conversely, the system should be adaptive in order to be able to accept new challenges as well as coping with innovation needs. The two main paradigms; constructivist and socio-constructivist have outlined the learning notion through the learner's perception and set out the basis to improve contemporary learning strategies. Some examples of the latter are problem-based learning, collaborative learning, game-based learning, discovery learning, project learning, and so on.

Constructivism has initially influenced the Theory of Didactic Situations. The TDS (Brousseau, 1997) proposes another perspective that enables the understanding between the interactions of learners, teachers and knowledge within a classroom environment; also the conditions under which learning occurs by introducing many innovative concepts like didactic contract, devolution, milieu, just to name a few. Micro-didactics have proven effective apparatuses to contribute towards the creation of didactic situations within the notion of strategies involving problem-based learning for instance.

Comparatively, opportunities for innovations in education have been increased by the advancement of technologies, where technological tools could complement the learning strategies. There has been much increase of focus in education from the scientific communities thus various technological instruments have been created for instance Computer-Supported Inquiry Learning (De Jong, 2006), Computer-Supported Collaborative Learning (Stahl, Koschmann and Suthers, 2006), and others.

The complements between new technological instruments and learning strategies have created a series of innovations as well as resulting in innovative strategies for designing and improving learning situations. Such advancement that is worthy of consideration is the concept of embedded phenomena (Moher, 2006). Its application to classroom space and time proposes simulations reproducing

scientific phenomena during regular classes and provides authentic situations of learning.

A combination of the above mentioned concept with learning strategies such as project-based learning, discovery-learning, game-based learning, and so forth, is an interesting initiative. It enables the implementation of simulations and learning games in schools through an ecologic perspective. It contextualises learning experiences finding support on new technologies.

The high education training such as in medical field is an essential area for the combination of innovative technologies and learning strategies. In such areas it is particularly essential for learners as they would not be initially able to understand the purpose of what they learn. They become demotivated because the learning does not contribute towards their learning objectives as well as personal experiences or learning projects. This is for instance the case with abstract teaching contents (e.g. statistics for medical students, calculus for engineers, etc).

The current thesis takes place on such context. According to traditional studies on Didactic of Disciplines (Jonnaert & Laurin, 2001) the current work revolves around psychology, thus fundamentally focused on the subject as the learner under unique state within a learning environment. However, it also possesses the elements regarding epistemology, emphasising learning objects and learning process as well.

Inspired by Moher's (2006) *embedded phenomena*, the Laboratorium of Epidemiology (LOE) project could present a possible response to some specific needs in the education system by associating new technologies with new learning strategies and frameworks. The present thesis focusses on those needs and the emergence of new innovations, specifically in the teaching of epidemiology in medical schools.

As part of the medical school curriculum, students have to become competent in the critical reading of scientific articles. The difficulty they subsequently face is in understanding the importance of biostatistics, mainly in terms of epidemiology and public health. One of the reasons for this is the length of time between the first classes on biostatistics (in second year) and the examinations on critical reading (in sixth year). Students feel that they put a huge amount of effort into acquiring

knowledge but do not understand how to apply that knowledge. It is difficult for them to appreciate the importance of learning about the discipline in the initial years when they are not in a position to put that learning to practical use in the field of public health. When they finally start working in the field, most of their acquired learning and competencies are no longer available to the environment they are in.

Thus, the LOE project is an attempt to contextualise the disciplines of statistics and epidemiology in a realistic and authentic setting in order to give students an opportunity for critical reflection. LOE is a full-scale simulation combined with a game scenario that includes role-play. It is a *serious game* which offers an opportunity for professional training in a fictitious but realistic context.

With the above scenario in mind, this thesis investigates the learning experience in this attempt to contextualise practical problems relating to epidemiology and biostatistics in an innovative learning environment using a practical, reality-based learning program. The focus here is threefold: (i) how students play the game, (ii) how they learn by appropriating a problem, and (iii) the perceptions they have about the authenticity of the simulated situation.

This thesis explores theoretical propositions rather than prioritising experimental validation. Theoretical concepts will be introduced and backed up by illustrations, but it is not my intention to offer full experimental validation of my contentions. I will emphasise (in the Discussion and Conclusion paragraphs) that my conceptual propositions require future validation; in other words, my aim in the first instance is merely to offer ideas.

The quality of students' learning itself is not the object of the study; rather the focus is on the process by means of which learning takes place in fictitious but realistic environments. This thesis presents theoretical and conceptual propositions regarding the appropriation phenomena, and its aim is to investigate the students' learning process in the context of a serious game that focusses on the very conditions in which such learning happens.

In the first part of this work, I will introduce the Theory of Didactical Situations, a theory that underpins my proposed model for the appropriation of problems by students. In Chapter 1, I will then introduce and develop the appropriation

phenomena in an etymological study in which I analyse the difference between the term 'appropriation' and its related terms in order to explain why that term is the most suited to the phenomenon under investigation. Secondly, I will explore the appropriation phenomena in a genealogical study investigating the origins of the concept of appropriation and the different forms it acquired prior to its use in the field of the Didactics of Mathematics. Finally, I will introduce a conceptual model for problem appropriation in the field of didactics inspired by Brousseau's work on micro-didactics as promulgated in his Theory of Didactic Situations. Based on the structure of the *Milieu* introduced in the Theory of Didactical Situations by Brousseau and later enriched by Margolinas, I will propose a model for *student problem appropriation*, which will be the main focus and contribution of this thesis.

To conclude this first part, in Chapter 2 I will introduce the Laboratorium of Epidemiology (LOE) in addition to the associated didactic study. The learning goals belong to the field of epidemiology (which draws heavily on the discipline of biostatistics). I will describe the computer environment and the practical classes within which the Laboratorium of Epidemiology (LOE) was implemented, in addition to analysing the problem students are asked to appropriate.

My research questions centre on the context of appropriation phenomena and I am primarily interested in investigating student learning processes through the medium of a serious game. The main goal of the game is to offer learners a situation mirroring real life, in which they can fully immerse themselves. Another goal is to offer a situation whereby the target knowledge is the optimal solution to a proposed problem (Brousseau, 1997). Tutors and designers want students not just to play, but to step into a problem-solving process especially designed to support them in gaining the target knowledge. Since the game adds a real-life dimension to the problem students must solve, it may become complex despite being educational. As a result, students run the risk of engaging in solving a problem different to the problem proposed by their tutors and the designers of LOE. Appropriation is a process whereby learners appropriate the target problem intended by their learning program, and this process shows them the relevance of their learning in a practical environment. The learning process evolves over time.

In the beginning of my investigation when I was trying to establish how learning happens I came up with the following questions:

- Do students play the game?
- Do they learn from the game?

A new question arises immediately from the above:

- Do students appropriate the game?

The game includes role playing, which leads us to the following question:

- Do students appropriate roles while playing the game (Question 1)?

In the didactic situation (see Section 0.2, Chapter 0), students are introduced to a learning object, a serious game in which a problem is embedded, and where the path to the solving of the problem is blurred.

- Do students appropriate the problem (Question 2)?

The game, featuring embedded phenomena, is supposed to be an authentic learning experience. The epidemiologist role is simulated; students play this role while conducting an epidemiological survey. The consequences of the outbreak of a specific disease in public hospitals are simulated and the students are requested by a public health commission to investigate the occurrence of the disease.

- Do they perceive the proposed learning situation as an authentic situation (Question 3)?

In the second part of this work, the three questions above are answered here on the basis of three distinct and independent studies.

In Chapter 3, which deals with the process I use to formulate the first question, my aim is to find out whether, when playing the game, students appropriate the game (1), which is partly designed to be a role-playing game. If there is a role to be appropriated, I am interested in the criteria used to consider whether a student has appropriated a role (1.1), and the indicators to be collected when observing students perform the game (1.2). In order to answer the research questions, I analyse students' interactions with characters in the game because these moments of interaction offer opportunities for students to play their roles.

Chapter 4 is dedicated to answering the second question. As a didactical situation, this serious game presents students with a problem. The question then addresses whether students appropriate this problem (2). Students work in small teams.

Investigating the manner in which they appropriate the problem involves considering whether they solved the problem posed and how they appropriated the problem both individually and collectively. Here, I will apply the model of student problem appropriation I introduced in Chapter 1 in order to illustrate how students appropriate a problem in the context of team work. This will provide an analysis of both individual and collective appropriation by students.

In Chapter 5, I will look at the design of the game, which is intended to promote an authentic learning experience. The next question centres on whether students perceived the game environment to be authentic (3). Authors who studied perceived realism in television or online content suggest that the judgement's focus should be on the specific moment and content that prompted the judgement rather than on the realism of the content or activity category as a whole. I will study perceptions of authenticity by investigating the judgements students express immediately after playing the game. I will also look at the cues in the game's environment that enable students to make judgements regarding authenticity, in addition to the role played by such cues in students' judgements.

Gaining a better comprehension of the phenomena underlying the learning process will contribute to future studies on the quality of teaching and to the conception of new tools to be introduced in the education system. The conclusion will feature a discussion linking the work in the three studies, and will present the perspective of an individual learner regarding the appropriation of a learning object. It will also focus on the perceptions of authenticity manifested in the learner's interactions. The conclusion will follow.

In the next chapter, I will briefly introduce the main concepts in the Theory of Didactical Situation, which will allow me to lay the groundwork for further development of the appropriation phenomena.

Thesis Organisation Chart

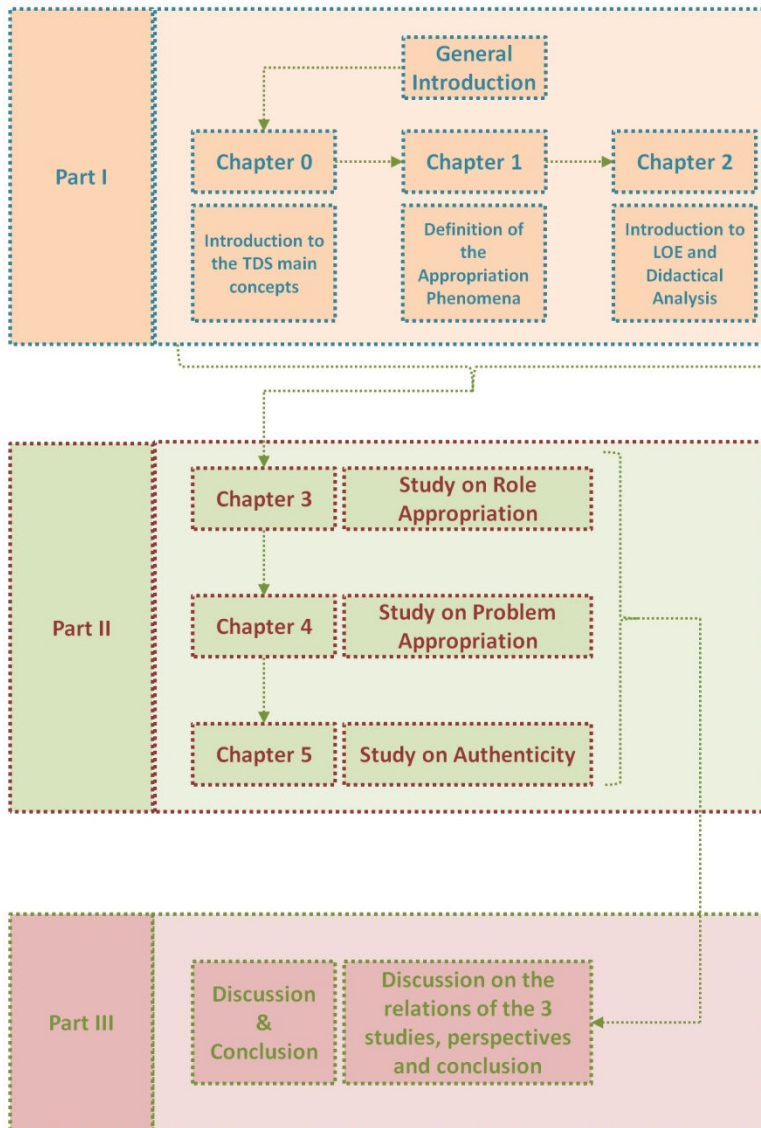


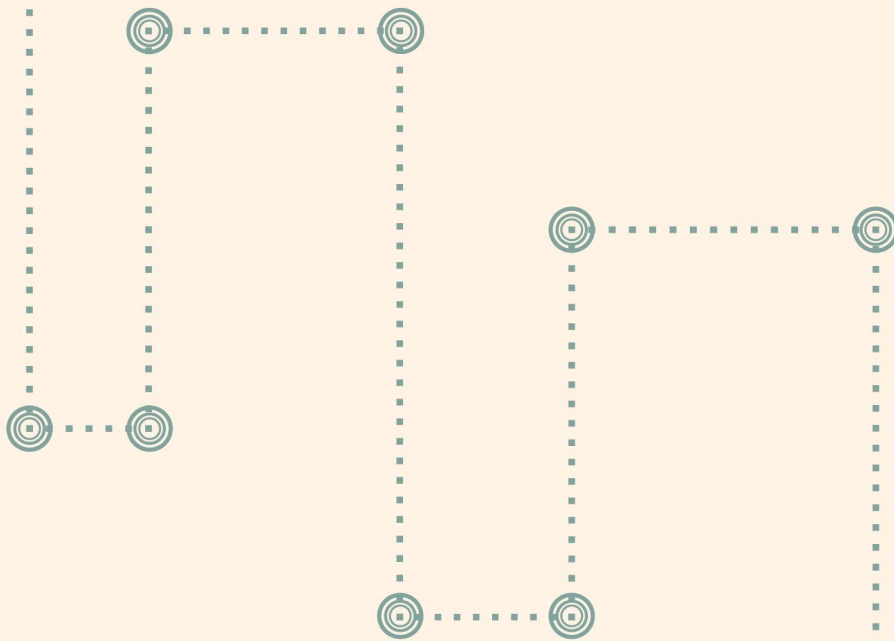
Figure 0.i. Thesis Organisation Chart

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Chapter 0



Chapter 0 Summary

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Résumé en Français

LES CONCEPTS PRINCIPAUX DE LA THEORIE DES SITUATIONS DIDACTIQUES

La théorie des situations didactiques émerge dans le contexte du paradigme constructiviste et propose une forme d'enseignement par laquelle l'enseignant provoque chez l'apprenant des adaptations productives à l'égard d'une connaissance ciblée, par le biais de problèmes adéquats.

Situation didactique

Une situation est dite didactique lorsqu'un individu (l'enseignant) a l'intention d'enseigner à un autre (l'apprenant) une connaissance donnée. L'enseignant élabore alors une situation visant à provoquer chez l'apprenant l'appropriation d'une connaissance donnée. La situation didactique est donc « la somme » d'un contrat didactique et d'une situation adidactique.

Contrat didactique

Un contrat didactique est une relation réconciliant enseignant et apprenants dans le cadre d'une situation didactique. Selon Brousseau, certains aspects de ce contrat doivent rester implicites, l'enseignant devant même provoquer d'éventuelles infractions pour ne pas révéler directement aux apprenants la solution qu'il attend d'eux. De plus, il doit pousser les apprenants à questionner leur propre compréhension.

Situation adidactique :

Désigne la situation dans laquelle l'intention d'enseigner n'est pas explicite pour l'apprenant, qui réagit comme si elle était non-didactique, c'est-à-dire en prenant des décisions, en appliquant des stratégies et en évaluant leur efficacité. La motivation est inhérente aux apprenants. L'enseignant ne peut pas imposer mais seulement négocier une situation adidactique.

La situation adidactique est déterminée par une négociation d'entrée, appelée « la dévolution », et une négociation de sortie, que l'on nomme « l'institutionnalisation ».

Dévolution : Ce concept est inspiré du paradigme socioconstructiviste et souligne l'action des apprenants, de même que leur responsabilité sur le processus d'apprentissage. Selon Brousseau, c'est l'action par laquelle le professeur s'assure que les apprenants acceptent non seulement leur part de responsabilité dans une situation adidactique mais aussi les conséquences de ce transfert de responsabilité (de l'enseignant vers les apprenants).

Institutionnalisation : Il s'agit d'un phénomène social et d'une phase essentielle du processus didactique. Elle constitue une situation d'institutionnalisation de connaissances. Selon Brousseau, son objet est une double reconnaissance car,

d'une part, l'apprenant reconnaît officiellement la connaissance ciblée et, de l'autre, l'enseignant considère officiellement l'apprentissage de l'apprenant.

Milieu

Le milieu didactique est l'ensemble des éléments matériels, des informations et des procédures avec lesquelles l'apprenant interagit pour construire une connaissance. Il peut être défini comme le contexte et les conditions dans lesquelles les apprenants agissent sur un problème donné, mobilisent leurs connaissances et réussissent sa résolution.

Situation d'action : C'est une situation dans laquelle la connaissance de l'apprenant s'exprime par des décisions et des actions régulières ou effectives sur le milieu. Celles-ci développent une connaissance implicite (des suppositions, des expériences, des choix, la prise de décisions) qui se manifeste par des moyens d'action dans le milieu. L'action permet à l'apprenant de construire des objets-connaissance implicites, tels que des outils de solution dans le cadre d'une situation didactique.

Situation de formulation : Le langage est ici à la fois moyen de communication et outil de résolution d'un problème. Ainsi, par exemple, un apprenant formule une stratégie et un autre apprenant évalue cette formulation en agissant dans le milieu. La formulation doit être le moyen d'agir dans le milieu qui permettra à l'apprenant d'obtenir des résultats. La formalisation permet l'institutionnalisation des aspects socialement reconnus de ces outils, et leur conversion en objets-connaissance explicites.

Situation de validation : Les apprenants établissent ensemble la validité de la connaissance caractéristique de la situation. Ils cherchent donc la valeur de la vérité des propositions – concernant « le milieu » et « la connaissance formulée » – au travers « du dialogue » en opposant leurs propositions et validations, mais aussi en les réinvestissant dans le milieu. À mesure que « le dialogue » se met en place, se développent aussi les propositions et validations. Ainsi, les apprenants s'approprient les règles de validation qui participent à la conceptualisation. La validation permet le réinvestissement de ces objets-connaissance dans de nouveaux problèmes, et leur utilisation comme autant d'outils de solution.

Au terme de ce processus, l'apprenant doit pouvoir faire face à d'autres situations similaires sans intention didactique, comme à de nouvelles situations adidactiques.

ANALYSE DE LA STRUCTURATION DU MILIEU

Cette structuration, composée de ces trois types fondamentaux de l'action didactique – action, formulation et validation, est une importante contribution de la théorie des situations didactiques. Brousseau propose en effet la structuration du milieu comme un outil pour moduler l'ingénierie didactique des situations didactiques. Paradoxalement, « pour savoir, il faudrait déjà connaître [...] un savoir qui n'existe pas encore ! ». C'est pourquoi Margolinas avance sur cette question de

la structuration du milieu en proposant une forme hélicoïdale dans l'ingénierie didactique qui fait « fonctionner les connaissances implicites avant et pendant l'appropriation du savoir proprement dit » et qui rend possible de « prendre en compte des aspects différents du sens d'un même savoir ».

La structuration assume ainsi une forme d'emboîtement qui va de la structure la plus interne, à la structure la plus externe, si on se place dans la perspective de l'apprenant, dans une analyse ascendante : Situation Objective, Situation de Référence, Situation Adidactique d'Apprentissage, Situation Didactique et Situation de Projet.

Chaque situation suscite en effet l'interaction entre l'apprenant et le milieu. Les différentes situations sont constituées en spirale et l'apprenant interagit à chaque fois avec l'objet d'une façon privilégiée. Le tout constitue les différentes formes d'interaction qu'un apprenant peut éprouver dans une situation adidactique.

Une telle structuration donne un support pour comprendre le processus d'appropriation d'un problème par un apprenant et pour mettre à jour les marqueurs d'appropriation.

Situation objective

La situation objective est le résultat de l'interaction entre un « étudiant objectif » et un « milieu matériel » dans laquelle l'étudiant rencontre le problème posé et agit pour le résoudre et finir une situation inachevée. Le milieu matériel contient un ensemble d'objets dont quelques-uns sont familiers à l'individu, ce qui lui offre quelques voies d'entrée pour accéder au problème.

Situation de référence

Dans cette situation, « l'étudiant apprenant agissant » cherche à trouver une réponse au problème posé. C'est une situation d'action dans laquelle l'apprenant trouve une connaissance qui lui permet d'adopter une stratégie de base. En interagissant avec un milieu objectif, l'apprenant élabore des connaissances implicites liées au contexte du problème posé. L'apprenant partage avec des collègues cette situation et participe ainsi à des discussions épistémologiques dans lesquelles il expose des arguments.

Les situations « objectives » et « de référence » sont ainsi des situations d'action dans lesquelles l'apprenant élabore des modèles implicites.

Situation adidactique d'apprentissage

Ici, « l'étudiant apprenant » anticipe, formule et valide des connaissances à un premier niveau. Il interagit avec un « milieu de référence » qui contient les objets produits dans la situation de référence. « L'étudiant apprenant » anticipe alors l'effet de ces actions, formule le développement de la résolution, etc.

Situation didactique

Dans la situation didactique, les intentions de l'enseignant rejoignent les intentions de l'apprenant. Le milieu d'apprentissage est composé par la situation adidactique

d'apprentissage. L'apprenant formule ici ce qu'il a appris dans la situation didactique, les raisons des erreurs commises et les formulations de preuve du résultat obtenu. Il veut prouver la valeur de vérité de ses propositions.

Situation de projet

Dans cette situation, « l'étudiant réflexif » interagit avec le « milieu didactique ». Il regarde avec une certaine distance la situation d'apprentissage et se projette dans les intentions de l'enseignant ainsi que dans la progression du contrat didactique.

PRESENTATIONS DES CHAPITRES SUIVANTS

Les prochains chapitres présentent : (1) l'introduction d'un modèle d'appropriation de problèmes au sein de la présente théorie, puis (2) une présentation du projet « *Laboratorium of Epidemiology* » (LOE) de même qu'une analyse didactique de la situation créée pour le jeu sérieux, à savoir une étude épidémiologique. Ensuite, trois études sont présentées : (3) une modélisation et une mesure d'appropriation de rôle, (4) une étude d'un cas illustrant le modèle d'appropriation de problèmes et enfin (5) une modélisation de la perception d'authenticité. Le dernier chapitre (6) propose quant à lui une discussion et une conclusion sur la perspective de l'individu apprenant, ses mouvements d'appropriation envers l'objet et sa perception de l'authenticité dans le cadre de l'interaction individu-objet.

Theory of Didactical Situations: The Principal Concepts

Didactics of Mathematics is a French school of Didactics, which “studies the processes of transmission and acquisition of this science, particularly in situations at school and universities. It intends to describe and explain the phenomena relative to the relations between its teaching and its learning” (DOUADY, 1984).

The learning theory proposed by Piagetian constructivists working in Didactics features a situation in which a learner is a principal actor in knowledge-building. Understanding evolves continuously by reference to (and realignment of) former representations of past events the learner has already appropriated. Learners reconstruct received information based on previous knowledge.

The Theory of Didactic Situations (the TDS) emerged in the context of the paradigm of constructivism and retains traces of the conditions prevalent when the Theory emerged. The TDS was developed by Guy Brousseau in the 1980s and is not strictly aligned with Piagetian theory though the objective characteristics of the two schools of thought are similar. Brousseau set up the COREM (Research and Observational Centre on Mathematics Education) associated with the Michelet School of Talence (France). In collaboration with local teachers, he established, developed, and studied various situations in which mathematics may be taught. The TSD encompasses views on knowledge, teaching situations, and the roles of teachers and students in class. The TDS embraces analysis of systems¹; the TDS is a systemic theory, in a broad sense.

0.1. Why study “Didactique”?

Teaching

Brousseau (1986) takes a systemic approach toward establishment of his Theory of Didactic Situations. Embracing this perspective, Brousseau decompose a

¹ **About the use of *Systems Theory* or *Systemics*.** Minati (2001) differentiates both related terms: The term “*Systems Theory*” or “*Theory of Systems*” evokes specifically a scientific context and evolves in concepts from physics and mathematics (i.e. the theory of control). The term “*Systemic*” highlights the cultural aspects underlying the reasoning of this theory and is valid when applied to any discipline or domain; “the scientific domain is but one possible context” (Minati, 2001).

teaching situation into sub-systems featuring defined actors, for example a student or an educational system. Brousseau applies an analysis by sub-systems which afford a simplified perspective of the student and the problem. This approach identifies the relevant didactic phenomena; a theoretical foundation is thereby built.

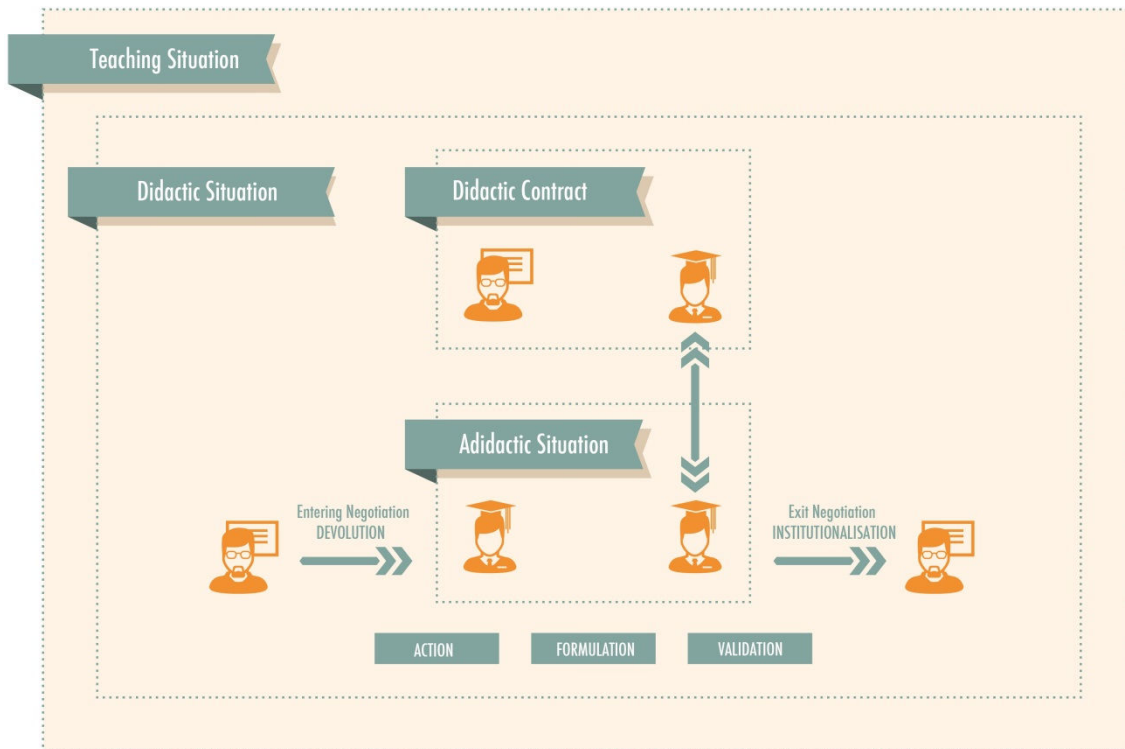


Figure 0.1. The Teaching Situation and the Principal Concepts of the Theory of Didactic Situations.

Brousseau (1986) decomposed a system into sub-systems to define the various games in which actors engage when interacting within the system. It then becomes possible to analyse the *knowledge game*. Who are the communicating partners? Are they student-and-student or teacher-and-student? On the other hand, the didactic game can also be analysed. What strategies are adopted? What does the teacher do when developing a didactic situation?

Such analysis facilitates comprehension of articulation between the design of games and difficulties that may arise. Brousseau then explains students play the "*students' game*" with their didactical environment regarding knowledge (the knowledge game); on the other hand, when designing a didactic situation, teachers play the "*teacher's game*" with the "*students' game*" regarding the strategies to be co-ordinated in the game of knowledge. This is how Brousseau developed the notion of didactic study.

Brousseau (1986) cites the studies of social systems conducted by Crozier and Friedberg (1977). These authors showed that it was possible to consider a group of people as a system. To do this, one must be able to identify the mode of government of the group. If it is possible to discover stable rational strategies exercised by a group, to understand the games, and to comprehend the rules and regulations of such games, it is possible to consider a group as a system. Brousseau suggests that concrete “systems of action games” cannot proceed in the absence of constant confrontation with reality. However, he warns of the risks of seeking to anticipate what elements might explain a phenomenon. It is important to be attentive and open-minded, thus to not become locked into a mindset.

0.2. The Didactic Situation

A situation is didactic when an individual intends to teach something to another. The term describes the relationship of a learner to a teacher in a situation established by the teacher to provide delivery of knowledge. Such knowledge is associated with problems and the solutions to these problems. The situation differs from a non-didactic situation in the sense that the latter is a situation without a didactic purpose, in other words, a situation in which the relationship with knowledge develops simply as an efficient means of action.

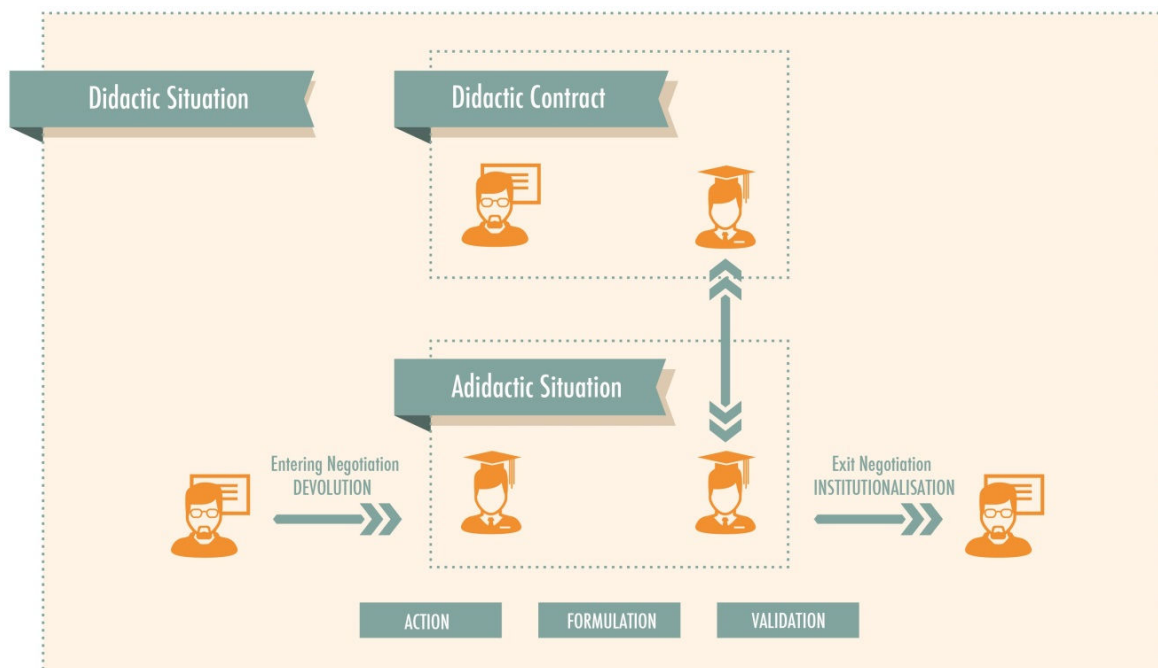


Figure 0.2. The Didactic Situation.

Brousseau assumes that existence of at least one problem, recognized among other problems characterizing the target knowledge, is adequate to protect the sense of this knowledge. Moreover, he assumes that this problem is among those that a student can solve. This is the fundamental hypothesis. Brousseau proposes a situation wherein teachers elaborate the problem; they present the problem to students who appropriate it, solve it, and build new knowledge. “The didactic situation is the sum of a *didactic contract* and an *adidactic Situation*” (Nicolas Balacheff, personal communication, November 5, 2009).

0.3. The Didactic Contract

The didactic contract is the relationship that brings teachers and learners together in a didactic situation (Figure 0.3). This involves (particularly) the implementation of mutual expectations depending principally on the value of the knowledge to be imparted. The contract involves negotiation of explicit or implicit relationships among students, the knowledge at stake, and the educational system, so that students appropriate the knowledge.

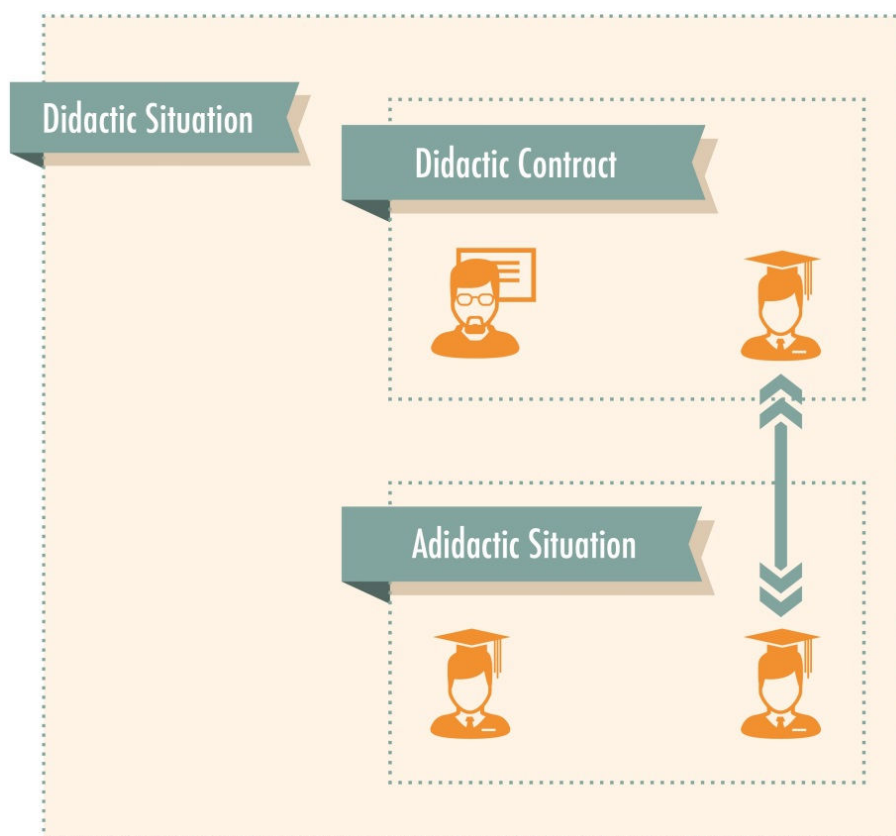


Figure 0.3. The Didactic Contract.

The classical discovery of Brousseau was that it was necessary that certain aspects of the contract should be implicit in nature, but also that breaches should be provoked. A teacher cannot directly tell a learner what solution is expected, and indeed must provoke the learner to stimulate questioning of his own (the learner's) understanding. From a constructivist perspective, knowledge processing in a classroom situation relies principally on breaches previewed in the contract. From this perspective, breaches are necessary to ensure learning. This view contradicts that of behaviourists; the teacher controls knowledge management at all times.

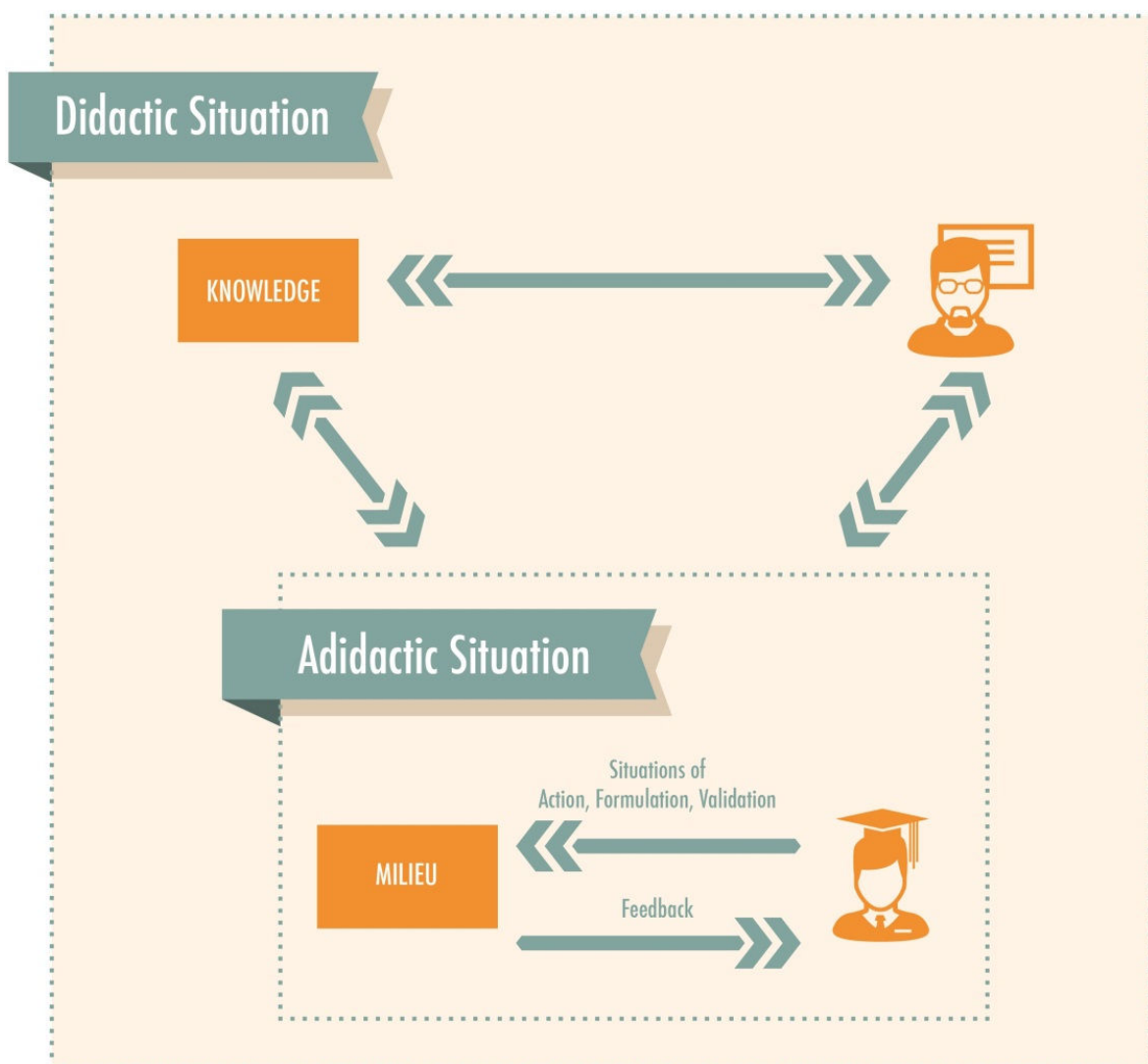


Figure 0.4. The Didactic and Adidactic Situations.

Under an optimal didactic contract, students assume responsibility for solving the problem whereas teachers must ensure that students learn. The contractual relationship involves the teacher, the student, and the knowledge, and contains (by

definition) an implicit component; this is the nature of the knowledge. “Effects” of such a contract are apparent when students do not understand teacher expectations, when a teacher deals with a student-perceived difficulty, or when a teacher (erroneously) interprets a commonplace answer as effectively demonstrating knowledge acquisition, and so on.

For example, in one version of the didactic contract, the motivation of a student to learn is likely to be rooted in teacher expectations. When students get involved with the problem they tend to enter into a didactic situation. In the course of a regular class (Figure 0.3), students tend to alternate between times when their motivations are guided by aspects of the didactic contract and moments when their motivations are guided by aspects of an *Adidactic Situation* (Figure 0.4).

0.4. The Adidactic Situation

An adidactic situation (Figure 0.4) is a situation in which an intention to teach is not explicitly communicated to a student.

Students react as if the situation was non-didactic, it is thus up to them to make decisions, apply strategies, and estimate the efficiency of their approach.



Figure 0.5. The Adidactic Situation.

“Teachers refuse to intervene as owners of the knowledge they want to arise. Students know the problem was chosen in order to get them to acquire a new knowledge but they must also know this knowledge

is completely justified by the internal logic of the situation.”

Brousseau

In such situations, the student interacts with the *milieu* but the teacher does not intervene to introduce any knowledge.

A didactic *Milieu* is the set of material elements, information, and procedures with which students interact to build knowledge; I will offer details below (see Section 0.7.).

“In the didactical situations, the students’ interactions with the milieu are supposed to be ‘significant and adequate’ enough so they can build knowledge, formulate strategies of action, validate knowledge. They do this by using only the feedback of the milieu and not the necessity of satisfying the supposed teacher intentions.”

Sensevy

Students try to solve a problem even though they do not have the knowledge that allows them to find a solution in the most effective manner. They rather rely on prior concepts and earlier knowledge. Therefore, students may come to an answer but this is certainly not the answer envisaged by the teacher. If students already knew the “correct” answer, there would be nothing to be taught. Brousseau states that even if instruction is clear, students do not understand the game in the absence of a basic strategy.

The basic approach described above must be so insufficient or ineffective as to force students to accommodate to and modify their knowledge. Students may not quite know what decisions they are supposed to take. The target knowledge then becomes an *a priori* requirement; a basic strategy becomes an optimal strategy. An didactic situation develops as a succession of allowed or possible states that students can inhabit. The *Milieu* models what students cannot control and shows how that *Milieu* modifies knowledge.

The Didactic Situation is idealistic and unstable. Students can become involved with a problem, but they sit in a classroom (thus, in a didactic situation), and other forces (the behaviour of other students; specific instructions from a teacher to another student, etc.) influence their actions. Thus, as mentioned above, students alternate between times when motivation is guided by the didactic contract and

moments when motivation is guided *adidactically*. As motivation is an inherent property, a teacher cannot impose an adidactic situation; the best that teachers can do is negotiate (Gonçalves, Croset, Ney, Balacheff & Bosson, 2010). The adidactic situation is defined by a form of entrance negotiation termed *Devolution* (Figure 0.6) and a form of exit negotiation termed *Institutionalisation* (Figure 0.7).

0.5. Devolution

This concept is inspired by the socio-constructivist paradigm that emphasises student responsibility for learning. According to Brousseau, this is the act by which a teacher ensures that students accept their share of responsibility if placed in an adidactic situation, and the consequences of such a transfer. When teachers seek to place a student in adidactic situations, they seek by this means to ensure that student effort is triggered and justified only by the needs of the Milieu and the requirement for student knowledge, and not by interpretation of the expectations of the teacher.

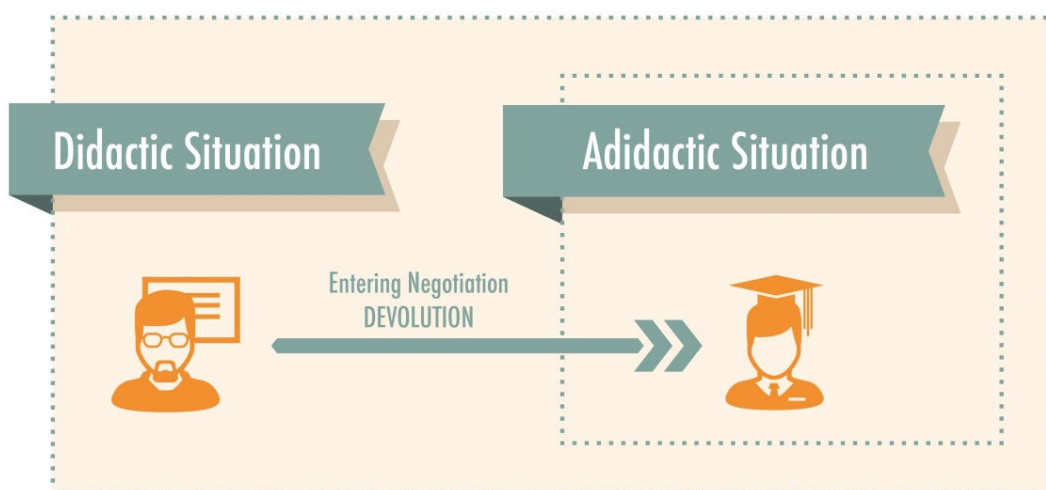


Figure 0.6. Devolution.

For the teacher, devolution consists not only of offering students a situation that is likely to stimulate them to engage in an activity they find unattractive, but also seeks to increase their sense of responsibility; the students assume responsibility for production of results. Students must accept the idea that the solution may be discovered using only knowledge that they already possess. If devolution fails, the cause may be interpreted in terms of the didactic contract.

0.6. Institutionalisation

According to Brousseau, the object of institutionalisation is double recognition. Students “officially” accept the value of the target knowledge and the teacher “officially” accepts that students want to learn.

This is a very important social phenomenon, and an essential feature of the didactic process. In essence, this represents an exit from an adidactic situation; knowledge is institutionalised. The situation is distinguished by transition from a stage wherein knowledge is a means of resolution, a formulation, or validation, towards a new stage; to a circumstance wherein the knowledge is a reference for future, personal, or collective use. Before knowledge institutionalisation, students do not know how to address a problem they need to solve; they can only articulate the problem. After Institutionalisation, students do not need to demonstrate or justify a problem because they can now address all such problems from theoretical or methodological viewpoints.

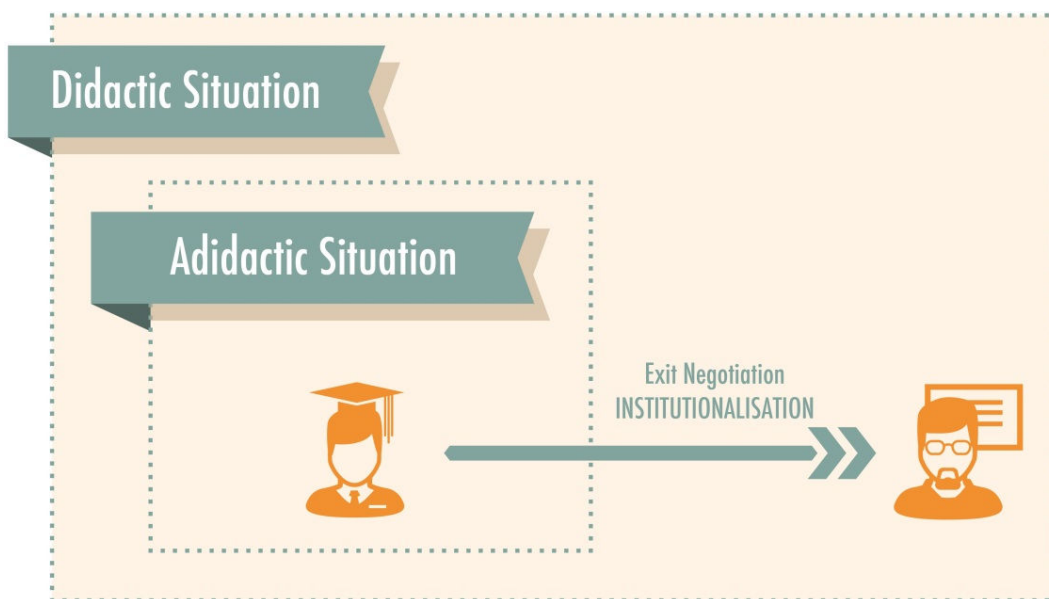


Figure 0.7. Institutionalisation.

0.7. Milieu

The didactic Milieu is the set of material elements, information, and procedures with which students interact to build knowledge. The milieu can be defined as the context and conditions within which students act on a problem, use their knowledge, and succeed in terms of resolution.

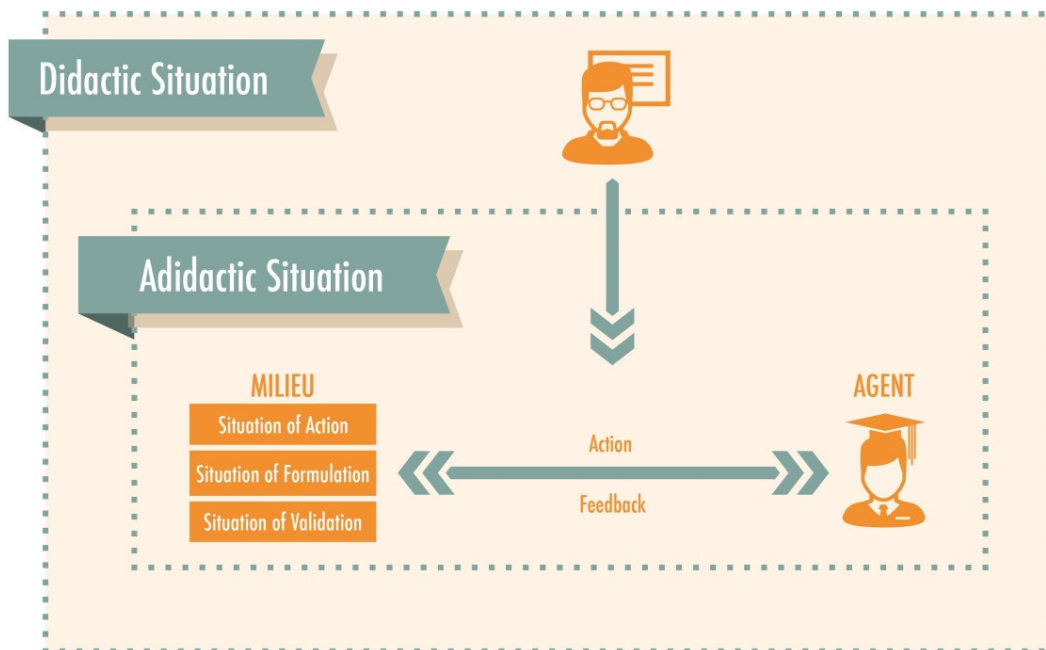


Figure 0.8. Milieu.

According to Brousseau, the milieu is the place wherein knowledge works and draws upon explicit and implicit references, including related conceptual fields, associated knowledge, the means of controlling actions, validation, useful instruments, accessible documentation, and other resources.

A milieu without didactic intentions is a milieu that has been involuntarily organized to teach and often fails to have students acquire all knowledge expected by society. This is why teachers attempt to develop a situation wherein students advance toward acquisition of target knowledge, or change this approach in response to requirements of the milieu (the adidactic situation). In such a milieu, students act as if the situation were not didactic, because they conduct themselves without reference to teacher expectations.

Therefore, from a systemic perspective, a didactic situation includes elements creating an adidactic situation. Two opposing sub-systems are evident; one is an adidactic milieu that opposes the aims of a student (Figure 0.8). Fregona (1995, p.45) insists on the antagonist character of the milieu:

“in order to act, to learn, students have to consider the means of control insufficient, thus the sub-system with which they negotiate cannot be their ally but their concurrent”.

In an action situation, for example, the milieu incorporates every stimulus or feedback delivered to students on the one hand, and the mode by which students

may individually act, on the other. In this model, the student (agent) is the person who interacts with the milieu in a rational and economic manner, thus according to the rules established by reference to personal knowledge. Structuring of the didactic milieu reveals that several situations (various projects) are interlocked and the milieu may be changed as described below, under the headings of *Action*, *Formulation*, and *Validation* situations.

0.7.1. Action Situation

In an adidactic situation of action, student knowledge is expressed only by decision-making, and regular and effective interactions in the milieu. Students develop implicit knowledge (guesses, experiments, choices, and decision-making processes) as means of Action within the milieu. In such a situation, students are not constrained to identify the knowledge to develop interactions with the milieu. For instance, a student may “play to win”, independent from learning toward a target. In other words, the student lacks a learning purpose. Knowledge per se is contextualised. The milieu provides information and feedback, and, by succeeding in a task, access to concepts and procedures is granted. In the Action phase of a given activity, students appropriate the problem via initial application of former knowledge, and next use implicit procedures to succeed in the task. They develop useful strategies via interaction with the milieu and, as such interaction evolves, so does their view of the problem. Brousseau terms this procedure the “dialectic of action”.

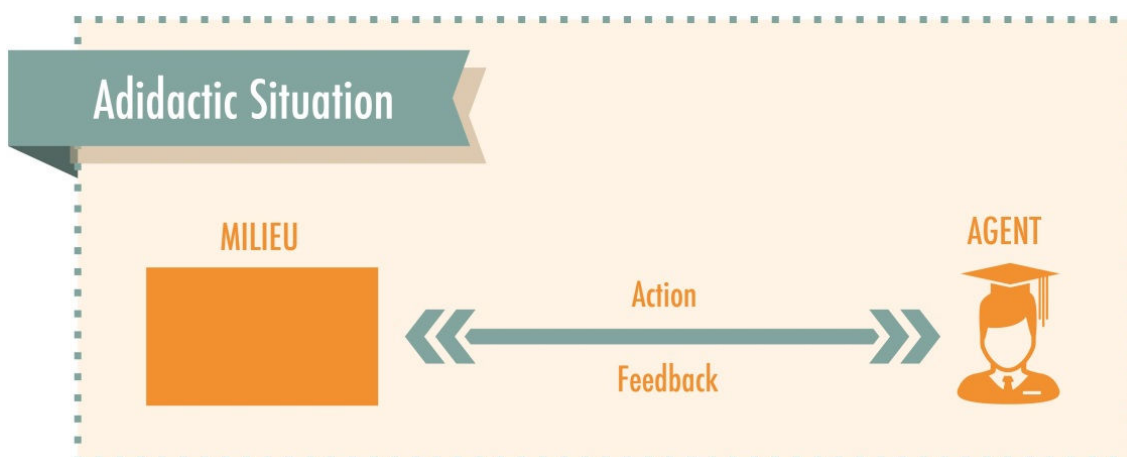


Figure 0.9. The Action Situation.

These interactions with the milieu form an implicit model. This is a very simple and systematic description of an agent’s behaviour in a given situation and is

generally termed strategy or, sometimes, tactics. This also serves as a simplified representation of the way particular knowledge can determine student behaviour in a given situation. Teachers can use this model to try to plan to make student behaviour effective. However, according to objective criteria, an observer is usually the person who builds such implicit models. The students in this context are not necessarily conscious of what they do and may not be capable of making their actions explicit.

This representation of how knowledge influences decisions, as far as such decisions are considered to be valid and of utility in particular circumstances, is the fundamental instrument of the TDS. This is a construct of experimental epistemology.

0.7.2. Formulation Situation

The didactic situation of Formulation is a situation connecting at least two agents with the Milieu. In this situation, every student “plays” in line with a decision developed by the group. Students formulate a strategy and evaluate that strategy.

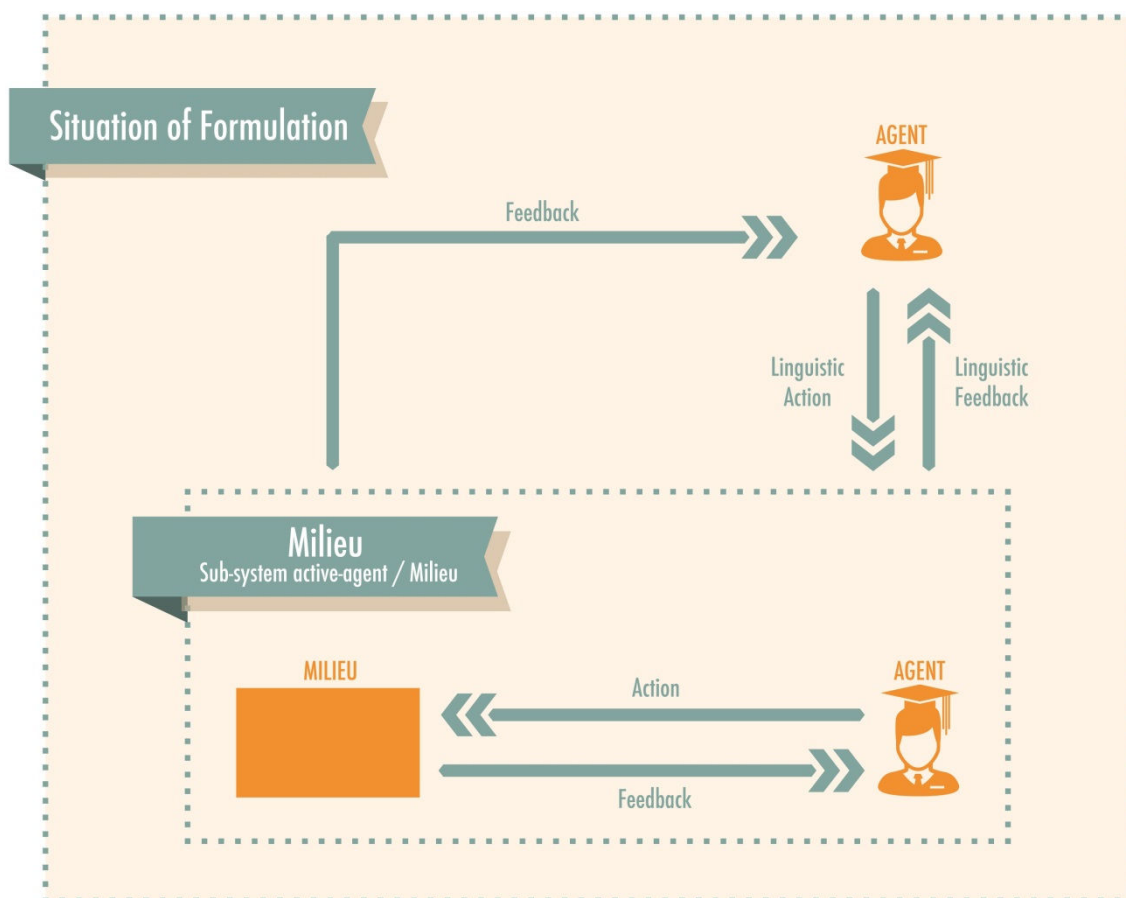


Figure 0.10. Formulation Situation.

Their common success requires that one of the groups formulates the knowledge in question (in any form) for the benefit of others who need that input to convert the knowledge into an effective decision in the context of the milieu. Language then becomes both a means of communication and a tool for problem-solving. It is via such an operational dimension that students participate in conceptualisation and knowledge construction.

Formulation involves the use, by students, of a common knowledge record to formulate an original message, although the situation can change the nature of the knowledge. A language is built that allows every player to understand the “game”; to analyse the game; and to formulate, discuss, and justify strategies. Formulation comprehends explicitation within a semiotic register, modelling, and interpretation of the Milieu. The aim of students in this context is to succeed in communication and, by doing so, they acquire vocabulary. They develop linguistic forms via a "dialogue" with the sub-system. This is the result of combining an active student with a Milieu and, as the dialogue evolves, so do the model of action. Brousseau terms this process the dialectic of formulation. Students explain their implicit model of action. Formulation must be a means of action within the Milieu; action that allows students to obtain results.

According to Brousseau, it is possible to infer theoretically, and verify experimentally, that “spontaneous” formulation of knowledge requires that such knowledge exists beforehand as an implicit model of action for both agents.

0.7.3. Validation Situation

From the didactic viewpoint, a validation situation is a situation in which arrival at the required solution requires that agents together establish the validity of the particular knowledge characteristics. A student expresses a proposition; an opposing student approves or refutes the notion with recourse to experience or reasoning. The students try to convince themselves and others that their solution is acceptable. Attainment of this objective depends on the capacity of students to (together) establish explicitly that the knowledge characteristics of the situation are valid. At this stage, student validations are empirically insufficient. Consequently, the students must develop intellectual proofs that convince their

opponents. The student aim here is to convince others and, by so doing, the students acquire implements of proof (tools) and debate the rules.

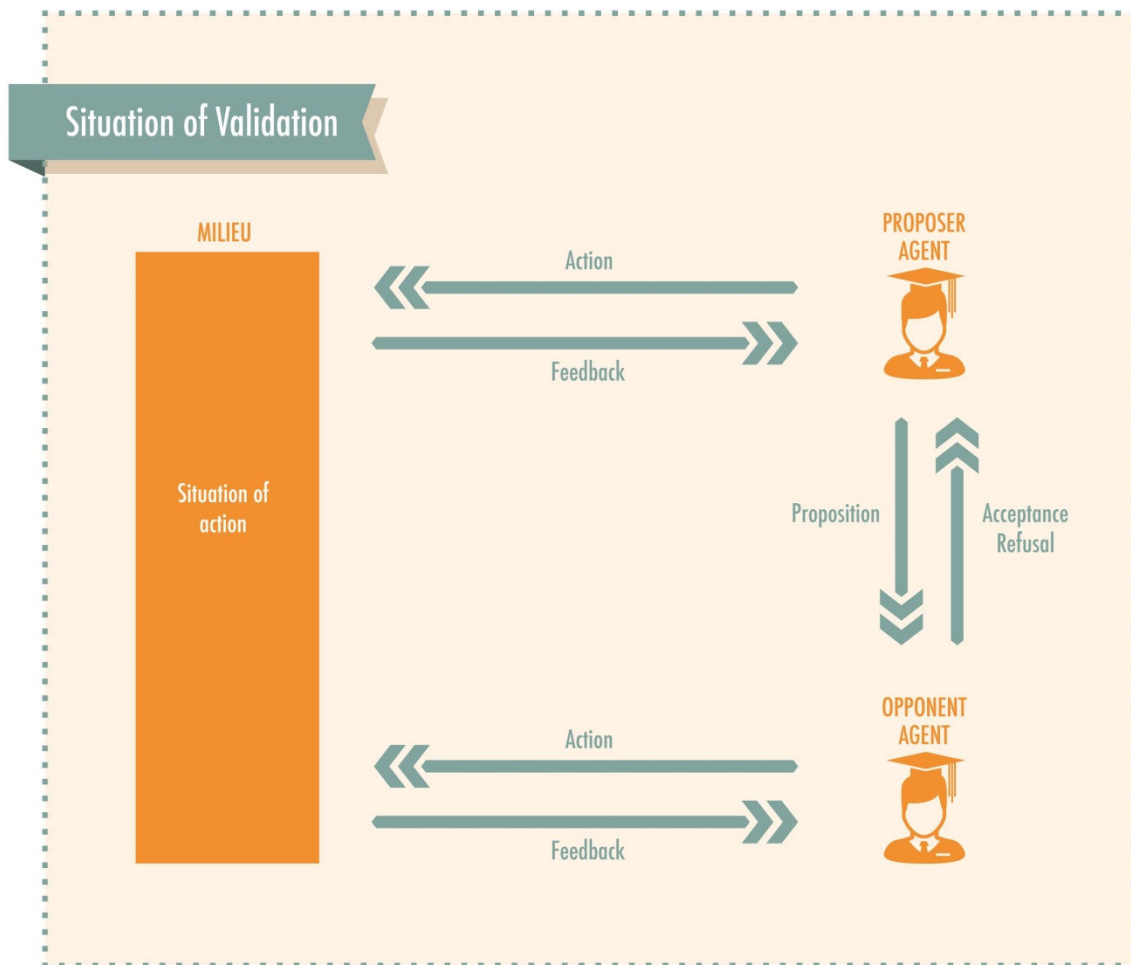


Figure 0.11. Validation Situation.

Students search for the value of the truth of propositions concerning the Milieu and the knowledge formulated thereby via a “dialogue” in which their propositions and the validity thereof are challenged; students also re-invest in the Milieu. As the “dialogue” evolves, so do the propositions and the validation. The validity of knowledge relies on acceptance by all students of the need to conform to a norm, such formal “constructability” is a well-known concept. Brousseau terms this the dialectic of validation. The concept presupposes that students confront their opinions on evolution of the Milieu and ultimately agree with the *status quo*, applying the rules of scientific debate to reach this conclusion.

Three fundamental types of didactic Action are important contributors to the TDS. Brousseau (1986, 1997) breaks with the classic views on interaction and proposes structuration of the milieu as a tool with which to model the didactic engineering

of learners. According to Margolinas (1994), an epistemological paradox exists in learning situations because “in order to learn something one must already be familiar with a knowledge which does not exist yet”. To break this “epistemological circle”, she suggests it is critical to recognize the importance of the need for the functioning of tacit knowledge before and during the appropriation of a knowledge itself; one must consider a “spiral” structure (Figure 0.17), in which no circle ever closes; this is possible only if the contexts of arrival and departure allow different senses of the same knowledge to be valued (Margolinas, 1994).

Following the propositions of Brousseau and Margolinas, serious gaming is a useful way in which students can apply tacit knowledge (that they already have) to develop implicit models (models developed while interacting with the milieu, before knowledge can be formulated), because such an exercise offers contexts of “arrival and departure”, presents different aspects of knowledge, and introduces a spiral structure whereby students access the object of learning using individual approaches. Dedicated gaming poses situations in which knowledge is simultaneously the definition of and the answer to the problem posed.

0.8. The Didactic Contract and the Milieu

According to Brousseau (1986), it is not possible to model a didactic situation using only simple communication or social interaction. One of the clauses of a Didactic Contract is a requirement that a new system be developed. This clause implies that the Contract contains a “time bomb” because it supposes, *ab initio*, that the Contract will eventually break.

A gaming situation seeks to offer students the opportunity to interact with a learning object independent of tutor expectations. Students do not practice exercises assigned by a tutor, but rather encounter a problem immersed in a context adapted to the specific needs of their training. Students engage in a task that they themselves design and the tutor plays the role of an expert consultant, giving advice every now-and-then.

Analysis of the Structure of the Milieu

Based on Brousseau’s (1986) structuration of the milieu, Margolinas (1995, 1998) developed a descriptive Table. Table 0.1 below shows some of these innovations. Margolinas defines some levels (-1, -2, and -3) as “internal levels”;

these represent didactic situations in which no tutor is present or a tutor serves only as an observer. As I am interested in the student perspective, I will not consider levels above Level 1 (these are Levels 2 and 3) or “external levels”, because the latter prioritize the teacher. I conduct ascendant analysis of certain levels (from Level -3 to Level 1); Margolinas (2004) suggests that this is appropriate for *a priori* analysis of a milieu.

» Structure of the Milieu					
	Milieu (M_0)	Student (E_0)	Teacher (P_0)	Situation (S_0)	
Level -3	M_{-3} Material Milieu	E_{-3} Objective Student		S_{-3} Objective Situation	Under-didactical Level
Level -2	M_{-2} Objective Milieu	E_{-2} Acting Student		S_{-2} Situation of Reference	
Level -1	M_{-1} Reference Milieu	E_{-1} Learner Student	P_{-1} Observer Teacher	S_{-1} Adidactic Situation of Learning	
Level 0	M_0 Learning Milieu	E_0 Student	P_0 Teacher	S_0 Didactic Situation	
Level 1	M_1 Didactic Milieu	E_1 Reflexive Student	P_1 Designer Teacher	S_1 Project Situation	Over-didactical Level
...(Next levels not shown here)					

Table 0.1. Part of the structure of the Milieu as proposed by Margolinas (1995).

Such structuration proposes the existence of different milieus at different levels that are connected by a spiral structure (Figure 0.17). Students interact with the learning object in a privileged manner. The model establishes the different types of interaction that students may experience in an adidactic situation. Within each level, a student E_n interacts with the milieu M_n via a situation S_n . As the levels are structured in a spiral manner, an upper level is the result of interaction of student E_n with milieu M_n , with M_n being the previous situation ($M_{n+1}=S_n$). For example, in the situation S_{-2} , student E_{-2} interacts with milieu M_{-2} , where M_{-2} per se is situation $S_{-3}=\{E_{-3}, M_{-3}\}$ (Figure 0.12).

This structuration helps us to understand how students appropriate individual problems and how different characteristics are manifest in different situations.

a. Level₋₃ – The Objective Situation; Accessing the Problem

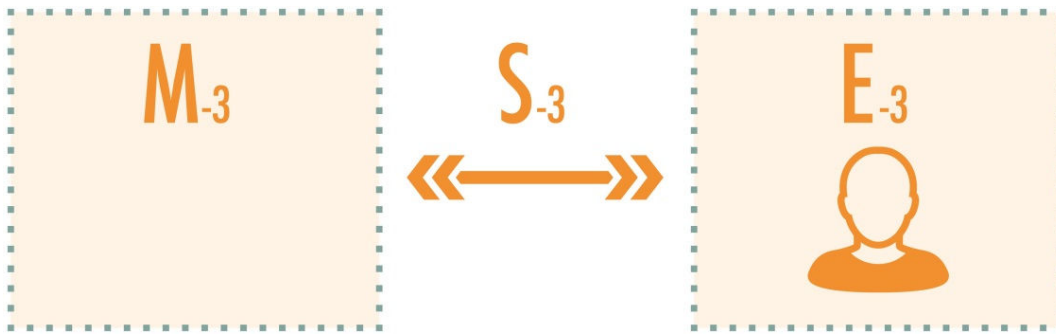


Figure 0.12. The Objective Situation.

The Objective situation. The “objective situation” (S-3, Figure 0.12) is the result of interaction between two systems, the “material milieu” (M-3) and the “objective student” (E-3). This is an unfinished situation wherein a problem is proposed to students via a material milieu (M-3, Figure 0.12). Students encounter the problem, and act to solve that problem to conclude the situation. I will describe this set of components in detail.

The Material Milieu. The material milieu (M-3) is the system; this includes sub-sets of objects, some of which are familiar to the students.

The Objective Student. The other player is a person termed the “objective student”. To be vested with this position, a student must interact with the milieu in the manner expected by the didactic engineering that underlies the activity.

Interaction between the “Material Milieu” and the “Objective Student”. An ability to interact with the milieu presupposes that students are already familiar with some of the objects contained therein. If we use the lens of Chevallard’s anthropological approach (2003), this means that students have already established a personal relationship with some objects; they “know” these objects. In addition to this personal form of behaviour, students are also expected to have already established an institutional relationship with some of the objects; this relationship is one recognized by the institution (for example, an educational system). Students have already established a stable relationship with the objects that occupy the position of the student within the institution. By this, Chevallard means that the type of relationship that is established with an object is respectful of the rules of the institution. Therefore, the student views the object not only personally, but also

from the latter perspective. Consequently, the relationships between subject and object are part of the cognitive universe of the students.

Familiarity with some objects opens doors through which the problem can be accessed. In this manner, students use their own knowledge to interact with the material milieu. In other words, the material milieu is the place wherein student knowledge establishes connections with the proposed objects. According to Margolinas (1994), the Material Milieu must contain objects that affect the interaction students establish with that milieu. Via such connections, students eventually build knowledge-objects (Margolinas, 2004).

b. Level-2 – The Reference Situation; Developing implicit strategies

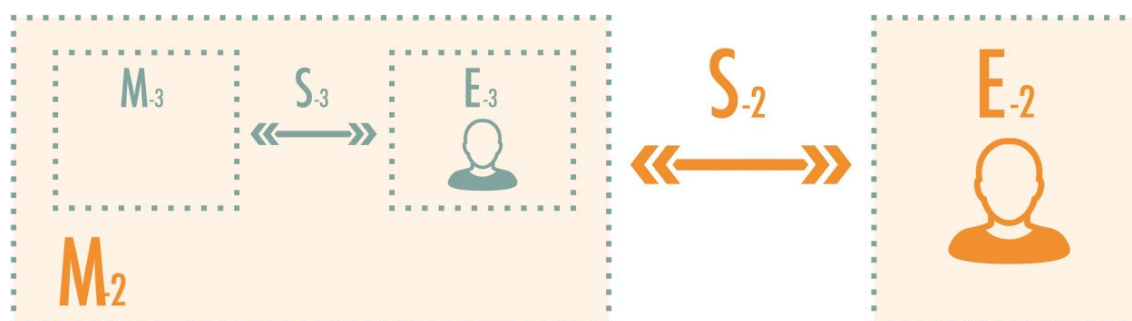


Figure 0.13. The Reference Situation

The Reference Situation. The Situation of Reference (Comiti, Grenier & Margolinas, 1995) is characterized by the need to find an answer to the question posed. This is a situation of action; students discover knowledge that enables adoption of a basic strategy. Sometimes, knowledge already considered in a prior situation is sufficient. The “Acting Student” indeed acts and receives feedback from the “Objective Milieu” system. Margolinas (2004) considers that a sense of purpose is introduced in the Situation of Reference (S-2). For example, students may manipulate signs, using rules, to achieve a goal. To describe a Situation of Reference, it is necessary to

“find a challenge in which the conclusion can be obtained from the interaction of the Acting Student acting with the Objective Milieu”.

(Margolinas, 2004)

This choice cannot be subject to validation (the Objective Milieu does not contain either conclusions or validity criteria).

The Objective Milieu. In line with the structuring of the milieu summarised above, the Objective Milieu (M-2) contains the previous Objective Situation (S-3). In that previous situation (Margolinas, 2004), the interaction between subject and milieu had defined stable knowledge and had produced knowledge-objects. The set of knowledge-objects produced by the interaction between the “objective student” and the “material milieu” constitutes the Objective Milieu (M-2).

The Acting Student. To be vested with the position of “Acting student” (E-2), a student must interact with the knowledge-objects produced in the prior situation. If a student attains such a position, the student must know the rules and may act as indicated by written signs. The reference situation must be shared by all students so that epistemological discussions can take place and arguments can be advanced.

Interaction of the “Objective Milieu” and an “Acting student”. Margolinas (2004) considers that students “crystallise” their knowledge when they articulate the knowledge-objects produced. Now, the objects introduced in the Material Milieu are deliberately combined. The interaction with the Objective Milieu must produce elements allowing the whole problem to be considered in the top situation. It is as if a new part of the proposed problem has been discovered. Knowledge builds on the knowledge-objects produced in the previous situation. The knowledge is not associated with a new knowledge body (*savoir*), but is rather an update, in the context of the particular situation, of the body of knowledge that will serve as the criteria of validity. As the Situation of Reference embodies action, the knowledge produced is implicit. According to Brousseau (1986), students act even when their cognition and mental processes are not explicit; they act to communicate but often without being able to develop new semiological tools; they build messages using codes shared by their colleagues without changing the codes (at least not by too much); and every proof advanced to justify action remains implicit. In such an action situation, students establish their basic strategies.

Levels -3 and -2 contain the principal elements of the action situation (Brousseau, 1997). Exposure to action situations ensures that students can develop implicit models. Students know how to make the model, but they do not know how to explain it, or how to make it explicit.

c. Level₋₁ – The Adidactic Learning Situation; Developing Explicit Models

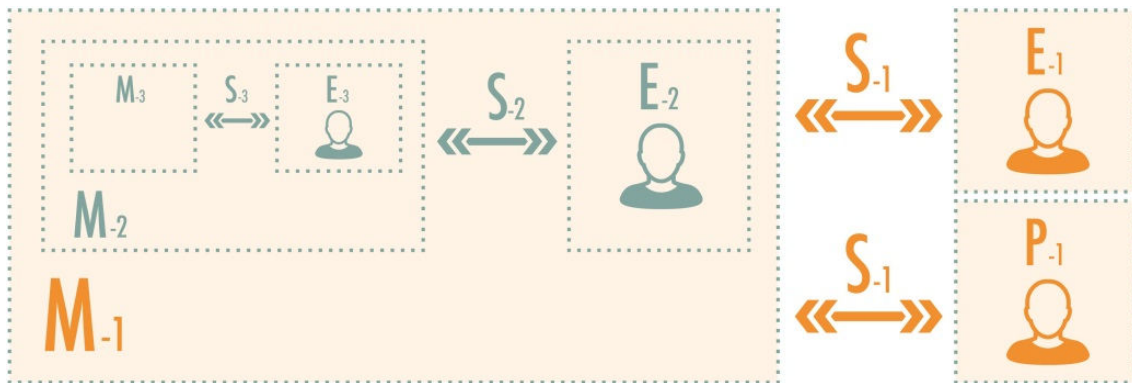


Figure 0.14. The Adidactic Learning Situation.

The Adidactic Learning Situation. Interactions between the Reference Milieu (M_{-1}) and the Learner Student (E_{-1}) form the Learning Situation (S_{-1}). This situation includes anticipation, formulation, and validation. Consideration of the problem triggers complex feedback from the milieu; prior knowledge remains a component of that milieu. In such a situation, aspects of knowledge will be in conflict, because students may interpret instructions differently.

Students build knowledge individually and exchange such knowledge when they form groups. The knowledge (integrated into the milieu) of knowledge-objects that were previously built serves as a first level of validation, experienced at the individual level, but feedback is actually triggered by difficulties students may encounter when they bring their own knowledge-objects to the common work session of the group. In this situation, the validity criteria stemming from the Reference Situation must be examined (S_{-2}). A learner student anticipates the effects of action; comes to conclusions about the nature of the action; develops a resolution; and creates a written record allowing verification of a given operation. Situation S_{-1} is in an Adidactic Situation. The required knowledge is being elaborated or learnt and the difficulties encountered in mastering this knowledge will create errors, but students will still work.

The Reference Milieu. The Reference Situation forms the Reference Milieu (M_{-1}). This milieu contains objects produced by the reference situation. These include a difficulty or an obstacle that the student encountered when applying the implicit strategy of level -2 . A gradual unreeling of rules takes place as a result of the interactive process. The prize at stake is the knowledge that the teacher expects

students to learn. The Reference Milieu allows the Learner Student to perform trials, but not to come to conclusions.

The Learner Student. Student E_{-1} must next seek an explanation of the unknown property of the milieu. The Learner Student is confronted with a learning situation that is problematic, thus not as transparent as the prior situation. The knowledge needed to produce the explanation is the knowledge that the tutor wishes the students to learn. Learner Students begin to question the validity of their findings. E_{-1} formulates answers to these questions and explains the reasoning. Students cannot draw conclusions in this situation because the milieu M_{-1} does not contain a validation phase. E_{-1} must thus seek to understand why the milieu lacks this property.

Interaction between the "Reference Milieu" and the "Learner Student". Milieu M_{-1} allows E_{-1} students to test but not to draw conclusions. The tutor P_{-1} may be present in this situation, but only as an observer. According to Brousseau, students in the E_{-1} position consider the actions of E_{-2} (sometimes, their own actions) either to communicate information about the action per se or to discuss the adequacy of the action; they can conceive of an action on M_{-1} . This calls (at least) for development of a representation or formulation. At this level, E_{-1} students must be able to formulate, to make explicit, and to recognize cognitive operations by reference to the actions of E_{-2} students (thus at the previous level).

d. Level₀ – The Didactic Situation; Knowledge Validation

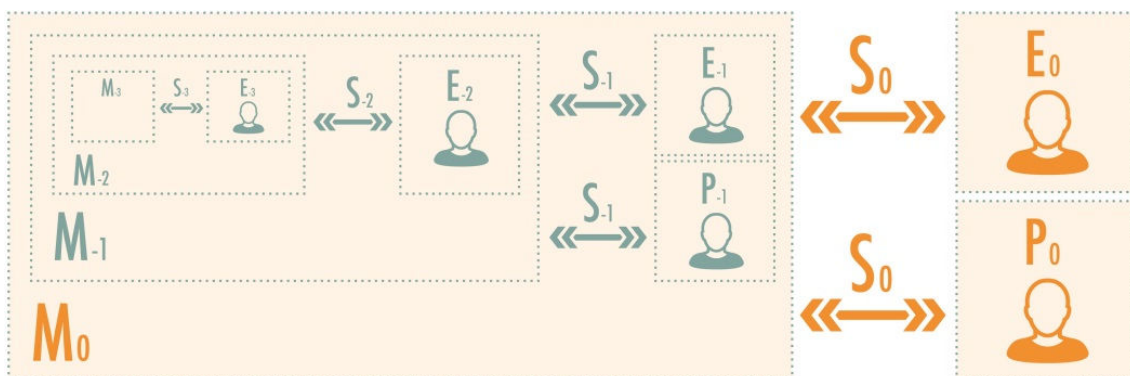


Figure 0.15. The Didactic Situation.

The Didactic Situation. If level 0 is subtracted from level -1, as performed above using other levels, one obtains a "Learning Milieu"; this is formed by the objects produced by the prior learning situation (for example, the value of the truth of

propositions; Margolinas 2004). In the Didactic Situation (S_0), a meeting of minds of the tutor and students occurs. Teaching and learning will take place according to the terms of the Didactic Contract.

The Learning Milieu. In the Learning Milieu, the rules established previously become more refined, and students discover the results of what they do.

The Student. In this situation, students need to discover why their prime strategy did not work. E_0 students must formulate what they learned in situation S_{-1} . They must also prove their conclusions. A Learner Student is concerned about the validity of such findings. E_0 subjects, students *sensu stricto*, are confronted with a Didactic Situation in which they have to deliver answers to posed questions to the tutor; they also have to prove the truth of these answers. Thus, I consider that P_0 has to use the observations made in P_{-1} about elements of milieu M_{-1} to decide what public interventions (evaluations and Institutionalizations) are reasonable. According to Brousseau, students in position S_0 look to their own learning situation, whereas students in P_0 discuss their learning.

The Interaction between the "Learning Milieu" and the "Student". The phases of Institutionalization and conclusion merge to update the views of students and tutors. This is the public dimension of the work.

Margolinas' examples:

M_0 : failure to identify the pieces of the puzzle using the strategies implemented.

E_0 : report on failure of implemented strategies.

P_0 : confirmation of failure and announcement that "good means" will be addressed in a future lesson.

Pooling of failure data on additive strategies allows consideration of such strategies as a class, thus not as individual trials. A tutor can then confirm that the discussion does not address a contingent failure but rather the impossibility of building a strategy in the way that a student has attempted.

In terms of proof, we can envisage the following knowledge (formed in the course of Institutionalization):

$\kappa \uparrow_{E0}$: Knowledge of how assertions may be proved:

$\kappa \uparrow_{E01}$: To prove that an assertion is false, it is sufficient to find a single counter-example.

$\kappa \uparrow_{E02}$: To test an assertion, one may explore all possible scenarios; if no counter-example is found, the assertion is true.

Situation S_0 can thus be described as a debate on the validity of the proffered proofs of assertions. As in any Didactic Situation, such a debate may potentially canvass the phases of conclusion in terms of the results obtained in Adidactic phases, as well as Institutionalisation of particular knowledge within a learning process.

e. Level₁ – The Project Situation

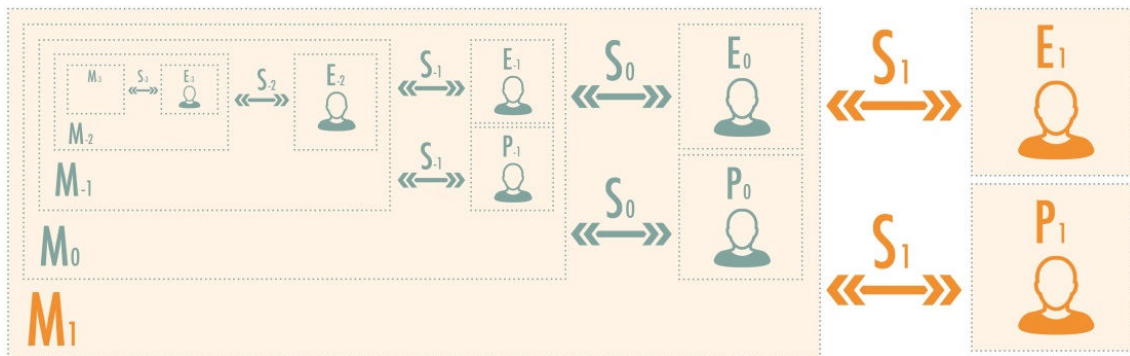


Figure 0.16. The Project Situation.

The Project Situation. An over-didactic situation is formed when a Didactical Milieu (M_1) meets a Reflective Student (E_1). According to Margolinas (2004), upon structuralization of a milieu, every level is a “meta-level” in terms of the level that preceded it. The reflexive character of every situation (a previous situation can be reflected upon) is core to such a model. This principle applies to all situations arising upon milieu structuralization.

The Didactic Milieu. The Didactic Milieu (M_1) is composed of “learned objects” produced in a Didactic situation.

The Reflexive Student. The Reflexive Student (E_1) is in a “meta-position” in which the student considers, at a certain distance, what was learnt in the Didactic Situation.

Interaction between the “Didactic Milieu” and the “Reflexive student”. Students look at teaching “from the outside” (Brousseau, 1986) and consciously observe, judge,

and take advantage of the didactic situation. In terms of milieu structuralization, students embrace a tutor's intentions and accept the tutor's suggestions as to how didactic time will progress. Margolinas (2004) states that, according to Brousseau, no "generic student" is envisaged at this level. A generic student is one who is in the mind of a tutor when that tutor prepares a course; "generic" is thus a descriptor that only a tutor might use. Herein, my analysis is focused on the student perspective; an ascendant *a priori* analytic mode is chosen. The student is not generic.

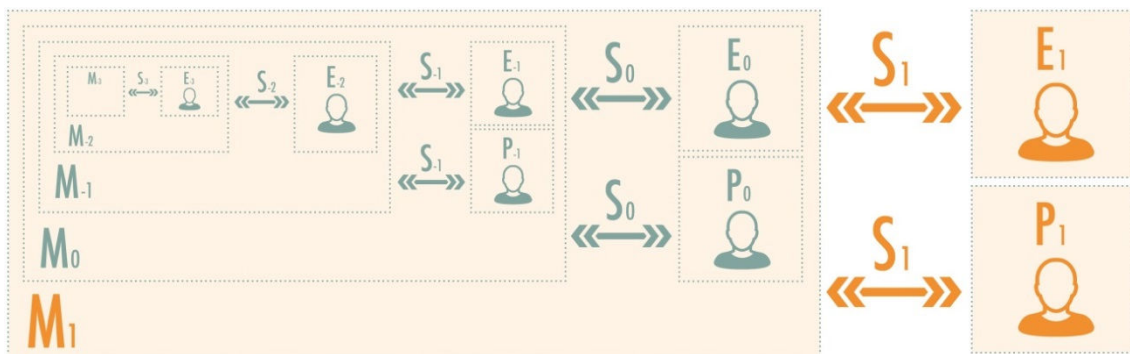


Figure 0.17. Part of the milieu based on the propositions of Margolinas (1995).

Conclusion

In the present Chapter I have briefly introduced some concepts derived from Brousseau's TDS, emphasizing the importance of milieu structure as proposed by Margolinas. This brief Introduction seeks to allow a non-specialist reader to comprehend the theory that fundamentally underpins my research.

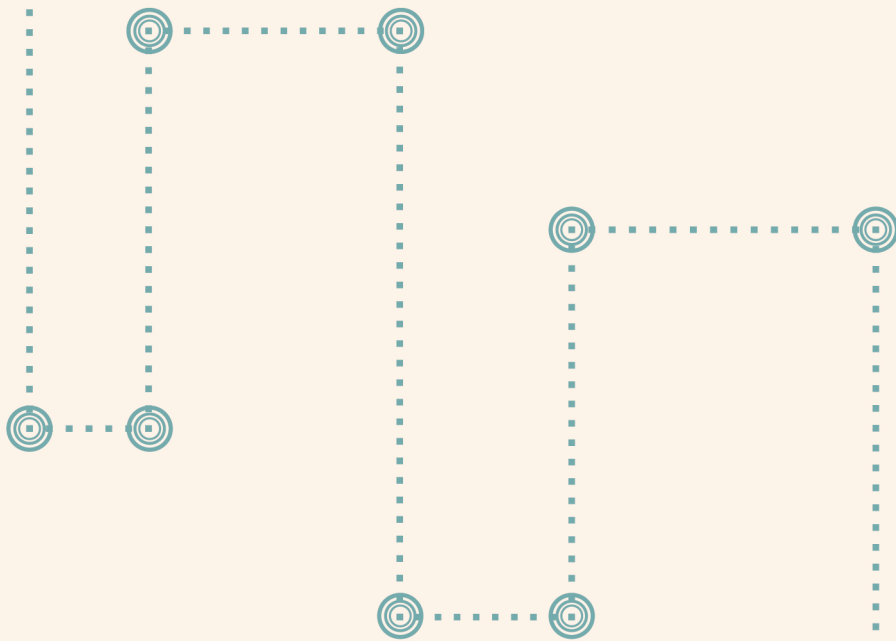
Development of an understanding of concepts such as the Didactic Contract and Devolution is a prerequisite for comprehension of the concept of Appropriation that I introduce in the next Chapter. The structure of the Milieu, as proposed by Brousseau and Margolinas, models the various situations that a student may experience when appropriating a problem; I will deal with this topic in Chapter 1. An understanding of the theoretical fundamentals of didactic situations is crucial if the case study of Chapter 4 is to be understood.

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Chapter 1



Chapter 1 Summary

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Summary of Illustrations

Figure 1.1. Prox calculates the proxemy of the noun “appropriation” and presents a tetrahedral figure..... **Erreur ! Signet non défini.**

Figure 1.2. The figure presents in bold letters the vertices of distance 1 from “appropriation” **Erreur ! Signet non défini.**

Figure 1.3. Close-up on the proxemy of the word “appropriation” in the dictionary “DicoSyn Nom”. Image A: Three neighbours of “appropriation” circled in red. Image B: Two neighbours of “integration” circled in red. **Erreur ! Signet non défini.**

Table 1.1. Key steps in the process of devolution, proposed by Brousseau. . **Erreur ! Signet non défini.**

Table 1.2. Categories and attributes in appropriation. ... **Erreur ! Signet non défini.**

Résumé en Français

Les jeux d'apprentissage sont des outils fascinants pour promouvoir l'apprentissage. Cependant, quelques aspects importants méritent d'être soigneusement considérés. L'un d'eux concerne l'appropriation de problèmes par l'étudiant, qui représente une condition *sine qua non* pour qu'un jeu devienne sérieux. Si elle a lieu, les étudiants sont impliqués avec le jeu et l'apprentissage peut arriver. Une définition générale de l'appropriation est d'abord proposée, puis le concept d'appropriation au regard de la théorie des situations didactiques est spécifié.

Définition générale

Le terme « appropriation » concerne deux idées : « l'adaptation » de quelque chose pour une utilisation définie ou une destination précise ; et « la prise de possession » pour réaliser de telles adaptations. Autrement dit, c'est l'acte de transformer pour faire sien quelque chose.

ÉTUDE ÉTYMOLOGIQUE

Le mot « appropriation » est la forme nominale du verbe « approprier ». Il vient du latin « *appropriare* », composé du préfixe « *ad-* » et du verbe « *propriare* » (en relation à, prendre comme sien). « *Propriare* » vient de « *proprius* » (sien, particulier à quelqu'un) qui vient à son tour de « *pro privo* » (pour l'individu).

Proxémie et synonymes

La proxémie du mot appropriation et l'étude des synonymes permet de retenir les mots suivants pour l'analyse : *assimilation*, *adaptation*, *acquisition*, *intégration*, ainsi que ces concepts : « *internalisation* » et « *ownership* ». Ces termes sont en effet utilisés dans le domaine des sciences de l'éducation.

Assimilation (alimentation) : acte ou processus d'assimilation. Action de devenir semblable ou de faire une chose semblable à une autre.

Adaptation (ajustement) : acte ou état de modification d'une chose à de nouvelles conditions ou circonstances. S'associe souvent au concept de milieu.

Acquisition (collection) : acte ou état d'obtention de quelque chose – « accumuler », « chercher à obtenir » ou « chose obtenue ». Concerne l'obtention pour une utilisation précise. S'applique aux compétences, techniques et connaissances.

Intégration (capillarité) : acte de réunir combinant dans un tout – en harmonie – des parties séparées, en soulignant la capillarité des interactions entre les parties dans ce processus.

Internalisation : acte ou état de fusionner, d'incorporer (mœurs, valeurs), devenir ou donner un caractère subjectif ou rendre interne un objet.

« *Ownership* » (propriété) : mot anglais d'origine proto-germanique – « *aiganan* » (posséder) et « *-skapaz* » ou « *skap-* » (créer, prescrire, nommer). Signifie « état ou condition d'être propriétaire ».

GENEALOGIE DE L'APPROPRIATION

Afin de définir l'appropriation en tant que concept en didactique, examinons d'abord ses différents usages préalables.

Philosophie

Dans l'antiquité, la dialectique était l'art de démontrer une théorie par le dialogue en définissant les concepts proposés. Aujourd'hui, c'est une approche qui comprend la réalité dans ses contradictions et transformations.

Platon utilise la dialectique pour désigner la méthode philosophique juste, tout d'abord comme la capacité de développer des questions et des réponses, puis comme l'art de classer des concepts pour les examiner et les discuter.

Hegel distingue quant à lui trois moments élémentaires lorsque le moi « se fait objet » : l'objectivation, l'externalisation et l'aliénation. En formant un objet, l'homme y met sa volonté ; l'objet reflète alors sa personnalité objectivée. Néanmoins, la « réintégration » de l'autre objectifié dans le moi ne peut pas être appelée « appropriation » car, dès le début, l'autre, c'est-à-dire l'objet, n'a simplement été que l'extériorisation du propre moi.

Anthropologie

L'appropriation selon *Marx* est une réalisation interne et un événement socialement médiatisé¹. L'homme s'objectivise dans le produit de son travail, lequel lui est étranger à moins de se l'approprier. C'est ainsi qu'il assimile des connaissances. L'homme ne devient un individu que dans une société, laquelle entretient l'appropriation humaine au fil des générations.

Psychologie

Selon *Vygotsky*, l'homme transforme son milieu par le biais d'outils symboliques. Par le langage, l'homme construit du sens en s'appropriant les expériences généralisées de l'humanité. Langage et pensée entretiennent des rapports dialectiques tendus (théorie de la signification). La pensée ne s'exprime pas mais se produit dans la langue. La pensée contextualise la langue en modifiant la signification des mots, alors que, en se transformant en langage, la pensée se reconstruit et se modifie. L'individu subjectivise et internalise les mots à la mesure qu'il objectifie et externalise ses pensées.

Selon *Leontiev*, l'homme se développe en interagissant avec des outils qui correspondent à ses besoins. L'appropriation d'une activité est un mécanisme de base du développement psychologique². Subjectivité et activité entretiennent des

¹ Serfaty-Garzon, 2003

² Graumann, 1974

rapports dialectiques³. De nouveaux besoins et motivations surgissent chez l'individu en conséquence de l'action et de la réalité qui se produit (théorie du sens).

Selon *Bakhtin*, les mots sont le cerne de l'appropriation, moissonnés dans le terrain où ils sont employés par un tiers qui les a peuplés de significations. Pour se les approprier, l'individu génère une signification réelle qui libère le mot de sa signification formelle dans le contexte créé par des activités sociales. Ce processus implique le déploiement d'un système qui représente à l'avance les actions possibles du langage. C'est le *genre du discours*, une ressource psychologique partagée, l'arène où le langage se développe graduellement au fil des dialogues de formes historique et dialogique, qui gère la polysémie des mots dans une constante réévaluation de l'unité du langage.

Didactique – théorie des situations didactiques

Les étudiants doivent faire l'expérience de l'appropriation afin de se reporter aux tâches d'apprentissage et aux objectifs de leur professeur, et afin de s'engager dans des activités de résolution de problèmes.

Dévolution : transfert de la responsabilité de l'apprentissage vers l'étudiant. Ce concept fut inventé par Brousseau qui a mis en évidence une négociation entre enseignant-élève se déroulant en 5 étapes : *jeu pur* – jeu sans objectif ; *dévolution de préférence* – succès mais sans comprendre comment ; *dévolution de responsabilité et de causalité* – reconnaissance d'options, de causes et d'effets ; *dévolution de l'anticipation* – projection de causes et d'effets ; et la *dévolution d'une situation didactique* – compréhension de la façon d'atteindre l'objectif.

Dans la dévolution, l'objectif n'est pas révélé mais les composants sont contrôlés, ce qui entraîne une appropriation du scénario didactique.

Modèle de l'appropriation d'un problème

Appropriation d'un problème

Les étudiants peuvent ne pas comprendre le but assigné, ce qui montre une faille entre la cognition et l'action. Une approche « pratique » individualisée peut aider l'élève à se concentrer. Leontiev et Brousseau considèrent que la motivation et la notion de sens sont importantes. Cette étude examine le processus d'appropriation dans un contexte de résolution de problèmes.

Le modèle

Pour s'approprier un problème, les apprenants doivent convertir leurs actions d'une manière prévisible et accepter, tester, faire des choix, anticiper et maîtriser le jeu. Le modèle SPA est inspiré de « la dévolution » et explique les expériences d'apprentissage des élèves lors de la résolution de problèmes. Les tâches doivent avoir un sens pour être appropriées, mais elles

³ Clots, 2006

peuvent nécessiter une orientation pour répondre aux objectifs du tuteur. Il doit y avoir action, formulation et validation. Cette étude souhaite proposer une méthode pour examiner comment les élèves éprouvent le processus d'appropriation.

Les catégories d'appropriation

L'acceptation : l'appropriation est liée à une intention, première étape du processus, qui, en général, dicte l'approche de l'étudiant. Elle sous-tend le contrat didactique entre l'apprenant et l'enseignant. Un étudiant peut ne pas accepter si le problème est trop complexe ou si son importance n'est pas cernée.

Le test : implique la production réelle de sens par les étudiants. Pour répondre aux objectifs des enseignants, les étudiants doivent tester leur approche, mais, à ce stade de l'apprentissage axé sur l'action, leurs erreurs ont moins d'importance que l'interaction. Ils peuvent ne pas être conscients des résultats potentiels, mais ils sont commandés par l'intrigue qui les pousse à apprendre par le biais d'essais et d'erreurs. Les tâches peuvent être accomplies à ce stade, mais cela laisse les élèves mal équipés, car ils ne comprennent pas comment ils ont découvert la solution.

Faire des choix : prendre des décisions éclairées peut conduire à la réaffirmation de la connaissance. Cependant, le résultat peut toujours s'écarter de la prédiction, encourageant alors une pensée évolutionniste. À ce stade, les élèves sont investis et concentrés sur la tâche. Les résultats peuvent survenir en raison d'une action ou d'une pensée stratégique, mais l'action ne désigne pas nécessairement une approche tactique. Les élèves peuvent ensuite adopter une réflexion stratégique, qui peut ajouter d'autres sens, actions ou investissements.

Anticipation : prédire de meilleurs résultats grâce à une capacité de prise de décisions rendue possible par la subjectivité et la planification cognitive. Le résultat peut dépendre d'événements conduits par les étudiants (menant à corriger les projections) ou de forces extérieures (projections erronées). Une réflexion stratégique holistique, qui peut s'améliorer avec l'expérience, est nécessaire pour s'attaquer efficacement à une tâche. À l'inverse, les apprenants peuvent être incapables d'appliquer leurs compétences de résolution de problèmes à d'autres tâches. Le processus d'anticipation peut être entraîné par la connaissance, la subjectivité ou la pratique, et l'appropriation de chaque type de tâche peut fluctuer.

Maîtrise : stade final et optimal d'appropriation, impliquant un engagement total et une transition de la compréhension vers l'application. À ce stade, les apprenants sont en mesure de s'attaquer à des problèmes de manière stratégique et catégorique, d'expérimenter un investissement subjectif plus important, et de s'engager dans le débat et l'innovation.

CONCLUSION

Ce chapitre définit l'appropriation, puis présente ensuite sa théorie scientifique et son application. Cette étude porte sur l'appropriation de la résolution de problèmes selon le concept de dévolution de Brousseau, et explique les principales théories qui sous-tendent le modèle SPA.

Defining Appropriation⁴

1.1 - Introduction

Learning games are fascinating tools that may promote learning. However, such innovations demand careful consideration in a learning context. One aspect that must be considered is the *student's problem appropriation*. In a game such as the one studied in this project, problems are not posed to students as such. Instead, students embark on a mission and encounter the problems along the way. They first have to acknowledge and then refine the problem before beginning to solve it. I argue that problem appropriation is a requirement for the game to become serious. If appropriation takes place, students get involved with the game and learning can happen.

In the previous chapter, I introduced the theory of didactical situations and adduced details concerning the Structuration of the Milieu. In chapters 3 and 4, I shall introduce two qualitative studies on what I will call *appropriation phenomena*. A core concept in my research is the *concept of appropriation*. I first propose a general definition of appropriation and then I situate the concept of appropriation in the context of the Theory of Didactical Situations.

1.2 - A General Definition for Appropriation

*...La langue en effet, plus elle est riche plus elle vous ouvre les yeux. Vous ne voyez que ce que vous savez nommer. Une langue pauvre donne un monde pauvre.*⁵

Alain Finkielkraut.

⁴ Chapter 1 is based partially on complementary studies published at four conferences: the EIAH 2009 (Environnements Informatiques pour l'Apprentissage Humain) in Le Mans, France, entitled "Les étudiants jouent mais à quel jeu jouent-ils?"; ECGBL 2009 (European Conference on Game Based Learning) in Graz, Austria, entitled "Students' Problem Appropriation in an Epidemiology Game"; ICLS Doctoral Consortium 2010 in Chicago, USA, entitled "Students' Problem Appropriation"; and LACLO 2010 in São Paulo, Brazil, entitled "Students' Problem Appropriation in a Persistent and Multi-Modal Simulation".

⁵ Alain Finkielkraut is a French philosopher, here entering a debate on the French government's "civilisation politics" related to young people and the educational system. English translation: "... Language indeed, the richer it is, the wider it opens one's eyes. One sees only what one is able to name. A poor language leads to a poor world".

The term appropriation in essence involves two dominant ideas (Serfaty-Garzon, 2003): on the one hand, the idea of adapting something for a defined usage or precise destination; and on the other, an idea derived from the first, namely the action of taking possession of it in order to introduce such adaptations.

In the course of developing a model to explain this aspect of the learning process, many questions are raised:

- How does such a phenomenon occur?
- How does a student appropriate a problem?
- Is it possible for the appropriation to be observed?

Naming the phenomenon also raises questions:

- Why name it appropriation? Why not adaption, definition, assimilation or another term?
- Why not ownership? This may sound better in English than appropriation.
- Are different words needed for the phenomenon in different languages?

Beyond choosing a proper term, we may consider explaining the phenomenon through a concept:

- Instead of appropriation, why not Vygotsky's "internalisation"?
- Why do we need a concept of "appropriation" at all when there is already one for "learning"?
- Where does such a concept come from? What other concepts is it related to?

In order to answer these questions, I propose to investigate the meaning of the term appropriation and offer a definition for a general concept of appropriation, before considering a specific situation – *a learning context* – with the specific aim of studying *the appropriation of a problem*.

1.2.1 - Etymological Study

Finding a term to designate a phenomenon cannot be done without careful thought. One cannot see what one cannot name and to apply a name means to produce meaning and to establish boundaries that separate what is from what is not. It is to identify a phenomenon as an object different from others but

simultaneously connected to others, merged in a web, causing and being caused by others, building a moment we struggle to call reality.

Recognising this, I intend to define the sense of the words I am applying to a phenomenon before I offer my own use of this word for a concept. This is why I introduce the definition of appropriation by means of a brief etymological analysis, for the following reasons.

- A brief etymological study can help to elucidate different meanings of the word appropriation as it arises in various fields.
- If the word has an origin common to other languages, it will be easier to propose cross-translations of the concepts to different languages.
- Studying the etymology of synonyms of a noun such as appropriation on one level may lead to a higher-level analysis of concepts named by these synonyms.
- An etymological study can support the meaning of the concept I propose here and provide justification for the choice of this particular word.

Etymology of the noun appropriation ⁶

The word appropriation means the act of appropriating. It comes from the Latin verb *appropriare*, which is a compound word made up of the prefix *ad-*, meaning “in relation to” and the verb *propriare*, meaning “take as one’s own”. *Propriare* comes from *proprius*, meaning “one’s own” or “particular to itself”, which in turn comes from *pro privo*, meaning “for the individual” – Transformation.

Sample definitions

Appropriation may be defined as taking as or making one’s own or seizing something, whether in a “negative sense” (appropriation without permission) or a

⁶ Dictionaries consulted: English Dictionaries: Bailey, 1770; Benson, 1997; Cambridge Dictionary, 1999; Century Dictionary, 2001-2011; Collins Dictionary, 2003; American Heritage Dictionary, 2009; Fellbaum, et al., 1991; Fowler & Fowler, 1919; Friedman, Harris, & Lindeman, 2008; Garner, 2009; Harper, 2001; Johnson, 1785; Johnson & Walker, 1835; Longman Dictionary, 2010; Mclean & Mcmillan, 2009; Michaelis & Pietzchke, 1982; Macmillan Dictionary, 2009; Merriam-Webster, 1984; Oswald, Thomas, & Lynd, 1853; Oxford Dictionary, 2005; Perry, 1800; Roget's, 2009; Siegel & Shim, 2010; Skeat, 1993; The Dictionary, 2011; Webster, 1872; Webster, 1828. Portuguese dictionaries: Almeida, 2005; Almeida, 2000; Bueno, 1963; Fernandes, 1984; Fernandes, 1995a; Fernandes, 1995b; Fernandes, 1993; Fernandes, 2000; Ferreira, 2010; Houaiss, 2009; Houaiss, 2003; Nascentes, 1976; Oliveira, 1971; Queiroz, 1943; Silva, 1971; French dictionaries: CNRS, 2005; Dauzat, 1938.

“positive sense” (through legal procedures – meaning acquisition or integration of ownerless goods or unclaimed property).

It may also be understood as the action of setting aside or adapting something to a particular use or purpose, for example money. In American English, the meaning here is close to adaptation; but the word appropriation is not so understood in French or German (Graumann, 1976) or in Portuguese or Spanish.

In the sense of seizure, appropriation may be defined as the mental activity of appropriating something, making acquired knowledge one’s own: the meaning is similar to assimilation. It may also have the related meaning of borrowing ideas or words from other sources for a specific use or in order to produce something new, a common process in intellectual or cultural productions such as the arts, literature and painting. Here the sense is what one gains over and above one’s own efforts or activities, thus meaning to accommodate or to fit. In education, seizure leads the individual to comprehend, to learn and to retain knowledge. Thus, there is an active and creative process in learning, in which the individual takes something that belongs to another and transforms it in order to make it his or her own.

Appropriation may also describe a natural process by which nutrients penetrate an organism or assimilation by the organism. Seizure may mean to embody, to assimilate, to incorporate or to digest.

The word “appropriation” can be literally translated into various European languages that are based on the same Latin root, as *appropriation* in French, *apropriação* in Portuguese and *apropiación* in Spanish. In German it is translated as *Aneignung* (Graumann, 1976) and in Russian as *prisvoenie* (Bakhtin, 1986).

1.2.1.1 - Proxemy

In order to study the proxemy of the noun “appropriation”, I used the online dictionary CNRLT (CNRS, 2005). In the section on proxemy in this dictionary, there is an option to calculate the proxemy of words using Prox⁷, “an algorithm which calculates [proxemy], on a hierarchical small world type graph” (Vanhove, Gaume & Duvignau, 2008). This algorithm produces a lexical graph based on “DicoSyn

⁷ <http://Prox.irit.fr>

Nom” (www.cnrtl.fr/proxemie/), a digital synonym dictionary compiled from seven standard dictionaries: Bailly, Benac, DuChazaud, Guizot, Lafaye, Larousse and Robert (Vanhove, Gaume & Duvignau, 2008). The vertices of this lexical graph can be seen in Figure 1.2.

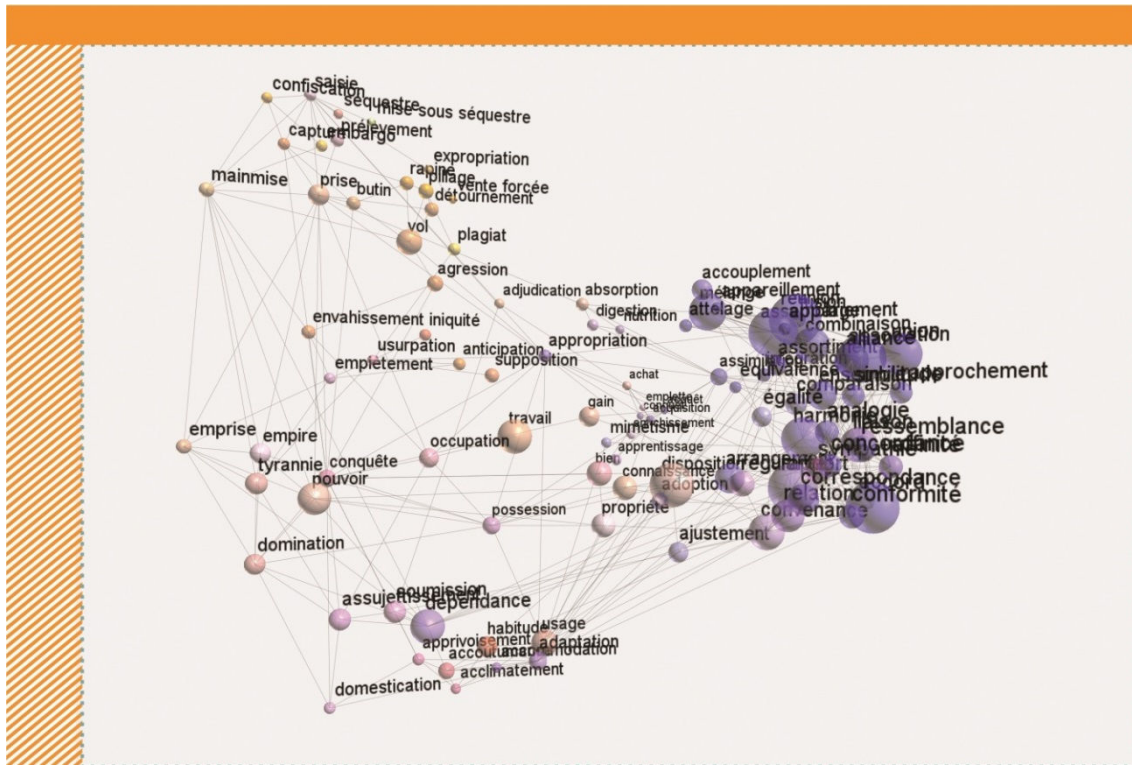


Figure 1.1. Prox calculates the proxemy of the noun “appropriation” and presents a tetrahedral figure.

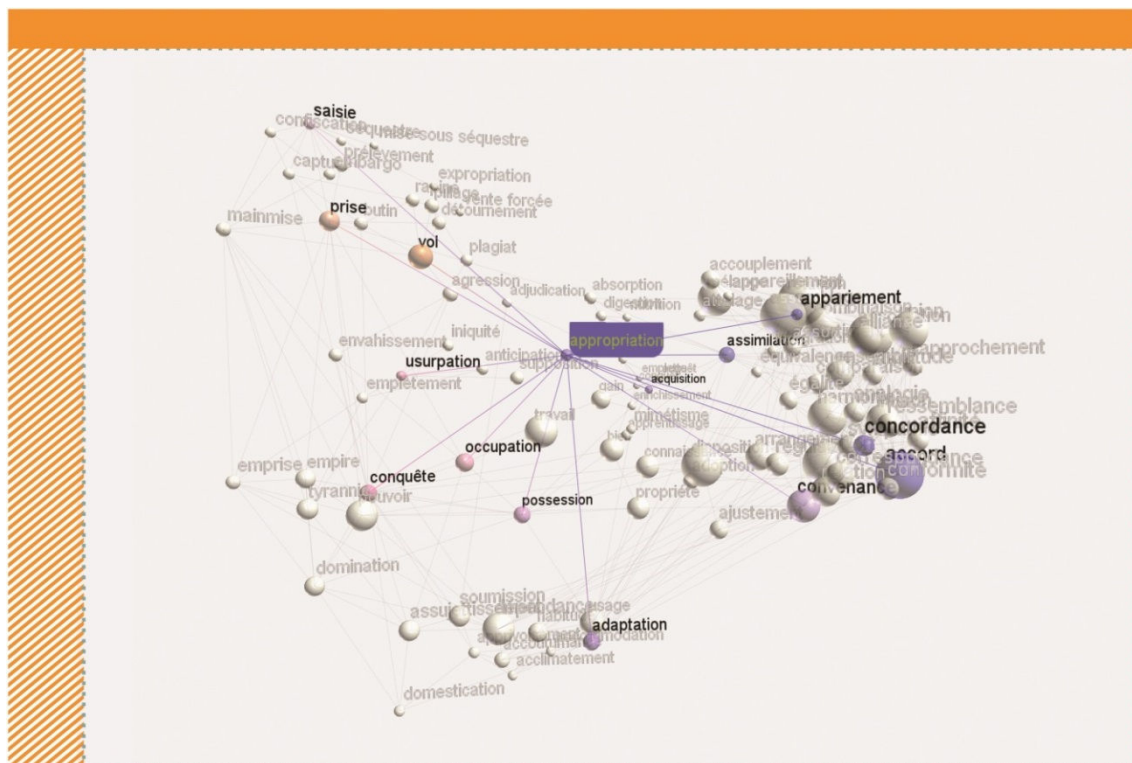


Figure 1.2. The figure presents in bold letters the vertices of distance 1 from “appropriation”.

Prox calculated the structural confluences between vertices. I limited the graph to 100 words and obtained a graph presenting a list of the 100 vertices, showing the strongest confluences to the noun “appropriation”. In this way, I discovered that the vertex “appropriation” has 14 neighbour words, as indicated in the figure. (In French the words are: *accord, assimilation, prise, saisi, vol, adaptation, convenance, possession, acquisition, concordance, conquête, occupation, usurpation* and *appariement*).

1.2.1.2 - Study of Synonyms

I selected three synonyms (Figure 1.3) among 14 synonym “neighbours” of “appropriation” (Gaume, Duvignau & Vanhove, 2008). This choice was determined by the vocabulary used in educational sciences to represent the concept of appropriation, a situation that has led to misunderstandings in the conduct of research. The three selected neighbour words are “assimilation”, “acquisition” and “adaptation”. By checking the proxemy of these three words, I selected the word “integration”, which appears as a neighbour word to “assimilation” and “adaptation” (intra-domain cohyponymy) but linked indirectly to “appropriation” and “acquisition” (inter-domain cohyponymy⁸), the latter two expressing a metaphorical meaning (Duvignau & Gaume, 2004b).

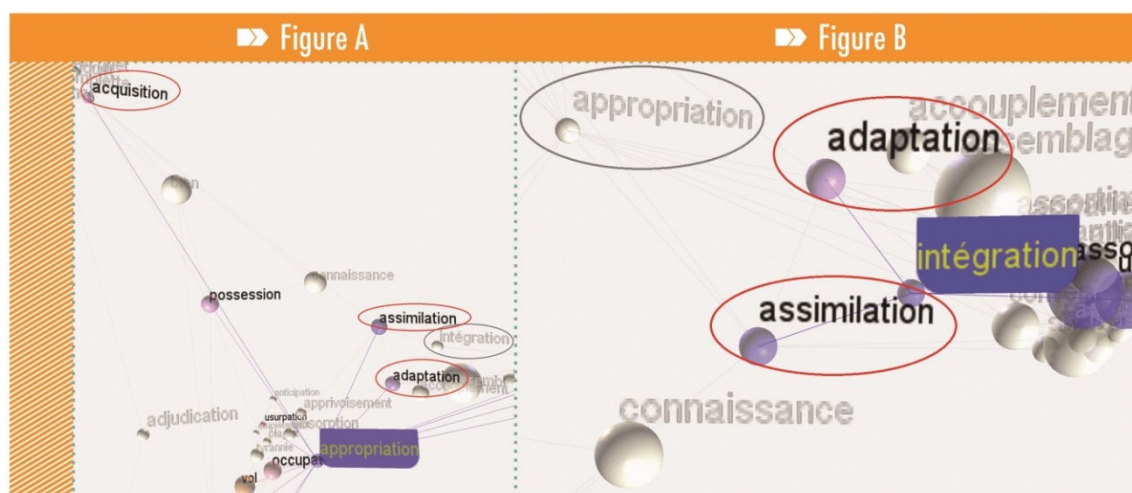


Figure 1.3. Close-up on the proxemy of the word “appropriation” in the dictionary “DicoSyn Nom”. **Image A:** Three neighbours of “appropriation” circled in red. **Image B:** Two neighbours of “integration” circled in red.

⁸ Cohyponyms: several words sharing the same meaning and with a common hypernym (a term for a word whose meaning includes the meanings of other words). “Appropriation” is the hypernym for the ensemble of neighbour words (assimilation, adaptation, acquisition, etc.). In this case, the neighbour words are hyponyms (subdivisions of more general words) of the word “appropriation”.

Further, I selected two other words representing concepts from the educational sciences standard vocabulary that I estimated to be connected, to a certain degree, with the concept of appropriation. These words are “internalisation” and “ownership”. In the next paragraphs I explore the meaning of these words and elucidate on the similarity and difference of their meanings to the word “appropriation”.

a. Assimilation

Assimilation refers to the action or actions by which something is assimilated. It is derived from the Latin *ad-* and *simulare*, the latter meaning the action of becoming or causing one thing to become like another – *Sustenance*.

In physiology and botany, assimilation is the absorption and incorporation of nutrition into bodily tissues. The nutrients fuse with the consumer and their original form is therefore destroyed.

Philosophy regards assimilation as a thought process through which concepts are drawn together by their similarities.

In anthropology and sociology, assimilation is a cultural adjustment, where members of one group temper their cultural traits to harmonise with those of the dominant group, in order to integrate with that group.

Psychology defines assimilation as the process whereby new facts or responses are acquired and melded with existing, conscious knowledge and responses to produce new or modified thoughts and behaviour.

Knowledge is said to be assimilated when it is integrated with the individual's existing mental structures. These are constantly modified in light of new experiences, knowledge and responses.

Similarities – Appropriation and assimilation describe active processes rather than states. Both refer to the absorption or incorporation of another, e.g. information or food.

Differences – There are important differences between the terms.

Assimilation is a process through which something external is absorbed or incorporated into an existing structure (the assimilator). That which is assimilated

becomes part of the assimilator and is integrated into it. The process is driven by the assimilator's need to assimilate, for example the need to eat, and failure to assimilate threatens the integrity or survival of the assimilator. Therefore, that which is assimilated secures the assimilator's continued existence.

Appropriation also requires that an appropriator actively seek out and acquire an element in response to a need. However, that which is appropriated is *added to* the appropriator, that is, it is seized. The appropriator takes what is appropriated and works upon it to create something new. In this way, something that was previously a difference between the two entities becomes shared and the process of appropriation is the production of meaning or sense from appropriation and the overcoming of what was previously a difference.

When knowledge is assimilated, the learner integrates it into his or her existing intellectual structure. When knowledge is appropriated, the learner acquires that knowledge to reshape in such a way as to suit his or her own needs.

b. Adaptation

Adaptation is the process or state of being adapted, derived from the Latin *ad-* plus *aptare*, meaning “modification of something to fit new circumstances”. Adaptation can also describe the product of adaptive processes. Polysemy occurs across various disciplines (Simonet, 2010), so context is crucial when considering the meaning of this term – Adjustment.

In biology, adaptation is a mutation that organisms undergo, through natural selection, to survive in an environment⁹. In physiology, adaptation is a response to stimuli, reduced to adjust to an environment that bombards the receptor with stimuli. An example is the fluctuation in pupil size seen in response to stimulation by light.

Sociology defines as adaptation behavioural changes that people make to meet group expectations¹⁰, while in anthropology adaptation comprises processes via

⁹ In biology, adaptation refers to changes in structure or function, achieved through natural selection to improve an organism's ability to thrive and reproduce in its environment (Boquet, in Simonet, 2010).

¹⁰ In sociology, adaptation describes gradual, unplanned modifications of individual and collective behaviour to adjust to a cultural context. The term is rarely used, yet sociology clearly exhibits a concept of social adaptation, particularly regarding the acquisition of aptitudes and integration within a group (Boudon, in Simonet, 2010).

which individuals or populations change, biologically or behaviourally, to adjust to environmental pressures¹¹.

In geography, adjustment occurs when somebody chooses to live in and adapt to an environment; adjustment stems from the individual rather than environmental pressures¹². In social welfare, adjustment is modification of the environment to meet the needs of an individual.

Psychology defines adaptation as the weakening of a response to stimuli, following repeated presentation of those stimuli without reinforcement. This model applies particularly to learning theory and reflects the physiology model as mentioned above. Piaget claims adaptation requires interaction between assimilation and accommodation, the modification being changes wrought under environmental pressure, by mental processes that influence individuals' actions¹³.

Similarities – Adaptation and appropriation refer to processes, as well as to states. When appropriation is used to mean an act or state of fitting, it echoes the use of adaptation to describe harmony between an object and its intended use (Serfaty-Garzon, 2003). Some definitions emphasise the meaning of adaptation as a process undergone by newcomers to meet the norms of an environment.

Differences – Concepts of adaptation often share a theme of the individual being influenced to act by external pressure. In contrast, appropriation commonly refers to individuals being propelled to action by an internal impetus.

Adaptation: general concept.

Adaptation suggests a process through which an organism is modified in response to contextual pressures, but it can also describe a process whereby the context is adapted to fit the organism. There is mutual movement: the context triggers adaptation in the organism, but the organism can act upon the context.

¹¹ Adaptation in anthropology comprises processes through which individuals or groups change biologically or behaviourally to secure reproductive success and therefore their survival. Effects are only measurable in the long term and their influences upon evolution are unclear (Bates, in Simonet, 2010).

¹² In geography, adaptation results from decisions made by human beings, independent of environmental influence. It resembles adjustment, in that it sees geography as concerned with the adjustment of people to their environment (Barrows, in Simonet, 2010).

¹³ Adaptation underpins the dialogue between people and the world within which they evolve and with which they interact (Jakubowicz, in Simonet, 2010).

Adaptation demands accommodation of one element by another. Either or both sides may adapt to facilitate this. The accommodator must act to receive that which is accommodated, but sometimes what is accommodated also changes. Once the process is complete, both are connected in a balanced way. There is no loss of identity by either – rather than consumption, there is mutual existence.

Appropriation: general concept.

The process whereby meaning is extracted from appropriation has been introduced above. Appropriation always produces a new identity, because it is a process in which the appropriator transforms that which is appropriated.

c. Acquisition

Acquisition is the act or state of acquiring or gaining possession over something. It is a compound word derived from the Latin *ad-* and verb *quaerere*, meaning “get in addition or accumulate”, “seek to obtain” or “thing obtained” – Collection.

In psychology, specifically behaviourism, it is the empirical demonstration of an increase in the strength of the conditioned response in successive trials, in which the conditioned and unconditioned stimuli are paired.

In linguistics, it means the act or process of achieving mastery of a language or a linguistic rule or element, specifically in child language acquisition or second language acquisition.

Similarities – Acquisition and appropriation express both act and state. They both convey the sense of the process or state of obtaining or getting possession over something.

Acquisition: general concept.

Appropriation means “making one’s own the acquiring knowledge”; there is transformation of the knowledge by the individual in the very moment when it is being obtained in order to own it.

Acquisition in the notion of obtaining does not refer to the production of meaning but to the use of the obtained element. Therefore, acquisition is a concept better applied to the acquisition of skills and techniques than to the acquisition of knowledge. It is indeed a process that happens after a stage in which meaning has

been produced by the individual. It is concerned with the pragmatics of actions, gestures and procedures that are enabled once signification emerges.

d. Integration

Integration, the act of integrating, is derived from the Latin *integrare*, meaning “to combine elements into a whole”. Integration occurs when discrete elements merge, resulting in a unified, harmonious unit – Capillarity.

In mathematics, integration is the process through which the integral of a function or equation is defined. In computer science, integration is the fusion of components (hardware, software or both) into a system.

In genetics, integration occurs when parts of an organism merge through recombination. Physiology defines integration as construction of an organism by processes including accretion and anabolism; or, alternatively, as the unification and function of elements required for adaptive activity.

In sociology, Durkheim defined integration as the extent to which a society is cohesive, specifically under rules imposed to support internal relationships and constrain individuals' actions. The sociology of immigration defines integration as applicable to the individual; integration of that individual occurs when he or she enjoys a secure place within a group. In special needs education, integration comprises processes intended to reduce the social impact of a disability.

In psychology, integration is the combination of elements of a personality into a harmonious whole, suitable for the individual and the environment.

Similarities – Integration and assimilation share a sense of combining elements into a whole, with the implication of merging, as seen in appropriation. Integration and adaptation share harmony as a final outcome, which is implied in some definitions of appropriation.

Integration: general concept.

Integration depends on reciprocity, unity, interaction and combination, creating networks of symbiotic relationships to form a coherent whole. Integration shows us how identities, roles and relationships evolve within their contexts (Westra & Rodgers, 1991; Simonet, 2010).

e. Internalisation

Internalisation is the taking in and incorporation within the self of an object or quality, adopting it as part of one's mental processes or state. Internalisation also has a more literal meaning: a cell or organism taking something into itself. The word comes from the Latin *internus* and suffixes *-ise* and *-tio*, indicating “the act or state of incorporating”.

The linguistic definition of internalisation is acquisition of a component of linguistic competence, e.g. a rule or language structure.

Psychology and sociology view internalisation as culminating in an individual's acceptance of norms already accepted by people who influence them. Such internalisation follows a predictable course: the individual learns what the norms are, considers and understands them and finally defines them as his or her own. In developmental psychology, internalisation occurs when a child learns through social interaction and processes and such learning becomes part of its own mental processes. Examples include language and the ability to conceptualise.

Similarities – Internalisation shares conceptual traits with other terms, including appropriation and assimilation (taking in another object), integration (making the object taken in part of the existing whole) and adaptation (creating a harmonious unit). Internalisation resembles appropriation because mental functions – altered by internalisation and used to appropriate – are crucial to each.

In the section below on psychological usage of the construct of appropriate, I will explain Yves Clot's¹⁴ preference for the term appropriation to describe aspects of internalisation.

f. Ownership

The word “ownership” comes from the old English root *agan* of the verb *geagnian*, meaning “to have, to own”. The root *agan* comes from Proto-Germanic **aiganan*, “to possess”, which in turn comes from Proto-Indo-European **aik-*, meaning “to be master of, to possess”. The suffix “-ship” comes from the Old English *-sciepe* and Anglian *-scip*, meaning “state, condition of being” and from Proto-Germanic **-*

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skapaz, as well as the base **skap-*, meaning "to create, ordain, appoint". "Ownership" therefore means "the state or condition of being an owner". It establishes the right of possession or proprietorship – Property.

Enghag (2006) has studied, analysed and described students' influence on their learning according to the framework described as "Student Ownership of Learning". The concept of ownership in the field of learning sciences is also known as "Learner ownership, [...] [where] students must be supported in developing a sense of responsibility for their management of problem-solving tasks, which suggests problem ownership".

Similarities – Both ownership and appropriation concern the state of being an owner, but according to the word's etymology, only appropriation refers to the process of acquiring a possession. In English-speaking countries, the term ownership is preferred to designate one's possessions.

Ownership: general concept.

The concept of learner ownership tends to designate a state of property, as the above etymological survey pointed out. Students are motivated to be empowered and to develop a sense of responsibility for their own learning. The concept of students' appropriation is linked to this concept in the sense that students are motivated to invest in solving the problem. Concepts of ownership designate individuals' responsibility and right of possession over something, but not the process of acquisition of proprietorship, which will be considered in the concept of appropriation.

Researchers intending to promote comprehension of human learning phenomena encounter a constellation of terms explaining micro-aspects of moments of the learning process. Appropriation in this field is only one element of the learning process. Depending on the term one chooses, a different aspect of this learning process will be highlighted, be it appropriation (production of meaning), assimilation (feeding a system), adaptation (preparation for a specific use), integration (capillarity taking place at the moment of the contact), acquisition (the specialisation of a set of actions, the development of a skill), internalisation (subjectivation) or ownership (state of being an owner).

1.2.2 - Outlines of a Genealogy for Concept Appropriation

Knowledge evolves across centuries. People have long contributed to the construction of philosophical and scientific discourses, each bringing something of their own to dialogues transcending generations. These dialogues have inspired others, no doubt contributing to countless future dialogues.

Theories, models, concepts and ideas are all human productions that evolve over time in different places, where they are learned, created, reproduced and enriched. They have a history and a trajectory, in which they are imprinted on individuals who give them life by applying them in a real and ephemeral context.

Awareness of the phenomenon of appropriation emerged in one of these trajectories. In what follows, I will discuss this in order to define the concept of appropriation. These outlines of a genealogical study will certainly not cover the issue exhaustively, but rather will provide some substance to the definition of a concept and situate this concept in history. This, in turn, will establish possibilities for the use of such a concept in the field in which I am intending to apply it (the didactics of science), specifically as a concept in the theory of didactical situations.

The appropriation phenomenon stems from a number of ancient Hellenic philosophies in the West. People attempted to explain natural phenomena by referring to the predominant myths of the time. The roots of the phenomenon of appropriation lie in the emergent notion of dialectics. Later, appropriation became an anthropological construct and then a psychological construct, well before its emergence as a didactical construct. Its use in psychology was, for a certain time, restricted to Soviet and Marxist literature. However, before exploring the use of the term in didactics, the basic meaning of appropriation should be clarified.

1.2.2.1 - A philosophical background for the construct of appropriation

For the ancient Greeks, dialectics meant the art of conversation and coherent argument. Aristotle and Plato credited Zeno of Elea with being the founder of dialectics; others cited Socrates. Hegel declared Heraclitus the founder of dialectics, but Heraclitus himself never used the term: Plato was first to do so.

The pre-Socratic thinker Heraclitus of Ephesus put forward the notion of the constant fluctuation of being; by contrast, his contemporaries regarded being as

essentially fixed. Heraclitus saw the need to understand a whole through the laws of unity, rather than examination of its constituent parts. For Heraclitus, those constituent parts were in permanent flux as a result of being in constant competition with their opposites and were governed by laws of unity. Therefore, Heraclitus worked from a model that demanded integration.

Plato believed that dialectics was a correct philosophical model to establish questions and answers. The concept evolved over time, extending its reach as a discipline of argument and reason, taking in aspects of genre, the use of paradox and reduction to absurdity.

According to Bornheim (1977), dialectics is now seen as an instrument that allows us to consider the nature of reality, a reality that is often contradictory and in a state of transformation.

a. Plato

Plato was first to use the term dialectics. In his work it is used mostly to mean the correct explanation of things through the concept of ideas (forms). Such an explanation would necessarily demand a demonstration of logical, reasoned argument, although there is also a sense in which Platonic dialectics can be viewed as internal dialogue (Inwood, 1977). For Plato, participation and the problematic nature of being were key themes in dialectics.

Other philosophers have made important contributions to dialectics, both before and after Plato's time. Heraclitus saw opposites as complementary and believed that their constant conflict was a basic principle of reality. The doctrine of Mobilism, from which Heraclitus emerged, claimed that reality was fundamentally in a constant state of movement. In contrast, the doctrine of Monism held that there was only one, still form of reality and that movement in or around it was superficial. In an attempt to solve philosophical questions left unanswered by his predecessors, Plato refuted old theories and declared that, "motion exists and it is as real as the stillness" (Bornheim, 1977).

Plato wanted to discover how reality was embodied or manifested in the world of the apparent, the world of beings. This meant bypassing appearances to find truths and objects that can be reached only through reason. This can be seen in Plato's

work *The Sophists*, with its references to the transcendental world of ideas (Bornheim, 1977).

Plato outlined two interdependent dialectic concepts: participation in and separation from the world of ideas or forms. Participation presupposed the possibility of separation, while separation influenced the form of participation. Plato saw separation as originating in the area of incompatibility between forms and appearances and as providing a means of movement between the two. He stated that there were degrees of separation between the world of forms and that of appearance, and referred to “ascent” in terms of the mind rising, through dialectics, above the world of the apparent to reach the transcendental world of ideas (Bornheim, 1977), thus bridging the fundamental gap (separation) between the two. Separation was defined as the fundamental condition of mankind and the starting point for the acquisition of knowledge.

The concept of participation conceived the idea/form to be an independent entity distinct from all else. Objects within the world of appearances that manifested that idea were not, themselves, the idea but *participated* in it. Plato declared that participation was governed by rules and not chaotic. Participation required forms to interact with other specific forms, leading to mutual completion (Bornheim, 1977). The role of dialectics, even today, is to trace such movements to their conclusions and understand the process (Bornheim, 1977).

Plato believed dialectics to be the discipline that allowed mankind to discriminate between types of being, to discern the nature of things through their participation in forms, their non-participation in other forms and by the outcomes of conflict between the forms and their manifestations (Gilson, 1948; Bornheim, 1977).

b. Hegel

In the preface to *Phenomenology of the Spirit*, Georg Wilhelm Friedrich Hegel (1770-1831) described the main differences between his conception of dialectics and that of Plato. Plato believed that ultimate truth and reality lay in the world of ideas, and it was this to which philosophers should address their attention. The fundamental difference between Platonic and Hegelian dialectics rests on the concept of negativity. For Hegel, *negation* of the right and true was the means of reaching it.

An understanding of negativity is crucial to Hegelian dialectics. By negativity, Hegel did not mean complete emptiness, but rather a movement between two extremes of being: at one end is absolute being and at the other end is its absolute negation. Reality oscillates between these, generating tension between negation and the process of manifesting truth.

This situation has two aspects: the process itself and the form of the process. Hegel declared truth to be the idea, the absolute being, the unity. In contrast, items in the concrete world are transitory and perishable; these very qualities in an object render it not the idea, not coinciding with the idea and therefore not true. The truth lives in the unity of idea and reality. Hegel declared that "a thing only has truth as far as it is an idea" (Hegel, 1951). Hegel saw truth as going beyond the finite, but he also included the concept of *adaequatio*: adequate or equal to the finite or real.

In this context, dialectics is the discipline through which one determines the being, via the process of truth. It has three parts: thesis, antithesis and synthesis.

The thesis delineates the initial identity. It is a name *for* the being and nothing more. The antithesis is the delineation *of* the being and contains an explanation of the negative. It can be seen how the thesis falls short of the antithesis, and that area of difference takes on an autonomy of its own, created through contradiction. This process of contradiction is at the heart of dialectics.

Hegel wanted to achieve a final unity, and saw that, to do this, the contradiction revealed by the antithesis would have to be overcome. This demanded the negation of the negation. Hence, there is a third movement, the synthesis, which ends the process with realisation of a truth. The synthesis is a form of reconciliation; a circular movement back to the foundation of the dialectical process in that it returns to a need to identify the truth. In this sense, one can see the dialectical process as cyclic, which is how Hegel described it.

In light of his dialectics, it is possible to understand Hegel's concept of labour. Fischbach (2008) claimed that Hegel introduced three key movements into this concept: objectivation (the moment at which an activity takes on an identity as object and an objective form), exteriorisation (at which point the self sees itself in the object and within it also the areas that are object and *not* self, hence the object

becomes the negation of the self) and alienation (the point at which the object is lost and the self-gains affirmation from seeing itself as independent of the object).

Graumann (1976) claimed that Hegel held alienation to be constitutive for the self, because it allows that self to produce reality through its own activity and thereby to take possession of that reality, making it a property of consciousness. Hegel believed that production (the act of making things) was not the only exteriorisation of the self, simply the means by which property was created, and stated clearly that, "property is the embodiment of personality, through which the self becomes real" (Hegel, 1942, in Graumann, 1976).

In Hegel's *Philosophy of Right*, he describes three ways in which objects can be acquired: "by grasping physically, by creating the object or by marking it as one's own" (Hegel, 1942, in Graumann, 1976).

The second is the most crucial to appropriation:

"When I impose a form on something, that thing's determinate character as mine acquires an independent externality...forming a thing, I put my will on it, it reflects my personality, which thus has become objectified" (Hegel, 1942, in Graumann, 1976).

In Hegel's view, labour drives human development and through their production humans produce themselves. Labour takes people away from nature and draws them into opposition with natural objects, so it is the activity of labour that brings about the subject/object relationship. Marx later decided that some of these features comprised appropriation, but for Hegel this was not the case.

1.2.2.2 - An anthropological usage for the construct of appropriation.

Marx

Karl Marx, like Hegel, believed that labour drives human development, although he accused Hegel of concentrating on the intellectual aspects of work. Marx wanted not only to interpret the world but to transform it through praxis.

Marx's approach to praxis was post- and anti-metaphysical. He explicitly traced the origins of his work to ancient Greek philosophers, seeing in this "bloodline" a continuous human need to resolve the issue. Marx did not see conflict between theory and praxis, but he did see conflicts between modalities of praxis.

Although Marx's work on praxis was influenced by Hegelian dialectics, the two men diverged on relationships between mankind and nature. For Marx, people may determine what they produce, but equally what they produce determines what the people are.

In Hegel's *Phenomenology of Spirit*, spirit is dynamic, generating a negative form of itself, which, in a dialectical relationship, is an alienated object that reinforces and is overcome by the subject. Such movement is reflected in Marx's *Material Dialectics*, but it now occurs in the material world and is manifested through work. Work is the vehicle that allows people to objectify their spirit in the product. That product becomes the alienated object, which must be appropriated for people to affirm themselves.

Marx introduced the dialectic of antagonistic contradiction, visible in class struggle, and argued that the negation seen in Hegelian theory does not pave the way for the overcoming of opposites in a higher unity, but the reversal of the dominance relationship between them, to culminate in the abolition of one and emancipation of the other.

Marx saw appropriation as the relationship between individuals and the objects they produce, as the internalisation of knowledge and skill; the concept of appropriation is then connected to action in the working world (Veschambre, 2005). Marxist appropriation is both an internal fulfilment and a socially mediated event (Serfaty-Garzon, 2003).

Marx claimed that human beings found self-realisation only through production, using powers that would otherwise remain mere potential. Hegel saw language, work and social relationships as prime factors in humanity; in Marx, work is the fundamental force. Work is objectified in products, which are alien to their producer unless he appropriates them. This process of appropriation lets man develop his human potential: altering the external world, mankind actualises his potential and true nature. Appropriation of an object always includes the appropriation of a skill or aptitude.

In Marx's work, appropriation describes man's relationship with nature. In making use of nature, man appropriates it. However, he does not do this alone: it is a social act, and man can develop into an individual only within society. Therefore, the

appropriator is not an individual but society; society maintains appropriation over generations. "Even the forming of the five senses is a labour of the entire history of the world down to the present" (Marx, 1963, in Graumann, 1976). Marx did claim that individual appropriation also existed and it is this form of appropriation that psychologists adopted.

1.2.2.3 - A psychological usage for the construct of appropriation.

a. Vygotsky

Lev Semionovitch Vygotsky (1869-1934) sought to explain psychological processes and states in terms of a "living cell", a reflection of Marx's use of that term. Vygotsky worked towards elucidation and explanation of the higher psychological functions and their development, through the processes and mechanisms involved; "mainly in his analysis of the relationship between thought and language the developmental perspectives coalesce" (Graumann, 1976). It was Vygotsky's intention to provide a fundamental understanding and firm basis to serve the discipline of psychology as a whole.

According to Vygotsky's social-cultural theory, language and thought have their origins in social and cultural life: hence, that culture is taken in and becomes part of the individual as he or she internalises relevant skills. The theory seeks to identify the origins of and developmental processes involved in behaviour and consciousness. Vygotsky was influenced by dialectics and historical materialism, and as a result his theory views phenomena as subject to constant movement and change.

Vygotsky's thought has clear links to historical materialism's description of mankind transforming both itself and nature through work and the tools of that work. However, Vygotsky extends this concept and replaces the instruments or tools, the historical materialism identified as fundamental for work, with signs. Those signs are effectively the instruments/tools of the work of literacy and numeracy; they are created by society and drive social and cultural change. Mastery of language also allows a person to share the experience of his predecessors (Graumann, 1976).

Early language acquisition is mostly communicative, but as skills develop and language use becomes more sophisticated, it is internalised as inner speech. Given

that the systems of signs used in language are cultural products, their internalisation creates a link between the development of the individual and his or her culture. Also, the acquisition of language prompts the individual to change, to act differently, and creates a link between the various stages of his or her development. Vygotsky, like Marx, saw individuals' development as being prompted by and originating from the society and culture around them.

Vygotsky believed that the development of human cognition and consciousness is catalysed by social interaction, and that aspects of development are experienced in the form of social interaction before being internalised by the individual.

"Every function in the child's cultural development appears twice: first, on the social level and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological). This applies equally to voluntary attention, to logical memory and to the formation of concepts. All the higher functions originate as actual relationships between individuals" (p.57).

Graumann (1976) echoed Vygotsky's belief in the power of interaction with regard to meaning, claiming that "meaning is the form by which the individual human being appropriates the generalised experience of man (for example of his culture, his class, etc.)".

Thoughts and words: a paradox

Language modifies thought

Yves Clot claims that, in *Thought and Language* (2006), Vygotsky "leaves two legacies: the theory of signification and the activity theory". Vygotsky believed that thought and words functioned through different models and, while there was interaction, there was also tension between them. Vygotsky saw language not as a straightforward reflection of thought, but as a process that worked upon thought prior to expressing it: "when the thought transforms itself into language, it restructures and modifies itself. The thought does not express itself but it realises itself in the language".

Thought modifies language

Thought gives language context and so affects the meaning of words. Words taken out of that context do not necessarily mean the same thing or carry the same connotations as they do within it. Language may well be compromised by loss of (thought-generated) context. Restricting words to their “strict” definitions impoverishes meaning, but the meanings of words may also affect the expression of thought. Therefore, in Vygotsky's view, the linguistic expression of thought demands a process that draws on inter- and intra-individual aspects, with the meaning of words coming from both shared, formally understood definitions and also from the individual context. The meaning of the words is separated from both formal definition and from the thoughts that generated it.

Mechanisms of Thought

Vygotsky claimed that individuals subjectivise words in order to make thought external and objective; therefore, words are taken within the individual at the same point as thoughts are placed outside that individual. Placing the thoughts outside the person simultaneously restricts and fixes the meaning of the words used within that context; hence, the individual has put them to subjective use in expressing his or her thoughts. At the same time, when individuals externalise their thoughts in language, that very process also changes their interior perception of the thoughts, which is a form of psychological development. This idea was echoed by Yves Clot (2006) when he stated that, "learning has to transform into development". Hence, in Vygotsky's view, there is constant and varied interaction between the personal and the cultural–social worlds. Clot stated that, "The concept of appropriation describes the process appropriately, frequently inadequately described by the notion of interiorisation". Clot saw this as appropriation because, in his view, learners appropriate social instruments (which we have previously discussed in terms of signs) and use them in service of their own needs. Clot saw both intellectual and emotional development as being the transformation of experiences into means of "maintaining one's passions", which has clear parallels with Vygotsky's statement that, "it is precisely the passions that constitute the fundamental phenomenon of human nature" (Vygotsky, 1933).

b. Leontiev

Alexei Nikolayevich Leontiev (1903-1979) developed the Theory of Activity. Leontiev considered learning a practical activity and primary operation.

Appropriation of activity is the basic mechanism of psychological development (Graumann, 1974), creating a continuum of human experience as individuals appropriate from their surroundings (Serfaty-Garzon, 2003), developing functions and abilities that have arisen throughout history. Appropriation from social interactions involves sensory, motor, linguistic and conceptual processes. During interaction between man and object, the shared, socially defined meaning of that object is appropriated (Graumann, 1974). This is a basic function of human endeavour.

Leontiev described this process through observation of babies developing the ability to eat with cups and spoons, i.e. learning to use objects to meet their needs. This is driven not only by the functional properties of implements but also by social interaction (adult guidance), which influences the child to submit its actions to the "objective logic of using a spoon" and hence "a functional motor system is built up in the baby, that is governed by topological relations" (Leontiev, 2009).

For Leontiev, "imitation of a presented example" is characteristic of human development, notable for generating functions and principles that can be abstracted and applied elsewhere.

Babies use the functional systems they build, to master human actions. This process arises from social contact. Initially scope is limited; most human experience is externalised through language and very young children cannot understand speech. As children grow, they assimilate the verbal form and verbal meanings (Leontiev, 2009).

Graumann (1974) summarises appropriation as

"essentially the interiorisation of socially defined meanings...individual capacities are developed into aptitudes, skills and functions only to the extent that social achievements and meanings handed down in history are appropriated. Appropriation being social in nature, it necessarily reflects the structure of society at a given point".

Leontiev considers not only meaning but also the sense (orientation) of activity. Vygotsky defines sense as the forms of relationship between the task and other, remembered tasks. For Leontiev, sense connects consciousness to context; it is a relationship between individuals' driving forces and objectives. The objective generates action planning and conceptualised outcome, and subjective forces determine what is important. Divergences between these may frustrate students even when an objective is achieved: attaining the objective may not equal psychological "success".

Clot (2006) finds Leontiev's work on reason and objective original. In Leontiev's view, new drivers and motivation arise in the individual as a result of action and the reality produced by it. However, subjective reason and cognitive planning are not the only elements in Leontiev's theory. Objectives connect not only to the mind of the individual but also to resources such as the forms of action available.

Clot (2006) examines Leontiev's activity theory in light of efficacy and efficiency, although Leontiev never used the latter terms, and declares that the main consequence lies in the relationships between subjectivity and activity. While Clot feels Leontiev extends Vygotsky's work in some aspects, elaborating on theories of sense and operational dynamics, he finds Leontiev's work on relationships between sense and meaning inferior. Clot claims that, in Leontiev's work, meaning loses dynamism and psychological importance: Leontiev does not present meaning as an object created by the individual.

c. Bakhtin.

Language is the fundamental unit of appropriation, because the appropriation of a problem relies on the appropriation of concepts, ideas or discourses which in turn rely on words. Appropriation is about deriving meaning, the ways in which individuals produce signification from the words they appropriate.

Mikhail Mikhailovich Bakhtin (1895-1975) declared that "words are not neutral, they are charged by the individual intentions" and "language lies on the borderline between oneself and the other". He noted that speakers do not go direct to the dictionary for words, but take them from social contexts in which they are used by others, appropriating and making them subjective (Holquist, 1996). This process resembles Vygotsky's processes of externalisation and internalisation.

Vygotsky identified two basic functions of language: communication and thought generalisation. The communicative function is the first to develop; thought generalisation emerges later, when language and thought interact. Thought generalisation allows the individual to apply a shared symbolic system to classify, conceptualise and generalise objects. Bakhtin viewed all relationships as dialogues, and internal speech as narrative. Clot (2006) recommended comparison of Vygotsky's and Bakhtin's works, but similarities between them are open to question.

For Bakhtin, individuals acquire language via its use by others, rather than going to a dictionary. Idiom is not interiorised but generated. Individuals assimilate others' words and language becomes individualised through a process during which words take three forms: the dictionary definition, others' words and one's own words.

This process occurs in contexts, in terms of both individual dialogue and of social and/or cultural context. It is only through such context that individuals can free words from a variety of potential meanings, make them subjective and their own.

“Language is not a neutral milieu which becomes easily and freely the intentional property of the speaker. To dominate it, to submit it to one's own intentions and accents, is a difficult and complex process.” (Bakhtin, 1988).

Bakhtin labelled this fundamentally social organisation of language "discourse genre¹⁵", stating that without such genres, discursive communication would be virtually impossible (Bakhtin, 2003). Discourse genres are highly reliant upon context, particularly social contexts, and through them words and language develop over time as they are employed within increasing volumes of dialogue. Therefore, according to Bakhtin, discourse genres are not norms, but a system of variants in motion. This is not a relativist standpoint, but a historical one, with the differentiation of meaning taking place and developing as dialogue progresses.

¹⁵ Bakhtin names “concept of discourse genre” this pre-existing social organization of the other's word. The genres prefigure the possible language actions. The relationships among subjects, the idiom and the world are not direct; they manifest themselves in available discourse genres, from which the subject must have so as to enter in the communication.

Polysemy indicates a constant re-evaluation of the unity of language, the real meaning of a word is freed from its formal meaning by use in life, yet this does not cancel out that formal meaning. Meaning is re-evaluated, constantly, through use.

This does not contradict anything in Vygotsky, but it takes Bakhtin beyond Vygotsky's work. Vygotsky's conclusions differ from Bakhtin's. For Bakhtin, meaning is created through social activities, and the discourse genres are shared psychological resources. Vygotsky sees things as being less clear-cut and more removed from social context. Wertsch (1998) tells us that the path from discovery to appropriation is rarely linear. In learning situations, differences may arise when students interpret a teacher's messages in light of their own context, resulting in resistance. From this, we can infer that appropriation depends not only on the individual, but also on context.

Bakhtin identifies a constant struggle between internal and external forces, between individual ownership and ownership by others. In chapter 4 I will examine such tensions in a teaching context. Until now, the appropriation phenomena was introduced as a construct rooting on dialectics in the field of philosophy. It was coined appropriation, acquired a materialistic perspective under anthropology and became a human mean of self-realisation through labour. Men perform activities on nature mediated by instruments. Men change nature through labour and by doing so they actualise their potentials: they change themselves. Psychology applied the materialistic perspective of human activity to the human development. Human activity is then mediated by symbolic instruments in social interactions. The symbolic mediation promotes appropriation by meaning making through the relation thought-words in dialogical interactions and by personal sense making through the relation thought-activity. In the next section, the symbolic activity underlying the concept of appropriation is applied to a specific situation, the didactical situation, enriching the concept with a new perspective.

1.2.2.4 - A didactical usage for the construct of appropriation

Theory of didactical situations and appropriation

When students engage in learning games, the objective is for them to become immersed in the experience, to 'live' it and to gain knowledge in the form of an optimal solution to a problem posed (Brousseau, 1997). Tutors generally use games with a particular knowledge outcome in mind, yet it is possible for students to embark upon learning processes or problem-solving processes *other* than those intended by their teacher within the context of the learning game set by them.

In this section I consider the student's appropriation of the problem that the tutor intends them to focus upon. Appropriation refers to the processes through which learners take possession of a problem to be solved and come to feel that it is relevant to them personally. In the context of a learning game, this is not necessarily a linear or constant process: students can dip in and out of engagement with as game and with appropriation. Solving the problem may demand a range of processes, such as practical involvement in problem solving, reflection, and decision-making.

Basic Steps to Devolution

Brousseau identified issues pertaining to appropriation in the early 1980s, examining them in light of his emerging 'didactical contract' concept (Brousseau, 1984). He recognised that there could be a distance between what teachers understood a problem to be (that they set as part of a didactic process) and what a student understood that same problem to be. In response to this, Brousseau proposed the concept of devolution¹⁶, by which he meant a process through which the teacher passes over to students the responsibility to engage with and learn from a problem. Unsuccessful devolution can lead students to engage with a problem in an ineffective way, without recourse to its underlying concepts (Millar, Leach and Osborne, 2001). Brousseau identified five key steps in the process of devolution, which are given in Table 1.1 (Brousseau, 1997).

¹⁶ Devolution means "it is no longer I who wills, it is you who must will, but I am giving you this right because you cannot take it yourself" (Brousseau, 1997, p.249). Broadly, the term refers to the transfer of something from one place to another, from an owner to a successor.

	➤ Devolution Steps	➤ Devolution Characteristics
	First Stage	Pure play
	Second Stage	Devolution of a preference
	Third Stage	Devolution of a responsibility and causality
	Fourth Stage	Devolution of anticipation
	Fifth Stage	Devolution of the Adidatic Situation

Table 1.1. Key steps in the process of devolution, proposed by Brousseau.

At stage one, students do not yet appreciate that a specific outcome is preferred. They act randomly, without specific objective(s).

Stage two is the stage at which students do appreciate which outcome is preferred, but they do not see a clear link between their actions and this outcome, instead believing their actions to be random or guided by some form of fate. Therefore they do not fundamentally understand the rules that underpin the game they are playing.

At the third stage, students discern their own responsibility for events within the game, and causality. Students see that there are choices open to them, and that these choices may lead to specific outcomes. Reflecting on past actions in the game, they can now see which were relevant and which were not. These events are key because, as Brousseau points out, only an appreciation of the link between choice and outcome will allow students to take responsibility for a game, and thus allow responsibility to be devolved from teacher to student.

The fourth stage sees a devolution of anticipation. Students must anticipate the relationship between their decisions and the results of those decisions, and then anticipate any potential disruptions to or interferences with this process.

The fifth and final stage entails the devolution of the adidactical situation. By this point students play the game with an understanding of how to get results in various circumstances. They are aware of this, and have at least an instinctive recognition of the conditions that they need to succeed in the game.

Therefore, the students now know what the game is, but they do not yet have a label for the learning that they have drawn from it. They know this learning only by context, by the circumstances in which they might apply it, and have not surrounded it with technical terms or formal knowledge. This is the adidactical situation: the students have taken possession of the task and decided that the challenge is important enough to them that they wish to solve it. The adidactical situation is distinct from the teaching objective, and its success can be identified solely by the outcome of the game.

The devolution outlined by Brousseau is the devolution of a problem; the teaching objective is not given to the students. The teacher's only real power over the adidactical situation is to negotiate elements, including the rules of the game, and establish a form of 'didactical contract' with students (Brousseau, 1997). This negotiation devolves responsibility for the task to the students. It is at this point that the concept of appropriation emerges in the didactical situation as an aspect of the student learning activity in which he or she appropriates a problem. Now comes a moment in which is worth answering the questions: What is appropriation after all?

Discussion on appropriation: definition and concept

We have already considered the concept of appropriation and its etymology. Appropriation is an active, creative process in which men take possession of an object, transforming this object in order to serve their own needs. I also considered the cultural and scientific development of the concept.

The concept of appropriation has its cultural roots in the dialectics of philosophers such as Plato, who believed dialectics to be the route to the discernment of truth and elevation of spirit. Hegel held that reality generates itself under a dialectical motion, and that this movement produces reality, in a *genetic deployment* (Sève, 2002). Marx describes an everlasting dialectic of *transformational development* (Sève, 2002). Different from a Hegelian dialectic where reality is generated, in Marx, reality is rather transformed. Such a process demands a recurring cycle of appropriation, handed down through generations. In Marx's dialectic, men develop human capabilities through work, actualising potential as they develop the skills

demanded by work. Man's relationship with nature is mediated by the tools of work, and human experience is stamped with our predecessors' appropriation.

In Psychology, Marx's *transformational development* influenced Vygotsky's Theory of Signification, which relies on the dialectical relation between thought and language and the introduction of the symbolic tool mediating the relation individuals establish with object. Man appropriates the experiences of past generations by mastering the meaning of words. Leontiev then developed Vygotsky's unfinished theory of activity and innovates investigating the relation between thought and activity, offering an original contribution on the variations of the sense (Clot, 2002) individuals realise in the dynamics of the activity.

Bakhtin outlined a concept of unresolved dialogue in the dialogical¹⁷ relationship between people: all language is thus intertwined in a network of symbiotic relationships whereby every speech is catalysed by another speech, and is in conflict with yet another speech. Language is a generative process shared by its users. Everything that is said is infused with meaning from other people's words. All of these words are active in the process, and the process is organised and directed through social norms. In these discourse genres, words confront their literal and social meanings and are transformed by individuals for their own uses.

Therefore the concept of appropriation includes the following:

- Active transformation, by the acquirer, of acquired objects.
- Dialectic, transformational development, interacting with contexts, mediated by instruments under social influence.
- Production of signification generated by the interaction between thought and words.
- Production of personal sense generated by the interaction between thought and activity.
- Production of signification in a dialogical relationship with the words of others and in the context of discourse genres.

¹⁷ Dialogism is a principle that underpins the real functioning of language, the element of speech that constitutes its essence.

- In didactical situations, appropriation of a problem occurs when students actively mobilise their knowledge and engage their actions to appropriate that which is devolved by the tutor.

In the next section we will further explore the relationship between devolution and appropriation.

1.3 - A Model for Problem Appropriation

« ... The limits of my language are the limits of my world. »¹⁸

Ludwig Wittgenstein.

In classroom settings, students do not always assimilate exactly what it is hoped - or intended - that they should. Leontiev saw this as a failure in the internal connection between student activity and student consciousness. Some teaching methods may make it difficult for students to concentrate on the matter in hand, and in these cases a more active, 'hands on' approach to teaching may be useful. Of course it is the responsibility of the teacher to arrange this, and to organise appropriate activities. These must be tailored to lead the students to assimilate the relevant material. Internally, students will link the motive behind the activity to the immediate goal of the related action (an educational activity). Therefore in learning processes, the successful completion of a task relies not merely on the objective contents of that task, but also on the motivation that drives it (and therefore drives the students to act). Through this process, the students will derive sense from the activity.

Leontiev and Brousseau coincide in some aspects of their concepts of activity, particularly those concerning the relationships between learners and objects in the course of that activity. As activity progresses, students develop a subjective sense and a subjective purpose: in other words, they appropriate something of value for them.

¹⁸ Ludwig Wittgenstein, Austrian-British philosopher (Wittgenstein, [1922] 2003 – section 5.6), attempting to be “more inclusive of perceptions that he admitted as perhaps unutterable, it expresses the difficulties students may have when attempting to mediate any kind of meaning through words, symbols and diagram” [In: Mathematics teacher education, Amongst mathematicians –NARDI, Elena, Mediating Mathematical Meaning Through Symbolisation, Verbalisation and Visualisation].

I have examined aspects of the process of appropriation, in order to prepare the field for the implementation of a model for the appropriation of problems in didactical, problem-solving situations. Now, let us consider attributes of appropriation of problems and introduce a model for student problem appropriation

Elementary Attributes of Problem Appropriation

In this section we will examine the concept of appropriation specifically as it is applied in didactics. In this context, appropriation is a twin concept with devolution (Gonçalves & al., 2009) in that it applies to appropriation in a problem-solving, learning environment. Students adopt behaviours that allow them to transform a problem in order to appropriate it, and such behaviours follow a predictable or characteristic pattern.

Table 1.2 shows the categories and attributes of appropriation that I propose. The model I present here is inspired by Brousseau's model of devolution (Gonçalves & al., 2010) and describes the various stages that students will pass through to solve a problem, not necessary all of them and in this order.

»» Appropriation Categories	»» Appropriation Attributes
Accept	to accept to play the game
Test	to act just to see what happens
Make choices	to make choices, to spot what provokes effects
Anticipate	to make choices and anticipate the effects of one's choices
Mastery	to recognize similar problems and resolution strategies

Table 1.2. Categories and attributes in appropriation.

During appropriation, students infuse words with subjective meaning that is drawn from subjective references and experience. Given the subjective elements involved, students may not necessarily appropriate the problem that their teacher wishes to devolve¹⁹. They may work together and exchange ideas, formulate

¹⁹ The verb to devolve (devolved, devolving) expresses a “rolling downwards or onwards” in a hierarchy, or to transfer from one person to another by succession of transference. Devolvement is the act of devolving. The adjective “devoluted” (verb to “devolute+”) is a terminology from administrative Law qualifying everything belonging to a public domain (i.e. land) standing in a condition of vacancy or

constructions of their own, or collaborate to develop meaning and understanding, yet none of this guarantees that students will appropriate that which the teacher intends to devolve. Therefore a project demands that pupils be constrained and guided toward the teacher's goal.

The appropriation of a problem is an unfolding process during which events can follow consecutively or overlap. There is not necessarily an order, chronology, or a hierarchy of events involved. Different points in a given task may demand different skills, so the categories in this model are likely to be associated with context and/or with different moments of a situation, as well as linked to the needs of the student or group.

Brousseau (1997) presents a protocol for establishing a relevant didactical situation. It structures the environment with action, formulation and validation situations, offers the tools needed to devise learning games, and develops scenarios to support the interaction of students in relation to context and to each other. Constraints are built in to stimulate meaning-making and guide students toward desired outcomes, namely the didactical objectives proposed by the teacher and learned by the student.

Psychological analysis is generally conducted retrospectively after manifestation of student behaviours. Conversely, didacticians' are usually required to stimulate expression of given behaviours in their studies. They must analyse didactic situations in advance in order to create an environment that will facilitate learning. Didacticians must anticipate problems or inconsistencies when modelling didactic situations. Brousseau (1997) refers to these inconsistencies as 'paradoxes' that occur within the didactical contract and in the devolution of situations.

The main aim of this research is to develop a model for the appropriation of a problem by students playing a serious game. Therefore it will concentrate not on problem solving *per se*, but rather on the route that students negotiate towards problem solving, which is appropriation.

1.3.1 - Appropriation Categories

Appropriation refers to both the state and the process of taking possession of a problem and making it subjective. In the next sections, I will examine the categories presented in Table 1.2.

1.3.1.1. Category “to Accept”

Appropriation does not involve the attainment of physical objects, but of meaning. Graumann (1976) states that "modes of relating are appropriated", which implies that the mere possession of or access to something is not enough to be considered appropriation. For appropriation to occur, the thing appropriated must be put to use and incorporated into the intellectual and behavioural life of the appropriator.

A readiness to accept is the basic state required for the process of appropriation. In learning situations, students must put an *animus appropriandi*²⁰ to work, appropriating that which they are taught through a dialectical process. This process, and the resulting appropriation, will probably inform or direct their actions in subsequent, related activities.

The didactical contract between tutor and student comprises the tutor's duty to teach and the student's obligation to learn. The tutor may establish the basic rules and strategies, but later adapt them to suit the student (Brousseau, 1997). For students, “the knowledge is the means of understanding the ground rules of the game; it is also the means of elaborating winning strategies and obtaining the result they seek” (Brousseau, 1997).

An individual must choose to be ready to accept. The fact that they are in a classroom does not *in itself* guarantee that students will accept what they are taught. There can be many reasons for a student’s failure to accept. For example tasks may be too difficult, or students may have competing priorities. However, such a refusal to accept need not be permanent. The student may fluctuate between states of readiness and refusal to accept over a period of time. Successful appropriation, in this context, demands students engage in the didactic

²⁰ *Animus appropriandi* is a Latin term meaning the will, desire or intention to appropriate something; the mental state of an individual ready to engage in appropriation.

situation²¹, acquire and transform knowledge, then act in light of it. In the case of a game, *Race to 20*, students decide to pay attention to the teacher (a signal that they intend to appropriate knowledge) and by completing the task they gain access to information which they then make subjective and extract knowledge from, demonstrating their extraction of meaning by creating their own version of the activity²². The step following this category will be the students' action determining a situation of action.

1.3.1.2. Category "to Test"

The production of meaning occurs during interaction between a reader or listener and a message. The recipient in his or her internal speech interacts actively with the "*formal meaning*" of words generating "*real meanings*" (Clot, 2006).

Therefore when a teacher communicates a message to students, those students decipher the language used and also imbue it with a meaning of their own. Of course, this may not be the meaning that the teacher intended (Brousseau, 1997). This means that the optimal production of meaning in such a situation now demands problem-solving. The significance attached to the message by the student must be considered in light of the context, as well as in light of what the recipient knows of the teacher's intended actions within that context.

The student must act upon the message regardless of the uncertainties that surround it. The student must act but has no way in the moment of being certain that their action is correct. This describes a process of testing: students have to test their understanding by engaging in related activity and see what happens. At this stage mistakes are irrelevant, because the primary aim is to establish a relationship with the object of learning so as to test it by applying internalised rules.

Students who have reached this point of testing are directing their efforts towards action. Action gives them a sense of a subject that is different to meaning received via language alone. However, at this stage, students may not have a clear idea of

²¹ The didactical situation is a theoretical concept, not seen in life. It is used as an a priori model upon which tutors base and plan for the situation they intend to achieve. In a real classroom the 'didactical situation' may begin as such but will necessarily be limited and directed away from that model by outcomes including student behaviour, interaction with tasks and appropriation.

²² See Appendix VI, *The Race to 20* (p. 318)

the probable outcomes of, or likely feedback regarding, their actions. To test means to invest in the unknown in order to get to know it better. Students apply rules and behaviours without necessarily knowing through reason or anticipation what will happen next. An example of this might be a student in his or her first contact with a given IT environment, and who clicks randomly on the available hyperlinks figuring on the computer screen just to get results and without having any clear objective or knowing what to do. In such a situation, the student's energies focus on their curiosity about the task, object or situation under consideration and not a solution or some kind of winning strategy.

In some cases, such testing may lead a student to solve a problem almost by accident. Therefore a problem may be solved and appropriated without full understanding of underlying elements, or even of the nature of the solution having been established. In such cases, although seemingly quick-won in terms of learning, the student is unlikely to be able to solve a similar problem in the future. An objective has been attained, but without great benefit for the student.

This behaviour-focused approach is also seen in verbal communication where speakers test new expressions and terms in conversation using context and response to define meaning.

In the game *Race to 20*, students play together with some understanding of the rules of the game. Some meanings have been produced with the acquaintance with the assignment and with the first actions in the milieu, the first rounds of play; students then a capable to apply the rules to the game. As the game progresses, the extent and sophistication of the students' meaning derivation increases. For example, those who began by randomly calling numbers realise that it is not an effective strategy in this context, and some deduce the advantage of calling the number 17. In the dialectical process of appropriation seen here, recurrent feedback and experience from their own and others' actions give students context and expectations of activity where none previously existed. Thus, their actions allow them to progress and to develop.

1.3.1.3. Category “to Make Choices”

Having appropriated knowledge through testing, students are now more familiar with the subject matter, and moreover they have a set of potential actions from which to choose in this context. Experience will have taught them which options are likely to produce which outcomes, and when the students begin to make choices, they are cognisant of the possible effects of those choices. As they proceed in making these choices, they may experience a new process of making meaning where their previous understanding of what they appropriated is strengthened and extended through the results of their new activity.

There may be other events. For example, students may be surprised by some outcomes, or find that the activity does not proceed as they expect, or that it stops altogether. Thus, a new conception of the activity and of related possibilities emerges, and is factored into the students' revised cognitive planning.

At this point students begin to take responsibility for the activity and the reality that results from engaging with it. The activity has a subjective quality and a personal interpretation based on an individual experience of it. Having learned about the potentials of action and outcome, students continue to engage and to invest in what is known in order to gain more meaning and more feedback. They begin to find constraints for their activities that require them to reason further and to re-focus their action within the context.

There are still many forms and aspects of action and strategy of which the students are unaware at the category of “make choices”. They may achieve a solution through active choice, yet this does not mean that they have formulated a strategy, but simply that they have appropriated the problem through choice and through an awareness of the likely outcome of that choice.

Such students are progressing toward the stage of strategy development. As they extend their experience and make results subjective, a strategy may emerge. Over time students move closer to being objective, but at this stage they still cannot guarantee the results of their actions. Students operating at this level are trying to discover the outcomes of a given choice. They may perform actions with specific objectives in mind, but are not yet able to strategise their actions. In speech, this behaviour is shown when participants collaborating on an activity discuss

potential courses of action but are unable to fully argue why they favour or reject a given action. Making such choices in context generally produces new meaning, which re-directs participants' actions and raises new expectations.

In the game *Race to 20*, students form two teams and each team sends a representative to play against an opponent while the rest of the teams observe. This represents a new constraint on the students' actions, as is another new rule that team members can discuss tactics before the game. At this point, past games and experience become useful. The students can make choices that may not be immediately obvious, but which are based on experience. They realise the value of pooling ideas, and group decision-making now has a vital role in the choice of approach and supporting action. In the dialectical process of appropriation that occurs in this setting, having established the outcomes of specific actions allows students to distinguish good and bad choices. Some students recognise the correct approach right from the beginning of this stage: "you have to say 17".

1.3.1.4. Category "to Anticipate"

As choice-making skills develop, individuals generate sets of good and sets of bad options. All of these comprise actions intended to achieve the objective - to solve a problem. Students develop the ability to achieve results in this sphere by making choices. When the testing process produces a result, this in and of itself does not equip students to produce a strategy; it merely provides feedback on the results of their chosen actions. However, if students develop skills in anticipation, they can become more efficient in making choices with a specific goal or result in mind.

Effective anticipation involves a process, steps in which comprise cognitive planning (including a conceptualised result) and subjective reasoning (the person must intend the action and conceptualised result). The actual results produced may contain elements that include the expected results, stemming from activity under the control of the individual, and also other elements, stemming from parts of the activity not under the control of the individual.

The portion of the activity that is under the individual's control will probably generate the results expected, as a result of subjective drivers such as that individual's will. The portion of the activity not under the individual's control is that portion likely to generate unexpected results. This may frustrate or surprise

the participant, creating new subjective reasons to solve the problem. These reasons demand a strategy.

In order to anticipate effectively, students must formulate a hypothesis. To effectively anticipate impact, they must have a vision of the entire situation and not solely its results. Only then can they identify variable factors that are likely to occur, and only then can they choose a strategy that is likely to be optimal.

Students must define their problem and produce a clear idea of the result they intend to achieve. Their strategy is driven, by their subjective needs, to produce the desired outcome, but they should assess the likely efficacy of their actions. Other elements to consider include the different forms that the planned action might take, and it might pay to consider this within a cultural context.

Over time, students gain skill in formulating internal models. Anticipation forces them to preview the results of their choices, and consider how likely or otherwise it is that variables (especially unexpected and obstructive variables) will occur; the students develop hypotheses around variables and/or likely outcomes and events, and may begin to be prepared for the unexpected; this process of development is often facilitated when unexpected results occur (Le Boterf, 2010). The final result should be an understanding that the students can communicate (in other words, a signification) of what they have appropriated.

Anticipation leads students to solve a problem, letting them appropriate it using reasoned action and strategy. They balance efficacy and efficiency, identify problems within their context. However, this may produce a challenge - while students may be able to solve a similar problem, they may not be able to identify differing but related problems.

Anticipation takes various forms and may be based on information the student has gathered while making meaning and personal sense. Anticipation may occur in mental processes, such as evaluation of feedback received, or arise from previous practical experience. Students can appropriate the same problem several times and appropriation may vary according to the point in the learning process at which it occurs.

In the *Race to 20*, students elaborate propositions. They formulate strategies by testing the validity of their choices, individuals formulate arguments to support their plans. Once students are able to specify a set of outcomes linked to specific choices which lead to strategies, they have the skills to master a problem.

1.3.1.5. Category “to Master”

Mastery is the highest level of the appropriation of what Rogoff, then followed by Overdijk and Diggelen (2006), called a 'cultural tool', by which is meant language, or a technical tool such as technology. Overdijk and Diggelen outlined "the process by which individuals transform their understanding of and responsibility for activities through their own participation". Others, such as Wertsch, distinguish mastery from appropriation, claiming mastery is "knowing how to use a mediational means with facility", or in other words, being able to put it to one's own subjective use in context.

Problems can be categorised by outcome, and this paves the way for mastery. By now students have efficacy and efficiency and can produce strategies for solving a specified problem. Their experience of anticipation will have generated outcomes that they can now use to categorise problems. This is a new process of meaning-making and may require a re-focusing of the student's efforts.

Students can develop strategies to attain specific results, as well as can coherently argue and give empirical proof to support their view. They can validate their own strategies, and invalidate others'. To evaluate their appropriation at this stage, students must experience the same problem in various settings, as well as test their strategy in each context.

In learning situations, mastery is the highest level of autonomy. In a field of study or practical skill, mastery is often an ideal state, coming from a long experience.

In the game, *Race to 20*, students anticipate the results of their own and colleagues' choices. This gives them a collection of strategies and challenges to those strategies, and a view of old strategies in new contexts. From this they draw reasoned arguments for or against strategies, which demands that they express their ideas and the meanings that they have made within the constraints of the activity. Students can now use intellectual reason and evidence from the activity to support or refute propositions.

Both the demands of the context, such as the rules of the game, as well as individual and group efforts to produce meaning and direct action support students' appropriation of the problem.

The dialectics of this situation (action, formulation and validation) are linked to appropriation. In testing, students test what they have accepted. When they make choices, they do so over elements that they have tested. When they anticipate, they do so over the choices that they have made. When students master, they recognise strategies that they explored when they could anticipate.

1.4 - Conclusion

In the present chapter, I introduced the appropriation phenomena in two different forms. First, I introduced the appropriation phenomena through an etymological study of the term appropriation intended to justify the choice for naming this phenomenon and compare term *appropriation* to possible other terms. This comparison was intended to clarify confusions on the use of term in literature.

Secondly, I introduced a genealogy for the appropriation phenomena seeking to highlight its historical rooting in dialectics and the evolution of this conception throughout history. I showed how the notion of dialectics coming from philosophy provided Marx with an anthropological use of appropriation, throughout the works of Vygotsky, Leontiev and Bakhtin, a psychological use of appropriation, and finally, a didactical use of appropriation in Brousseau's Theory of Didactical Situation.

In the context of my studies, the appropriation phenomena are limited to the appropriation of a problem and are defined as a dual concept of Brousseau's concept of devolution. As such, it is the students' project to appropriate a problem. I introduced a model for student problem appropriation in five elementary categories, with each one of them being influenced the different theoretical concepts and frameworks introduced in the until now: the structuration of the milieu, Vygotsky's theory of signification, Leontiev's theory of activity and Bakhtin's philosophy of language.

In the next chapter I introduce the Project Laboratorium of Epidemiology (LOE) and a didactical analysis in which I analyse elements of the problem students have to appropriate and solve in the context of the serious game.

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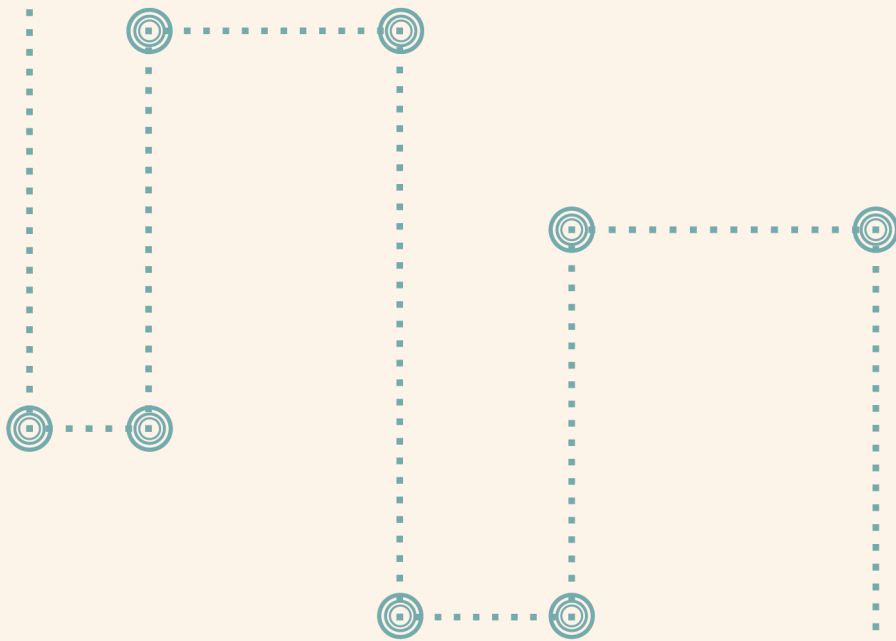
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Chapter 2



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Résumé en Français

LE PROJET « LABORATORIUM D'ÉPIDÉMIOLOGIE » (LOE)

Ce projet de recherche concerne le système didactique dans lequel l'apprentissage joue un rôle majeur. LOE simule une situation médicale donnée au cours de laquelle des étudiants de premier cycle pratiquent la biostatistique. LOE est un simulateur conçu pour l'expérimentation et l'entraînement mais c'est aussi un jeu sérieux. Puisqu'il modélise une activité médicale professionnelle, ce simulateur comprend l'utilisation de jeux de rôles. Le « jeu sérieux » comme un jeu « dans lequel la pédagogie (sous toutes ses formes) est l'enjeu principal, au-delà du simple divertissement »¹.

Composant du système didactique, LOE s'inspire de différentes approches d'apprentissage, telles que l'apprentissage par le jeu, l'investigation ou par le projet, chacune s'inscrivant dans une vision constructiviste de l'apprentissage. Le constructivisme est une théorie selon laquelle l'apprentissage de l'homme s'explique par sa tentative active et autonome pour construire du sens et s'adapter au monde. On pourrait aussi en trouver la source dans les caractéristiques de l'apprentissage par l'enquête ou la découverte, qui est « une approche de l'apprentissage impliquant un processus d'exploration du monde naturel et matériel, et qui mène à s'interroger, à faire des découvertes et à les expérimenter rigoureusement dans le but de rechercher une nouvelle compréhension »². LOE vit le jour lorsque les chercheurs souhaitent fusionner ces différents domaines.

LOE possède 5 caractéristiques : (1) l'immersion – les étudiants sont immergés dans un phénomène qui les touche physiquement et émotionnellement. (2) L'évolution dans le temps et l'espace et sur une longue période. (3) La multimodalité – l'avancée de la simulation est suivie via différents médias. (4) La personnalisation par les étudiants des campagnes de collectes de données. (5) La résolution collaborative des problèmes.

LOE s'inspire du concept de « phénomènes embarqués »³ comprenant 4 attributs de base : (1) Simulation d'un phénomène scientifique – généralement simulé dans une salle de classe. (2) Simulation distribuée, multimodale – accessible par ordinateurs, smartphones, etc. et quel que soit l'endroit. (3) Simulation persistante – les activités peuvent se dérouler dans plusieurs endroits dans la mesure où LOE continue d'évoluer même en dehors des heures de classe. (4) Contrôle et maniement par les étudiants – les étudiants contrôlent et manipulent eux-mêmes les données collectées.

¹ Michael et Chen (2006)

² de Jong & Joolingen (1998)

³ Moher (2006)

LA CONCEPTION DE L'ENVIRONNEMENT

Durant cette phase, il est important de trouver un compromis « entre les exigences de la référence professionnelle [...] et les contraintes d'une situation d'apprentissage qui se tiendra dans un contexte institutionnel »⁴. La première étape consiste en l'analyse du métier d'épidémiologiste en vue de sa modélisation. La seconde étape est l'imagination d'un scénario dans lequel les étudiants doivent concevoir et réaliser une étude épidémiologique, mais aussi écrire un article scientifique qui sera présenté lors d'un congrès. Le jeu se compose d'une série de problèmes. Une Commission Santé attribue aux étudiants une mission qui nécessite une étude épidémiologique. La simulation utilise une base de données anonymes réelle, fournies par les épidémiologistes participant au projet, contenant jusqu'aux problèmes éventuels liés aux patients (informations incomplètes, etc.).

L'ANALYSE DIDACTIQUE

Cette partie entend présenter une analyse didactique du contenu des trois premières classes (d'un total de huit) de cette discipline obligatoire qui s'occupent de la conception d'un protocole de recherche scientifique et de la collecte de données. Ce contenu est exploré principalement par le prisme de l'étude épidémiologique, la biostatistique n'étant utilisée par les étudiants que pour « anticiper » les données qu'ils prévoient de collecter et les résultats qu'ils en attendent. L'épidémiologie est l'étude de la distribution et des facteurs des maladies, ainsi que des phénomènes pathologiques en général chez les humains.

Si elle remonte à la Grèce antique, l'épidémiologie est devenue une discipline autonome dans la seconde moitié du xx^e siècle. Son domaine s'étend des maladies aiguës aux maladies chroniques et évolue avec ses propres méthodes, par l'observation ou par l'expérimentation, ainsi que ses propres programmes de formation. Bien que ses liens avec le domaine de la médecine soient importants et permanents, ils ne sont pas exclusifs, rejoignant également les domaines législatifs, pharmacologique, de la santé publique, etc.

Les concepts en épidémiologie

Les principaux concepts utilisés en épidémiologie sont *l'incidence* (taux d'apparition de nouveaux cas d'une maladie donnée, souvent appliquée dans des études de cohorte), la *prévalence* (nombre total de cas d'une maladie donnée, fréquemment utilisée dans les études transversales) et le *risque* (probabilité pour un individu de développer une maladie). Il y a aussi le *risque relatif* (relation entre la probabilité de développer une maladie en fonction d'un type d'exposition et celle de développer la maladie sans lui), le *Odds Ratio* (taux entre les individus exposés et non-exposés) et le *risque attribuable* (proportion de cas d'une maladie attribuée à un facteur d'exposition donné).

⁴ Ney et Balacheff (2008)

Le protocole de recherche doit s'ouvrir avec une formulation précise et concise de la question de recherche. Les études en santé publique sont menées afin d'étudier la maladie, d'intervenir pendant ou d'évaluer l'intervention. Deux de ces objectifs peuvent être atteints en utilisant des procédures fondées sur des méthodes d'études classiques : études descriptives (étudier l'incidence d'un événement), études analytiques (étudier les causes) et études d'évaluation (évaluer l'intervention).

L'étude d'observation analytique peut être sous-divisée en « exposées/non-exposées » (observation prospective du développement de maladies sur des sujets exposés à des facteurs de risque), « étude de cas-témoins » (observation rétrospective des patients exposés à des facteurs de risque) et « étude longitudinale » (estimation descriptive de la prévalence d'une maladie ou du nombre de personnes exposées à des facteurs de risque connus au sein d'une population).

L'épidémiologie de nos jours

L'épidémiologie permet aux apprenants de se familiariser avec l'incertitude. Elle propose une approche qui permet la mise en place de présupposés de causalité quand il n'est justement pas possible d'être certain ou de tout expliquer. Elle comprend l'apprentissage d'une culture du risque, le développement de la conscience qu'il existe des mesures visant à réduire l'impact de cette incertitude, la prévention, la mémoire des événements passés, la compréhension et la préparation aux événements actuels et futurs, etc. Par conséquent, l'étude de l'épidémiologie aide les élèves à comprendre la nature des connaissances scientifiques et médicales et ses problèmes sous-jacents, qu'ils soient économiques, sociaux, éthiques, politiques, etc.⁵

Objectifs pédagogiques et scénario de jeu

Pendant le cursus scolaire médical en France, les étudiants doivent développer des compétences de « lecture critique » d'articles scientifiques. La difficulté à laquelle les étudiants font alors face est d'appréhender l'importance de la biostatistique, principalement pour l'épidémiologie et la santé publique. Lorsque les élèves accèdent au site de LOE pour la première fois, ils font face à un texte de la Commission Santé qui attribue une mission à des équipes de médecins. Dans le jeu, les étudiants sont des épidémiologistes devant étudier l'apparition de la maladie thromboembolique (MTE) dans les hôpitaux. Les étudiants doivent choisir et élaborer un objectif, explorer l'environnement informatique et élaborer un calendrier pour l'enquête. Grâce à leur acquis, ils sont capables de concevoir un protocole de recherche scientifique et sont censés l'élaborer dans les deux premières classes. La conception d'un protocole doit permettre de répondre, en lien avec leur étude, aux questions⁶ « pourquoi » (définir la question et les objectifs

⁵ Coquidé, Lange et Tirard (2006)

⁶ Singh et al, 2005

de recherche), « comment » (définir l'étude, le raisonnement et la méthodologie), « qui » (définir la population cible), « quoi » (définir les variables et les résultats à mesurer) et « dans quel but » (trouver la signification des résultats et des applications à venir).

Le protocole de recherche scientifique que les étudiants sont censés concevoir est composé de 6 thèmes : (1) types de questions – pour exprimer leur intérêt pour un problème ou une population spécifique en matière de santé publique et justifier l'importance de ce choix ; (2) type d'étude – pour élaborer des études descriptives et analytiques couvertes par le scénario de jeu proposé ; (3) type de méthodes – pour prévoir des moyens et des méthodes de collecte de données selon le type d'étude menée ; (4) types d'analyses statistiques – pour anticiper, au sein du protocole, les statistiques descriptives et analytiques qui sont censées être appliquées ; (5) type de biais – pour anticiper les biais susceptibles d'être rencontrés et les limites de l'étude ; (6) considérations éthiques – pour certifier l'enquête, qui doit être menée conformément aux législations française et européenne.

CONCLUSION

Dans le présent chapitre, nous avons présenté le projet LOE, depuis ses concepts sous-jacents jusqu'à sa conception en tant que jeu sérieux.

Dans la prochaine partie, le chapitre 3 présente une étude sur l'appropriation d'un rôle par les élèves. L'activité professionnelle de l'épidémiologiste sera ainsi étudiée en partant de l'élève qui est supposé s'approprier le rôle d'un épidémiologiste au cours des activités proposées. C'est un élément important de l'activité que d'expérimenter le vécu d'un épidémiologiste et d'en comprendre son rôle.

Nous avons proposé également dans le présent chapitre, une étude didactique du problème inhérent au LOE et avons exploré les principaux concepts de l'épidémiologie mobilisés.

Dans le chapitre 4, nous présenterons une étude sur l'appropriation du problème, dans laquelle deux éléments des phénomènes scientifiques simulés seront développés : L'élément de la maladie sera considéré puisque les élèves devront s'approprier la dynamique de la maladie dans sa complexité afin de concevoir un protocole d'analyse. En même temps, avec l'appropriation de ce problème, les élèves devront déterminer les problèmes méthodologiques d'un point de vue professionnel.

Laboratorium of Epidemiology & Didactic Analysis

2.1 Introduction

This research concerns the didactic system in which learning takes place. I have already explained how interested I am in the role of students' appropriation inside this system. This chapter focuses on the milieu, or the Laboratorium of Epidemiology (LOE), an important component of didactic analysis. The chapter decomposes the structure of LOE in its various components in order to better understand it.

What is the Laboratorium of epidemiology (LOE)?

LOE is a simulation⁷ (Figure 2.1) of a specific medical situation in which undergraduate students can practice biostatistics. It is a conceptual model of a real-world situation including a representation of a given phenomenon and the professional practices associated with it. The conceptual model evolves over time producing a simulation. LOE is not a mathematical model and is supported by computer hypermedia and distributed over different digital devices. What usually maintains the development of this simulation is not an algorithm but mainly a didactical program.

From the perspective of the researcher, LOE is a simulation intended for experiments, while from the perspective of tutors and students LOE is a simulation intended for training. The latter model represents aspects of the real world on an easier and smaller scale, in order to facilitate their study. It mimics probable real life conditions in which students attempt to find a cause of a past occurrence, such as a disease. As a simulation, LOE is a tool that allows students to experience a professional situation which may be impracticable for them, given their undergraduate status. It simplifies reality through underlying assumptions of the

⁷ There are many different definitions for "simulation" in the literature; Ören (2011) introduces a hundred definitions.

real-world, including some of its factors, and explains how a real-life system works under some specific and selected conditions.



Figure 2.1. Opening image of the serious game Laboratorium of Epidemiology (LOE)

LOE is not just only a simulation, but also a serious game. Since it models elements of a medical professional activity, it sometimes involves the use of role-playing. Students get involved with problem-solving in a specific situation, and are given a specific role. LOE therefore, is not simply about acquiring technical skills, it also involves aspects of a role through which such skills are executed.

Serious Games and Learning Approaches

« ~ Man only plays when, in the full meaning of the word, he is a man, and he is only completely a man when he plays. »⁸

Friedrich Schiller.

As a component of the didactic system, LOE inspires different learning approaches, such as game-based learning, inquiry learning, and project-based learning, all of which originate from the constructivist view on learning.

⁸ Johann Christoph Friedrich von Schiller, German philosopher in "On the Aesthetic Education of Man".

a. The Constructivist Approach

Constructivism is a learning theory according to which human learning is explained as an active and self-directed attempt to construct meaning. Humans create knowledge in order to adapt to the world. This desire and willingness to learn lead individuals to actively assimilate by elaborating their own mental models based on their own experiences, and accommodating such new models by adjusting them to previous knowledge. The construction of meaning is initially simplistic and gradually increases to more complex, differentiated and realistic models. Many theories of instructions are influenced by the constructivist approach (i.e. discovery learning, hands-on learning, experiential learning, collaborative learning, project-based learning, task-based learning, etc.). From this stand-point, effective teaching guides students to discover their own meaning, and the teacher helps to guide students' self-directed learning.

b. Serious game

The term "serious game" dates back to the mid-nineteenth century in the literature on people's behaviour during chess games.

According to Huizinga, games are among the essential elements for the generation of culture and society. This brought the author to describe human beings as *Homo Ludens* (in addition to the *Homo Sapiens* and *Homo Faber* labels), in order to highlight the faculty of humans to develop culture and society from games. For the author, "play is older than culture, for culture, however inadequately defined, always presupposes human society, and animals have not waited for man to teach them their playing" (Huizinga, 1980). According to Huizinga,

"play is more than a mere physiological phenomenon or a psychological reflex. It goes beyond the confines of purely physical or purely biological activity it is a *significant* function – that is to say, there is some sense to it. In play there is something "at play" which transcends the immediate needs of life and imparts meaning to the action. All play means something" (Huizinga, 1980, p. 1).

The use of serious games for training is not a recent idea as it has been used by the army in different countries for quite some time, for instance, war-games developed by the Prussian army in the beginning of the nineteenth century. The motivation

for the development of these games was to develop strategic skills, needs which preceded the arrival of new technologies. The use of games in education is not recent either (Rice, 2007), and it is possible to find records of the use of learning games in schools from the beginning of the twentieth century. Moreover, the use of paper-based educational games became well known during the 1960s and 1970s with the educational movement's theme of "back to the basics". The proliferation of computers during the 1980s also introduced the application of educational games on computers.

As a general definition, Zyda (2005) differentiates between games, video games and serious games. He contends that games are "a physical or mental contest, played according to specific rules, with the goal of amusing or rewarding the participants", while video games are "a mental contest played with a computer according to certain rules for amusement, recreation, or winning a stake." Moreover, a serious game is "a mental contest, played with a computer in accordance with specific rules that use entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives."

Michael and Chen (2006) go further to define serious games as games "in which education (in its various forms) is the primary goal, rather than entertainment". Serious games educate by engaging players in the pursuit of a purpose, although there is the added value of entertainment. Usually supported by new gaming technologies, serious games intend more broadly to communicate a message relating to education, information, advertising, communication or training in an attractive manner.

Serious games cover numerous professional circles, publics, and domains including education, defence, advertising, and politics. Their classification is complex, such as, Advergame, Edutainment, Exergame, Edumarketgame, Newsgame, Socialgame, and are still evolving with the progress of new technologies. Djaouti et al. (2011) focus on both "serious" and "game", proposing a model with three dimensions. According to them, the gameplay, or how the game is played, refers to the type of gameplay used and provides information about the game structure of the serious game. The purpose, or why the game is played, refers to an optional purpose apart

from entertainment. This refers to the design purpose and accounts for eventual purposes intended by the designer of the serious game. The scope, or who used the game, refers to targeted use, or the targeted application of the title. This suggests the actual use related to the serious game, the kind of market or audience.

c. Game-based learning

LOE is a resource on game-based learning which consists of enriching the learning situation with games that aim to favour a defined learning outcome and to fulfil learning objectives. The game-based learning approach is characterised by Squire (2005) as “having learning driven by personally meaningful scenarios; constructing problems to extend previous understandings and shape future ones; paying close attention to users' pre-existing beliefs; carefully designing for what the user experiences from moment to moment; and situating facts and knowledge in the context of doing”.

d. Inquiry or discovery

Another source can be found in elements of inquiry or discovery learning (de Jong & Joolingen, 1998) which is “an approach to learning that involves a process of exploring the natural or material world, and that leads to asking questions, making discoveries, and rigorously testing those discoveries in the search for new understanding”. Students are motivated to act towards a scientific approach in order to make their own inquiry that includes stating hypothesis and collecting and analysing data. The phenomenon is simulated and supported by the computer, and the didactic program offers a situation for inquiry-learning and mimics an authentic inquiry.

e. Project-based learning

LOE also presents elements of project-based learning because the learning situation is organised around the design of a project. This relates specifically to this research which is based on a survey conducted by students. Project-based learning incorporates complex tasks based on challenging questions. It involves students in “design, problem-solving, decision making, or investigative activities” giving them an opportunity to “work relatively autonomously over extended periods of time, and culminates in realistic products or presentations” (Jones, Rasmussen & Moffitt, 1997; Thomas, Mergendoller & Michaelson, 1999).

2.2 The Laboratorium of Epidemiology Project

Our planet is geologically composed by a set of layers enclosing one another. A heavy internal portion – Barysphere – enclosed by a rigid shell of rocks – Lithosphere – enveloped by a watery layer – Hydrosphere – and gases surrounding it – Atmosphere. Ecology introduced, as portion of the earth and its atmosphere, the Biosphere (Suess, In Vernadsky, 1998) formed by the “felting of vegetables and animals from the globe” and right under the latter the Noosphere (Chardin, 1956), a human phenomenon, the zone of thinking.

Nowadays, the Biosphere – the layer where human bodies and activities evolve – and the noosphere – the layer where human minds and intellectual constructs evolve – are being bridged by emerging digital technologies, driving learning beyond traditional tools – symbolic technology such as language, writing, reading – producing highly interactive simulations and virtual worlds (Ney & Balacheff, 2008).

The Laboratorium of Epidemiology project emerges in a context where researchers are seeking to merge the above mentioned spheres. Originally designed by Muriel Ney, Nicolas Balacheff, Claudine Schwartz, and Jean-Luc Bosson, the Laboratorium of Epidemiology (LOE) intends to create an ecological⁹ learning situation without the boundaries of the screen. The program permanently implemented a “learning aware environment” (Balacheff, 2012) in an institutional context aiming to engage learners in a scientific inquiry. The learners are second-year undergraduate students from the Grenoble Medical School. In the context of their practical classes, students work on an experiment involving interdisciplinary content relating to biostatistics and epidemiology. My PhD program takes place in the context of this project but I am not in the origin of the Laboratorium of Epidemiology design. However, I participated actively during the first 3 years of its implementation and contributed for its improvements.

⁹ Brown (1992) notes that an ecological situation is a concept in Didactique or the Science of Education, which defines a genre of experimentation conducted by the researcher in a classroom. This research is integrated in the curriculum and therefore takes place in an ecological manner, in the students’ natural milieu. The development takes the time of a discipline, for instance, a semester. The concept contrasts with a genre of experimentation in which researchers conduct experimentation relying on a single and short intervention or in a laboratory situated out of the school and out of the students’ natural place.

2.2.1 Design Characteristics of LOE

LOE has five characteristics:

a. Immersive learning experience

Students experience randomness by immersion into a phenomenon (occurrence of a disease in a hospital) and they are plunged physically and emotionally into the phenomenon.

b. Simulation and Serious Game

The simulation evolves over time and space and is accessible continuously over an extended period of time. It seeks to comprehend a professional situation that is otherwise inaccessible because hospitals are not open to student for such experiments. The simulation is mapped onto the sensible and temporal space of the learning context, a medical school.

c. Multimodality

Rather than centralizing information access on a single medium, information on the progress of the simulation is available via different media devices such as laptops and cell phones. These are tangible access points to the virtual phenomenon.

d. Personalisation

Students collectively design data collection campaigns. They gather and interpret their own data in order to make a decision regarding the hospital they are studying. They obtain their data from a rich and extensive database under time and location constraints.

e. Collaborative Learning and Collaborative Problem-Solving

Students work in groups and are expected to solve their problem collaboratively. The LOE IT environment does not interfere directly with their knowledge co-construction and students collaborate naturally under the constraints and difficulties imposed by the didactic situation. However, LOE is an experimental platform open for the possible future development of computer supported collaborative learning tools.

2.2.2 LOE as an Embedded Phenomenon

LOE is inspired by Moher's (2006) concept of embedded phenomena. It reflects Moher's basic attributes of embedded phenomena:



Figure 2.2. Representation of double-faced simulation in a learning situation

a. Simulated scientific phenomena

These are usually simulated in a classroom. LOE has two simulated phenomena that potentially exceed this space:

- Outbreak of disease in hospital, emerging through patient interviews.
- Simulation of a professional activity (epidemiological investigation of a public health incident).

LOE has the dual characteristic of simulating the emergence of disease, which then interacts with another representation, of the epidemiologist's professional activity. This supports enquiry and project-based learning, requiring students to design a protocol replicating both characteristics of the simulated scientific phenomena. For example they carry out an epidemiological study under the restraints of the professional activity (see Table 2.2).

b. Distributed and multimodal simulation

LOE has elements of multimodal simulation in that it is accessed via various routes (PC, notebook, tablet, smart phone) in various locations. Modes of communication include e-mail and text message. Embedded situations include:

Portals into the phenomenon

In LOE, screens are portals through which students access phenomena and gather data:

- Depicting the local state of relevant information.
- Simulating a professional activity.

In the simulation students replicate elements of a professional activity (an epidemiological survey), acting within professional constraints.

LOE simulates emergence of disease in a hospital

Using the procedures of LOE, students gradually uncover the emergence of disease in a hospital. They specialise in aspects of a thromboembolic disease, develop elements of a research project and establish data characteristics. Simulated patient interviews let students translate this information into medical data. Students analyse data and test hypotheses, making experimental discoveries.

c. Simulation *persistent* over time, concurrent with regular instructional flow

As LOE unfolds, activity is mainly within one room. Events are simulated on screen or desktop, students 'walk' around simulated environments. They act in character and may, for example, be asked to contact an operator from the genuine Medical Information Department. They contact other game characters through webmail.

Moher (2006) considers persistence because this continues when students leave class. LOE evolves over time. Simulated events such as patients being unavailable at some points, the evolution of records and occurrence of events when students are not active in the game, create an awareness of movement that is independent of student actions.

Students are also contacted in connection with LOE outside their formal engagement with the game, e.g. they may be contacted at home at the weekend. LOE persists in space and time.

Classic simulations, based on calculation, let students decide when they started and stopped that calculation. If they stopped and returned days later, nothing relevant would have occurred. LOE is not like that. It is not based predominantly on calculation, the simulation evolves continuously. Events occur randomly, reflecting the activity simulated and following a didactic program.

d. Monitoring and manipulation by students

Students monitor and manipulate the data they collect at various points in the LOE simulation.

It is clear from that LOE is an embedded phenomenon. Students' interactions are modelled within the context of the game, interacting with other characters and reproducing aspects of the professional work of an epidemiologist.

2.2.3 Design

In the designing phase of this simulation, it is important to find a compromise “between the requirements of the professional reference as it is scientifically and technically defined, and the constraints of a learning situation to be held within an institutional context (issues of time, space, resources, assessment, students’ initial conceptions, etc.)” (Ney & Balacheff, 2008).

2.2.3.1 The professional Epidemiologist Task Tree

The first step made by the original designers of LOE was a task analysis of the professional epidemiologist’s actions during a survey.

The results of this analysis is a task tree (Figure 2.3) describing in a sequence of steps every action a professional performs in order to solve a problem. The task tree then becomes the basis for development of the student’s task tree and provides the students’ situation with an authentic setting.

2.2.3.2 The Students task tree in LOE

Modelling trails of a professional experience enables the study of activities in the environment and feeds the design-based research. Also important, was the need to “specify the characteristics of the physical space, the time schedule and the gameplay in order to ensure the devolution to learners of the meaning of the situation, to provide scaffolding to maintain an evolution of the activities likely to lead to the expected learning outcomes” (Ney & Balacheff, 2008). As a result, LOE is based on the following Hierarchical Task Diagram (Girault et al., 2011). The activity decomposes into 3 main tasks (T1.1, T1.2 and T1.3) corresponding to a sequence of three sub-cycles of the activity, and three goals students have to attain in order to accomplish it.

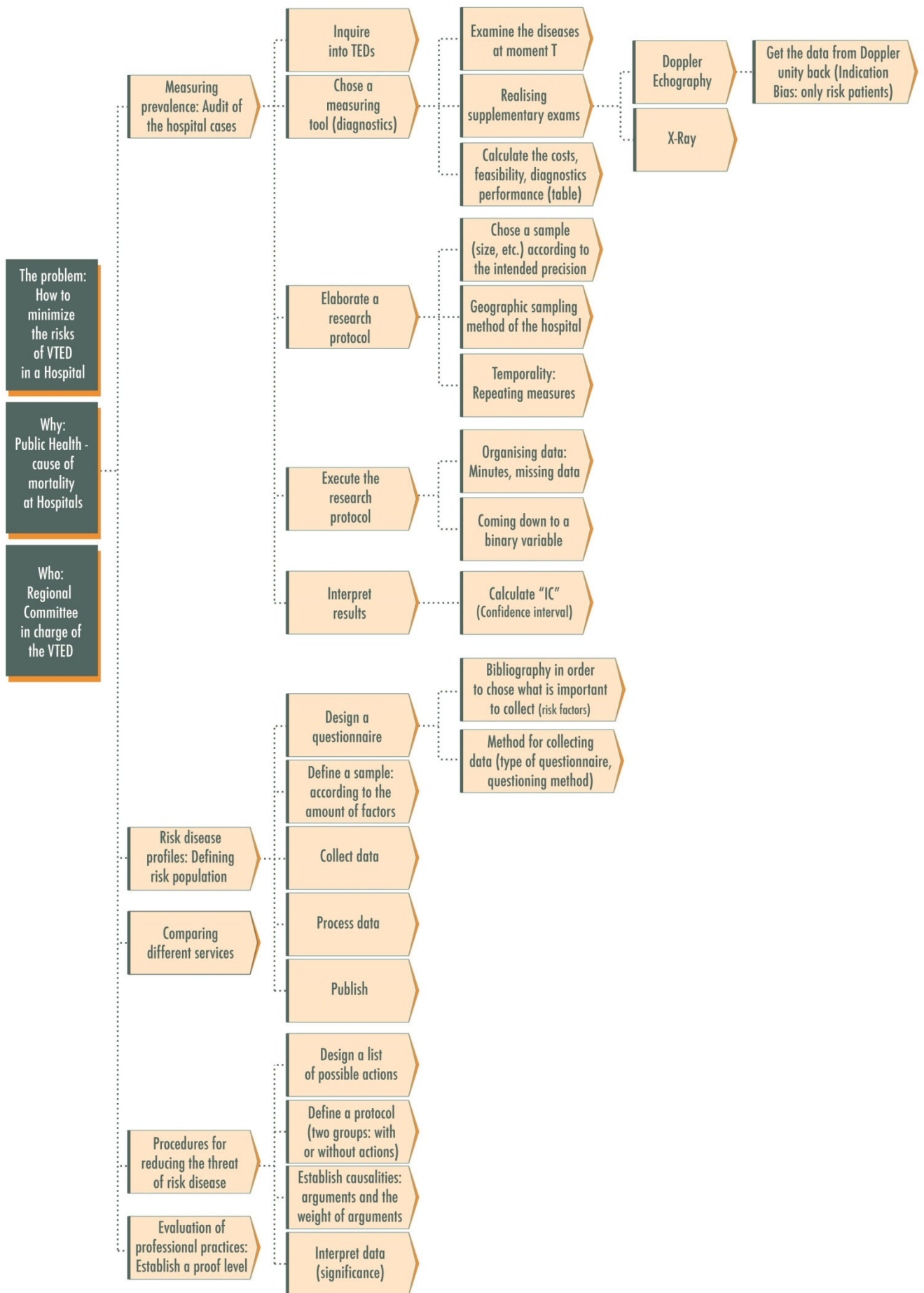


Figure 2.3. Diagram representing the professional task tree.

The cycles follow a timeline going from left to right, which means that students should perform tasks on the left before the tasks on the right. The tasks are: T1.1 validation of a protocol; T1.2 data collection and analysis; T1.3 validation and defence of a scientific paper. Each one of these tasks is decomposed into tree sub-tasks which represent the objectives students must attain in order to achieve a task. For example, students have to sequentially elaborate a schedule, elaborate a protocol and submit the protocol to the Ethics Committee to accomplish the task, “validate a protocol” (T1.1).

Downwards on the diagram, under each sub-task is a set of actions students have to perform in order to accomplish each sub-task. For example, in their first actions in LOE, students have to explore the IT environment, getting to know it and looking for information in order to perform the second action of filling-up a job journal. When they complete this sequence of two actions, the schedule is elaborated.

According to Leontiev (Girault et al., 2011) an activity can be broken down into actions, which in turn, can be broken down into operations. The difference between action and operation is the level of consciousness present in both processes. While actions are connected to conscious goals, operations are related to routine behaviours performed automatically, not related to goals but to conditions. This means that operations can be different depending on the conditions offered by the activity.

In the present diagram, I do not get into the details of the operations students execute during their actions. The diagram describes the tasks and the actions, and I connected the actions directly to another diagram on the features of the environment. Therefore, in this diagram, instead of getting into the details of the students’ operations, I introduce the features supporting students’ actions, and consequently their operations. Their operations are suggested juxtapositions of their actions with its corresponding features. The expected outcomes and the strategies adopted by the students are analysed in the next section. The IT environment supports features used to sustain students’ actions and operations, both of which are parameters of the activity. Table 2.1. below gives details of each parameter.

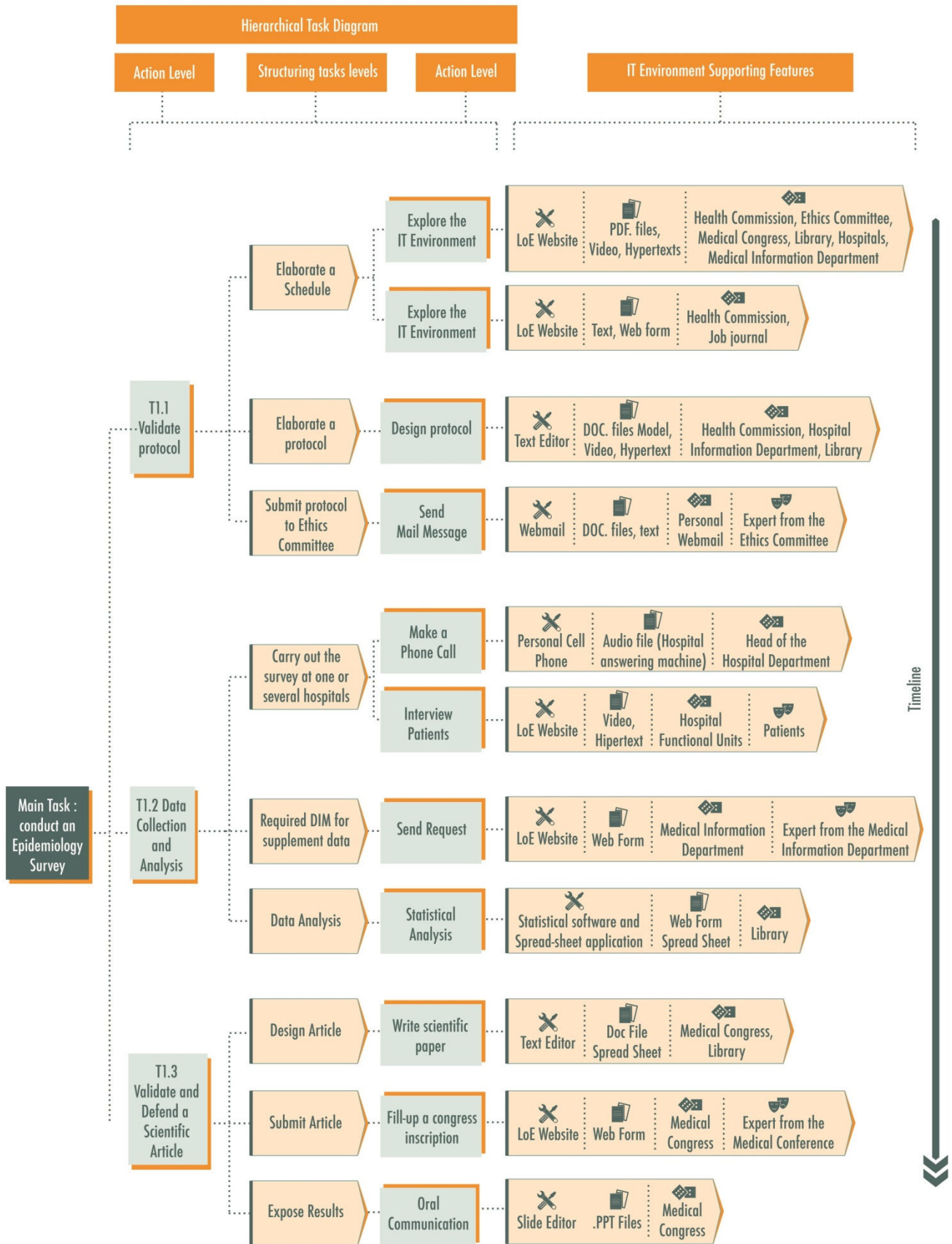


Figure 2.4. The Laboratorium of Epidemiology Hierarchical Task Diagram.





Parameter	Description
 Tool	The tools students need to perform actions and operations. They may use devices such as computers or cell phones. Example: LoE website, web form, text editors, personal webmail, personal cell phone, answering machine, statistics software, spread-sheet application, slide editor, etc.
 Document Support	The document support students obtain in the LoE IT environment by either finding or producing it during the activity is what provides them with the information they need to accomplish their survey. Example: .pdf files, .doc files, .ppt files, videos, audio, hypertexts, web form, spread-sheet, etc.
 Game Environment Support	The game environment support concerns the situation and places of the game; the constraints of the gaming situation influencing students' action and operations, giving them a specific meaning. It is the "why" students are performing the task. Example: The health commission, ethics committee, medical congress, library, hospitals, medical information department, job journal, personal webmail, hospital functional units, medical congress, etc.
 Game Character Interaction	Delving into the gaming situation, students interact with a fictitious character of the game. The latter will also provoke more situational constraints in order to drive the student's intentions towards a "medical intention" while they go towards the accomplishment of the activity. Example: experts on the ethics committee, head of the hospital department, patients, experts from the medical information department and experts from the medical conference.

Table 2.1. Parameters for student's actions and operations in the LOE IT environment.

2.2.3.3 The task tree translated into a scenario

Starting from this task tree (Figure 2.4), the designers of LOE imagined a scenario in which students have to design and carry out an epidemiological study, and write a scientific article to be presented at a congress. The main learning goals concern epidemiology including the statistical analysis of a medical database. Students are given a mission in epidemiology that contextualizes the problems of doing statistics. The mission is to design a diagnosis tool for VTED (Venous Thrombo-Embolitic Disease) for hospital use. While working on this problem, students will learn statistics, understand the role they play, and more generally the function of statistics in public health. The game is fully integrated into the standard medical school curriculum. It lasts four months including eight four-hour sessions in class (Table 2.2).

»» Session	»» Main Tasks	»» Tasks Goals
1	Bibliographical research, choose the main objective and make a plan	To gain knowledge about a specific disease as well as the methodologies used in epidemiological surveys
2	Design an epidemiological survey and send the protocol for validation	To construct and structure a survey (sample quality, indicator quality, ethical considerations, etc.)
3	Carry out the survey at one or several hospitals	To implement a survey (translate patient saying into data, control and organize data)
4 and 5	Analyze data Bibliography	To analyze data with statistical tools and thus understand them
5 and 6	Write an article and submit it to a congress Review Committee	To understand how a scientific article is structured, and how to select and present evidences (statistics may come in different forms)
7	Prepare an oral presentation	To synthesize results taking into account a reviewer's comments
8	Attend a medical congress	To defend orally their decision tools based on statistical arguments

Table 2.2. Task tree and respective goals for each one of the 8 Practical Classes.

2.2.3.4 The professional situation in the gaming scenario:

The simulated professional situation in the game consists of a chain of problems (task list). In the game, a Health Commission assigns students a mission that requires an epidemiological study. The simulation uses an information system filled with real anonym data sets, with problems contingent to real patient data (including incomplete information, etc.). These data are provided by epidemiologists participating in the project.

Each of the tasks mentioned in Table 2.2 is assessed and validated during the game by a character. The protocol is validated by an Ethics Committee and the students' capacity to summarize their research objectives are assessed by the Chef Hospital Department via telephone. The scientific paper is then validated by the experts from the Congress Scientific Committee.

2.2.4 IT environment – linked to didactic goals

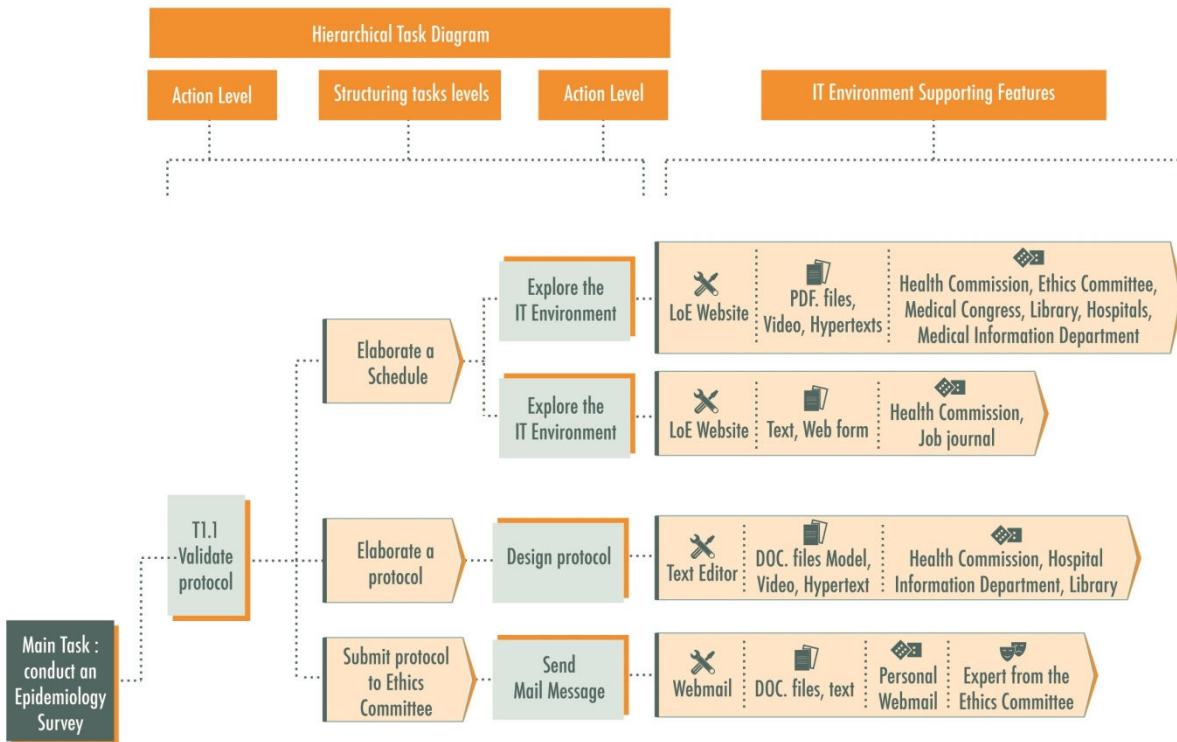


Figure 2.5. Diagram with a zoom on one of the tasks from the hierarchical task tree.

In the next pages, Figures 2.6 and 2.7 present partial map of the LOE Website. Figure 2.6 shows the navigation from the LOE desktop towards different institutions. Figure 2.7 shows the navigation specifically from the LOE University Hospital towards a patient's room.



Figure 2.6. LOE Website map from the main desktop.

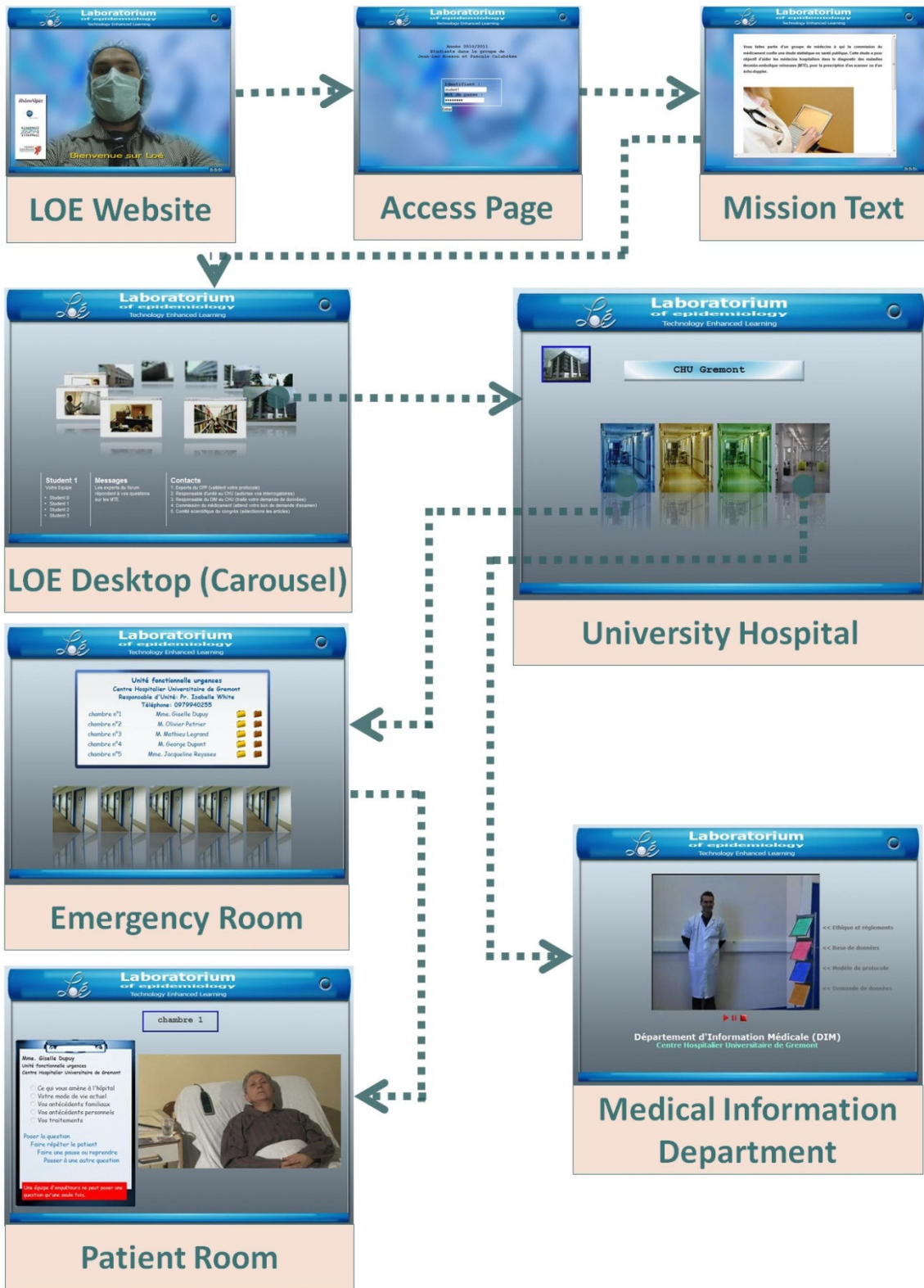


Figure 2.7. LOE Website map from the University Hospital.

2.3 Didactic Analysis

This section of Chapter 2 aims to present a didactic analysis of the content explored in the first three classes of eight, of this mandatory discipline. The first three classes, as will be shown, concern the design and validation of a scientific research protocol and data collection. The curriculum content explored is mainly on the study of epidemiology, and biostatistics is used by students only in an effort to “anticipate” the data they plan to collect and the results they expect.

The didactic analysis is divided in four parts. Firstly, some historical aspects of the domain of epidemiology, and a general definition of epidemiology, as well as some aspects of design will be analysed. This part will introduce the so-called “Scholars Knowledge” in the field of epidemiology. Secondly, some aspects of disciplines such as epidemiology and biostatistics in France, the US and Brazil will be briefly presented. The aim is to enlarge the view of the current teaching of these disciplines. Thirdly, the pedagogical aspects and gaming scenario of the Laboratorium of Epidemiology will be introduced. In this part, the pedagogical context of this mandatory discipline, the knowledge instructed by the institution, and some professional aspects of the gaming scenario are also introduced. Finally, an analysis of the problem proposed in the game to the students, including the mission, the IT environment, what students are expected to learn and what students really learn will be introduced.

Part 2.3.1 is composed of free translations and summaries written from the literature consulted. Historical aspects of the arguments are supported with Benichou et al. (2006), while Bouyer et al. (2009), Czernichow et al. (2001) and Meirik, O. (2008) are referenced for the aspects on Scholars Knowledge.

2.3.1 Epidemiology: History and Concepts

Epidemiology is the study of the distribution and determinants of diseases, as well as pathological phenomena in general, in human populations. Biostatistics and epidemiology are disciplines with a connected development. The first epidemiologists were, historically, often biostatisticians and many statistical methods were developed to give practical answers to problems stated in epidemiology. Each domain of epidemiology developed its own methods. For

instance, Analytical epidemiology developed a priori calculus of the size of a sample to determine the number of subjects to be included in a study to reach a significant result according to the intended data analysis. Although these methods were collectively developed by biostatisticians and epidemiologists, these disciplines gradually separated. Today, biostatisticians are more interested in developing statistical tools or dealing with data analysis while epidemiologists deal with protocols as well as the field of study management. Epidemiology is a science with its own concepts, methods, and know-how, since these professionals are experts in selecting the subjects, collecting data with the lesser measure, and the classification of errors, designing questionnaires, bias analysis and management of long-term and multidisciplinary projects (Bénichou, 2006).

2.3.1.1 Origins and modern history

Epidemiology as an independent discipline is relatively recent, but its origin dates back to Ancient Greece when Hippocrates (460-377 BC) emphasised the role of the environment in pathological phenomena. Furthermore, a number of works considered as epidemiologically relevant appear throughout the 17th century, as an interest to determine the amount of pathological events arises. Examples include the first "life tables" (or mortality tables – showing the probability of an individual to die according to sex and age, also called life expectancy) and the development of demography (John Graunt 1620-1674), or the "numerical method" an original quantitative approach from Pierre Louis 1787-1872, one of the founders of the idea of evidence-based medicine¹⁰. Modern epidemiology takes its development in the Anglo-Saxon countries especially in Great Britain with William Farr (1807-1883), considered to be the founder of epidemiology, and published various works about British mortality statistics. Epidemiology then became an independent discipline in the second-half of the 20th century after the Second World War. It spread mainly in Great Britain and the United States in the first instance, then in other developed countries.

¹⁰ More recently, in English speaking countries, the immerging movement of the evidence-based medicine has been driving the medical domain towards a medicine based on proven facts. Evidence-based medicine integrates the doctor's decision making, his/her experiences and the preferences of the patient, but also the research results. This approach also suggests classifying the results according to their level of proof.

The domain of epidemiology broadens from acute diseases to chronic diseases and evolves with its own methods, either observational or experimental (this will be explained below). Many tools and concepts are developed such as incidence, prevalence and risk factor, association and impact measures, as well as statistical analysis methods.

Eventually, epidemiology became a profession with its own training programs, and the first epidemiology department was inaugurated in 1919 in Baltimore at the Johns Hopkins University School of Hygiene and Public Health. In France, epidemiology emerged between the 1960s and the 1970s, and worldwide, the domain of epidemiology evolved with a progressive separation from medicine. As such, many epidemiologists are non-physicians (Bénichou 2006).

2.3.1.2 Different domains

Epidemiology connects with various disciplines, and although its connections with the field of medicine are significant and permanent, they are not exclusive. It connects with law, pharmacology, public health, etc. The domains enlarged gradually with regards to both types of disease and exposure. Types of disease concern infectious diseases and chronic diseases such as cancer, cardiovascular, neurological and psychiatric diseases. Types of exposure entail environmental epidemiology (pollution, alcohol), professional epidemiology (asbestos in workplaces), nutritional epidemiology (diets and diseases), genetic epidemiology (progress on genetics and genetic tools), epidemiology of ionizing radiations (radiation on humans), pharmaco-epidemiology (drug side effects in the market) etc. (Bénichou 2006).

2.3.1.3 Concepts

The main concepts in epidemiology are incidence, prevalence and risk.

a. Incidence

The rate of appearance of new cases of a given disease, frequently applied in cohort studies (see Section 1.4.1.5 types of study).

b. Prevalence

The total number of cases of a given disease, frequently used in cross-sectional studies (see Section 1.4.1.5 types of study).

c. Risk

It is the probability of an individual to develop a disease (Bénichou, 2006).

Other types of parameters can be divided into two groups: measures of association and measures of impact. The measures of association are constituted by a relative risk and odds ratio. A simple example is the contingency table, composed of a risk factor in two categories (exposed and non-exposed) and an infection reaching, or not, a population (case and control).

	» Case	» Control	» Total
Exposed	a	b	$e_1 = a + b$
Non-Exposed	c	d	$e_0 = c + d$
Total	$m_1 = a + c$	$m_0 = a + c$	$n = a + b + c + d$

Table 2.3. A model of a general Contingency Table.

In Table 2.3., “a”, “b”, “c” and “d” represent the amount of subjects corresponding to a combination of exposure to a given factor (exposed, non-exposed) and health status (case, control). In the last column on the right, e_1 and e_0 designate respectively the number of exposed and non-exposed individuals, while “ m_1 ” and “ m_0 ” designate respectively the amount of sick individuals (cases) and non-sick individuals (control). Designate “n” represents the total number of individuals involved in the survey ($a + b + c + d$).

d. Relative Risk

This is the link between the probability to develop the disease due to a type of exposure and the probability to develop the disease without this type of exposure.

Relative Risk

$$RR = \frac{F \text{ case / exposed}}{F \text{ case / non-exposed}} = \frac{\left[\frac{a}{a+b} \right]}{\left[\frac{c}{c+d} \right]}$$

If the relative risk value is greater than 1, there is a correlation between exposure and pathological event. If the value equals 1, there is no correlation. If the value is located between 0 and 1, the correlation suggests a level of protection.

e. Odds Ratio

This is the ratio between exposed individuals and non-exposed ones.

$$\text{Odds Ratio} = \frac{\text{O case / exposed}}{\text{O case / non-exposed}} = \frac{\left[\frac{a}{b} \right]}{\left[\frac{c}{d} \right]}$$

Impact measures are based on attributable risk.

f. Attributable risk

$$\text{Attributable Risk} = F_{\text{case exposed}} - F_{\text{case non-exposed}}$$

The number or proportion of cases of a disease attributed to a given factor of exposure.

2.3.1.4 Types of (study) question

The protocol should open with a precise, succinct formulation of the research question. This may be best expressed as a question. Precision increases the likelihood of the research providing new knowledge, while a question format tends to elicit greater precision and a logical approach to the topic.

The relevance of the research question to public health, the feasibility of any study required to answer that question being conducted and the probability of the findings being implemented, should be considered.

2.3.1.5 Study types

Studies in public health are conducted in order to investigate disease, intervene in disease progress or evaluate intervention (David-Tchouda, 2011). Two of these aims can be met using procedures based on classical study methods; descriptive

studies (to investigate the incidence of an event), analytical studies (to study causes) and evaluative studies (to assess intervention) (Bouyer, 2009; Czernichow et al, 2001).

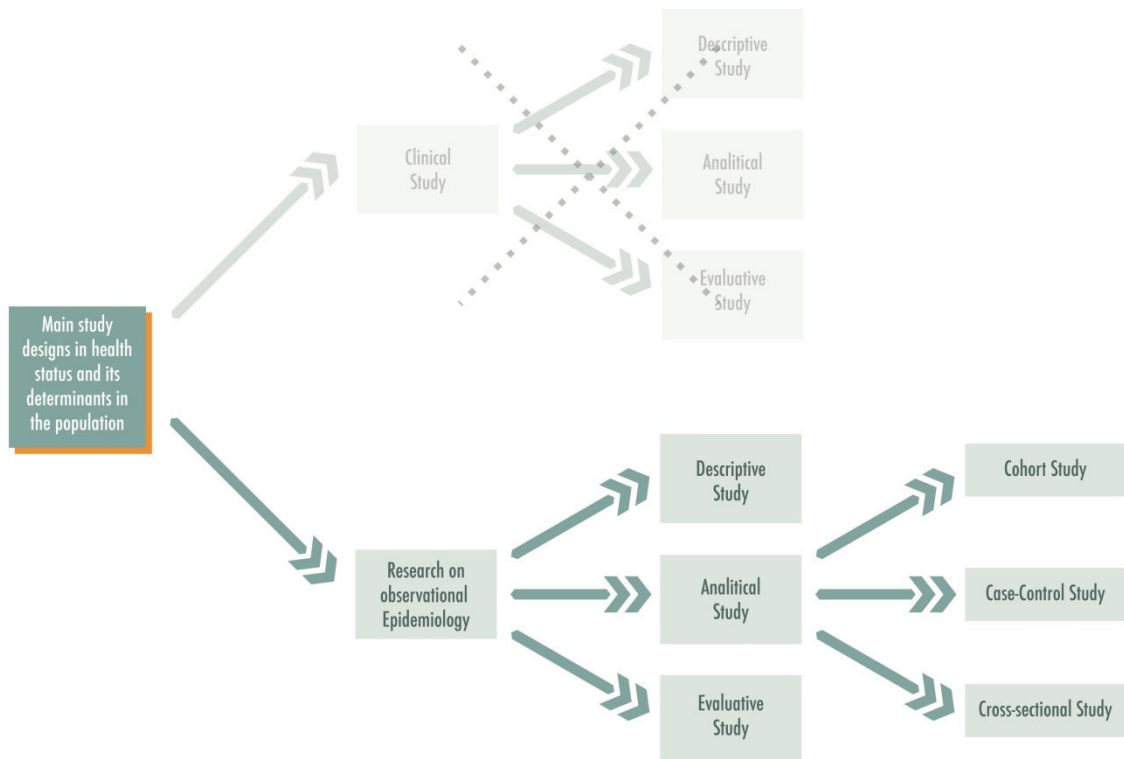


Figure 2.8. Main study designs in health status and its determinants in the population

As will be explained in section 2.3.5.1 (b.2 types of study), the game scenario is not compatible with experimental (or clinical) study and so will not feature in this analysis. Evaluative and cross-sectional studies are not supported in the game scenario but will be briefly defined in order to better illustrate observational studies in epidemiology.

a. Descriptive studies

These describe the incidence rate or mortality of pathological events, tracking the incidence rate or mortality of a disease through time and place. They do not allow the establishment of proof (Bénichou, 2006), but usually introduce an analytical study.

b. Analytical studies

Analytical studies establish or confirm hypotheses that connect exposure factors and events (Bénichou, 2006). Observational analytical studies are common in

epidemiology and can be sub-divided into prospective, case-control and cross-sectional studies.

b1. Prospective studies (follow up or cohort) (LAST, 2004)

Cohort studies are prospective and follow, over a period of time, subjects who are known to have been exposed to one or more risk factors. Incidence of the relevant event is then noted. Cohort studies allow an estimation of the incidence rate according to exposure and an assessment of relative risk. They avoid selection bias, but cannot avoid confounding bias completely because the model is not experimental.

b2. Case-control studies (case referent study) (LAST, 2004)

While cohort studies are optimal in terms of data quality and observation, case-control studies may be used in their place due to their comparative ease of administration and lesser cost. Case-control studies take two groups - those affected and those unaffected - then a retrospective analysis is made to discover past exposure and compare the two groups' characteristics.

Case-control studies permit an estimation of associations between exposures and pathological events. There are risks of confusion bias, recall bias and selection bias, but these risks may be mitigated by benefits in terms of cost and ease.

b3. Cross-sectional studies

Cross-sectional studies are descriptive and estimate the prevalence of a disease or the number exposed to known risk factors within a population. They study a population at a given moment in time, observing each person just once. This study type is common due to its convenience, speed and restricted cost (Czernichow et al., 2001). Cross-sectional studies can also be used for etiological purposes.

c. Evaluative studies

Evaluative studies investigate risk factors for disease and focus on the frequencies and causes of that disease. They are a vital preparation for intervention in disease; correct evaluation is crucial because the pursuit or extension of a programme of intervention will rest upon it. Evaluation contributes to rational decision-making, measuring the effects of a health programme with regards to its objectives.

2.3.2 Biostatistics and Epidemiology in Medical Schools Today

Generally speaking, epidemiology and its underlying “bio-statistic” methods (experimental, observational, etc.) enables learners to develop an awareness of the randomness underlying the events, decisions and phenomena of life. Familiarity with uncertainty, it proposes an approach, which enables the establishment of causal presuppositions when it is not possible to be certain or to explain. This offers a new level of understanding in which establishing a second level proof allows individuals to act and take decisions. Epidemiology therefore involves learning a culture of risk, development of learners’ awareness of possibilities of developing measures to reduce impact, developing prevention, memory of the past and understanding of the capacity of current and future events, preparedness for future events, etc. Epidemiology and its methods enable reflections on the way knowledge is validated as well as the conditions under which it is elaborated. Students get to know the complex mechanisms and multiple causes underlying life, and the importance of the tools offered by this discipline. Learning epidemiology therefore, helps us understand the nature of scientific and medical knowledge and its underlying economic, social, ethical, political issues, etc. (Coquidé, Lange, and Tirard, 2006)

Today, biostatistics and epidemiology appear to be integrated with the higher education curriculum of certain courses. At this level of study, these subjects are applied to professional issues specific to a program, and in our case, medical studies. These principles are followed worldwide in medical school programs (see Appendix II, p. 278 for examples). Despite some differences in the modality of classes and hours dedicated to these disciplines, probably due to the educational systems and cultural issues, epidemiology is integrated in the medical schools early at the undergraduate level, becoming with biostatistics, one of the fundamental disciplines of the curriculum. The University of Grenoble is in this sense, in the Avant-guard movement implementing a serious game in the curriculum practical classes in order for students to practice what they learn in previous lectures. The next section presents the content of courses in biostatistics and epidemiology from this medical school.

2.3.3 Implementation of LoE in a curriculum

During the Medical school curriculum in France, students have to develop competences on “critical reading” of scientific articles. The difficulty which students face then is to comprehend the importance of biostatistics, mainly for epidemiology and public health. One of the difficulties in this context is the length of time between the first classes of biostatistics (first and second year) and the examinations on critical reading (sixth year). Students have difficulties to understand the importance and utility of the discipline in the first years when learning takes place away from the field of public health. When they finally arrive to the field, most of the learning having taken place away of the context is lost. This way, the project LOE seeks to contextualise in a realistic and authentic experience, problem of statistics and epidemiology, in order to set the basis to a critical reflection within medical students.

2.3.3.1 The Biostatistics Practical Class – general introduction

Former Biostatistics Curriculum (before 2009)			
First year		Second Year	
First semester	Second semester	First semester	Second semester
∅	∅	Lectures: - Biostatistics Lectures - Statistical Hypothesis Testing - Epidemiology - Epidemiology and Clinical Research	- Biostatistics Practical Classes
Current Biostatistics Curriculum (after 2009)			
First year		Second Year	
First semester	Second semester	First semester	Second semester
Lectures: - Biostatistics lectures - Statistical Principles and Hypothesis Testing - Epidemiology	∅	Lectures: - Epidemiology and Clinical Research.	- Biostatistics Practical Classes and Lectures

Table 2.4. Biostatistics curriculum changes in Grenoble Medical School

In Grenoble, students from this biostatistics practical class were LOE is implemented are in their second year of medical school in the second semester. Table 2.4 shows the major changes affecting the course’s curriculum from 2009 onwards, when biostatistics and epidemiology moved to the first year. In the academic year 2008/2009, LOE was first implemented in one of the six

biostatistics practical tutored classes as a pilot experiment and then extended to the other classes the following year. Prior to 2009, students were assigned a survey they could carry out on a subject of their choice. However, most surveys designed by students had nothing to do with medicine or medical issues. The group which designed LOE wanted students to practice biostatistics on important medical issues in order to learn the importance of the discipline in professional practice. In the following chapters, our data analysis concerns the curriculum after 2009, except where otherwise mentioned. The practical classes required from students more than a simple application of the knowledge acquired, but offered, through a gaming scenario, an opportunity to apply such knowledge through the elaboration, execution, and synthesis of an epidemiological study. In other words, it offers a chance to practice biostatistics in a simulation of a professional situation.

2.3.3.2-Instructed Knowledge

Table 2.5 lists the curriculum students follow, followed by the details of the lectures in the curriculum mentioned above (Table 2.4).

2.3.4 Problem Analysis: An Analysis of the Problem Proposed in the Game

» Discipline	» Program
Biostatistics	Biostatistics Principles Descriptive Statistics Probability Estimation theory Confidence intervals
Biostatistics Statistical Hypothesis Testing	Statistical Hypothesis Testing Principles Parametric statistics for mean comparison Tests for comparing proportions - χ^2 Correlation and regression analysis Performance evaluation of a diagnostic test
Epidemiology	Descriptive Epidemiology Analytical Epidemiology
Epidemiology and Clinical research: The main studies	Descriptive Studies Analytical Studies Studies aiming at diagnostics Evaluative study

Table 2.5. Biostatistics and Epidemiology curriculum before the practical classes

In the first session, when students access the web site from LOE for the first time, they find the following text by the Public Health Committee assigning a mission to teams of physicians.

2.3.4.1 Mission

“You are a physician and the Public Health Commission entrusts you with a public health survey that will result in a decision tool for hospital physicians.

This Public Health Commission is promoting an assessment process of the thromboembolic disease (TED) diagnostic procedure. This assessment aims to determine the relevance of the analysis requested for TED diagnosis and the appropriateness of the treatments prescribed. It also aims to optimise the functioning of this diagnosis procedure by improving the means through which urgent analysis is spotted.

Your mission is to propose a diagnostic tool allowing hospital physicians to form two groups of patients: patients presenting a high risk profile and therefore must benefit from testing within 12 hours (or, if not, immediate start-up of anticoagulant) and patients presenting a low risk level allowing reassessment of diagnosis within 24 hours, before confirming the request for an analysis (without start-up of anticoagulant). To fulfil this mission you will have to analyse positive tests results, clinical signs and associated factors relevant to the existence of TED.

This is an important mission as Venous Thromboembolic Disease (TED) is the first cause of unexpected death at the hospital. This pathology is increasing regularly, particularly in medical environments. Within limits you will specify how your work may contribute to existing studies in France, showing the annual incidence of TED around 50,000 to 100,000 cases and responsible for 5,000 to 10,000 deaths. The mortality risk rate of an untreated TED case is estimated at 30%.

Estimations concerning TED incidence are actually inaccurate because in many cases they lack simple diagnosis elements visible during a clinical test. TED is a multi-factorial pathology associating biological thrombophilia, venous stasis (confinement to bed) and other complex circumstances in different hospitals, all of which obviously complicates the task. It usually follows other pathologies, particularly relating to senior patients.

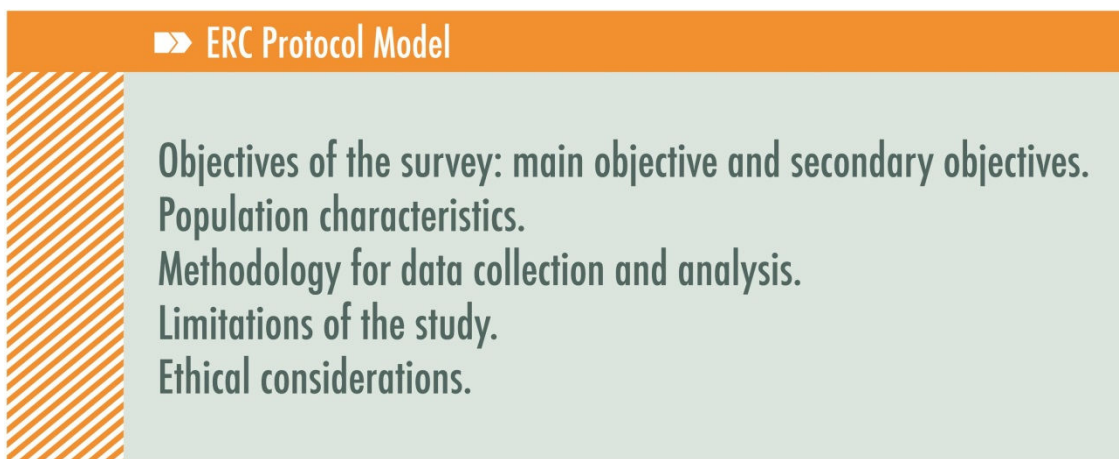
Such a diagnostic tool can rely on a score combining risk factors and clinical signs, of which the considered high value leads to additional test series (echo-Doppler, scan, etc.) according to the platform of technical hospital resources. However, it is necessary to consider that various tests urgently made on suspicion of TED cases, present their own risks, and also justify the necessity to minimise the risks of mistreatment. Furthermore, the technical platforms for running these tests are often saturated: immediately sending unnecessary patients lengthens waiting times and harms real care emergencies.

You can lead an epidemiological survey at the Gremont University Hospital on selected patients (they present a clinical suspicion of TED)”.

This *a priori* didactic analysis describes in details what the students are supposed to do and the paths they may follow to attain their objectives.

2.3.4.2 Expected Protocol

Students have selected an objective, explored the IT environment, and estimated a schedule for the survey. At this point, with their background acquired from previous classes, students are able to design a scientific research protocol. In the medical information department of the IT environment, students locate a protocol model (Table 2.2) to guide them during the design phase.

A graphic titled "ERC Protocol Model" with a list of five elements. The title is in white text on an orange background. The elements are listed in dark teal text on a light green background, separated by a vertical orange and white striped bar on the left.

ERC Protocol Model	
Objectives of the survey:	main objective and secondary objectives.
Population characteristics.	
Methodology for data collection and analysis.	
Limitations of the study.	
Ethical considerations.	

Table 2.6. Basic elements of a protocol.

2.3.5 Analysis of the Students' Problem

In the game, students are epidemiologists in a mission to study the occurrence of thromboembolic disease in hospitals. In the first two classes they have to design a research protocol aiming to program the investigation of the occurrence of this

disease. They are supposed to submit this protocol to the ethics committee as presented in Chapter 3 (Figure 3.3, pg. 140) for validation purposes. This research protocol identifies a research problem and explains in details how students intend to conduct the investigation, what they expect to obtain from it, etc. The problem identified in the protocol can be apprehended as a question students have to answer (Singh et al., 2005).

2.3.5.1 Expected Protocol

a. Designing a Protocol

a1. "WHY?" – Defining the research question and objectives

One of the first challenges faced by students starting the game, is that of defining their study question. The game demands that they investigate one of several aspects of thromboembolic disease. This requires students to formulate a clear, precise research question, while bearing in mind issues such as its relevance to public health, the likelihood that they will be able to conduct research capable of answering the question and the probability of their findings being practically applied. Students have to look at the context and question and ask themselves why it makes sense to tackle this particular research problem. Some have suggested that such a task is facilitated through the students defining their objectives by indicating their "specific approach to answering the study question", and using their main and secondary objectives to describe - in clear and measurable terms - why they want to conduct the research and what they intend to achieve (Singh et al, 2005).

Such tasks can challenge students because they must distinguish between the main objective of their participation in the game, their main study objective (which is defined in light of the main objective of their participation in the game), and any secondary objectives.

In public health, a scientific research protocol will be used to help the researcher define and respond to their investigation, by dividing the problem and process into steps. These steps form 'sub-problems', that must be solved if the research is to progress. In the game, students encounter these sub-problems and must tackle each in order to solve the main question. The sub-problems can generally be framed as questions, which the students must answer.

a2. "HOW?" – Designing the study, rationale and methodology

Having identified the question and objectives, students must move on to design their study - including overarching methodology and details of any tools and instruments used for data collection - and provide a rationale for it. They must be able to "state how the research question arose from current knowledge of the subject, outline [their] approach to addressing the research question [and possibly] explain how [their proposed] study will benefit the community" (Singh et al, 2005). At this stage, students may consider the use of data collection techniques that are new to them.

Quality control procedures become relevant at this stage. Students must determine how data will be collected and may run pilot testing of methods and instruments. They must consider the validity of proposed definitions and limitations of any instruments or definitions. It can be helpful to clarify all definitions at this point. Some students will find this aspect of the work challenging, as they try to link their objectives to the design of their study. Many will only have encountered models of research methodology in a theoretical context. Using these concepts in practical contexts will form part of the 'meaning making' of the study, as students appropriate the definitions that have been put to them previously, and develop an ability to apply them in a relevant situation.

a3. "WHO?" – Population

Having defined the purpose and nature of the study, students must define those whom they intend to study: their "targets, the study population and sample size" (Singh et al, 2005). This means that they must describe the study cohort, including details such as subjects' age, gender, location, any presenting signs and symptoms, medical tests, clinically relevant characteristics, family history and so forth. Subjects' eligibility for the study must be explained, along with any inclusion/exclusion criteria and mechanisms for selection. Students should decide how many subjects they wish to include, which will require them to estimate the number of potentially eligible individuals, the proportion likely to take part and therefore the feasibility of reaching their target number of subjects (Singh et al, 2005).

A challenge for the students lies in defining a population and sample size that is large enough to generate meaningful statistics, and that can also, realistically, be found in the general population. They may, for example, have problems in studying upper-limb surgery patients who have suffered a deep vein thrombosis (DVT), or those who have had a DVT following a long-haul flight, since occurrences of these are rare and it is very difficult to collect a sample population that is large enough to provide valid statistical results.

a4. "WHAT?" – Variables and outcomes

Having defined their sample, students must identify the variables that they will measure and their expected outcomes. Quality control procedures should be clearly defined. Therefore students must "define terms, the validity and reliability of the definitions proposed, as well as the limitations of the measurement tools and definitions proposed" (Singh et al, 2005). For students, this may be their first attempt at testing data, in which case choosing which statistical methods to apply might prove difficult. Issues that they will be forced to tackle include coding and data entry, ensuring completeness and accuracy, comparison, display of data and hypothesis testing (Singh et al, 2005).

a5. "SO WHAT?" – Results and further application

The final question that students will face centres upon the expected significance of their results, and the extent to which they contribute to understanding of thromboembolic disease. Students must objectively evaluate the qualities of their work, the strengths and the limitations of their study. They should anticipate possible criticisms of their design and methods, and be ready to explain why the limitations imposed by their choices are not critical. Students should predict outcomes, restating the justification for their study in terms of these expected results and describing the impact that such results are likely to have upon understanding and practical handling of the matter being studied (Singh et al, 2005).

Of course, students must also take account of the ethical implications of their study, and acquit all of their duties with regard to this. They must therefore be able to identify all ethical issues involved, such as (but clearly not limited to) any benefits arising from study procedures, hazards, danger of injury and the nature of

consent (Singh et al, 2005). Mitigating actions by students might include the composition and distribution of information leaflets or letters to study subjects.

b. Structure of a Protocol

b1. Types of questions

Students have to express their interest in a specific problem or population concerning public health and justify the importance of this choice (study a public health issue under the chosen perspective).

b2. Type of Study

The designers of LOE selected some types of study amongst the various ones available in the practice of medical epidemiology. However, students are supposed to elaborate descriptive and analytic studies, and some studies were not covered by the proposed scenario, such as evaluative or clinical studies.

Students can conduct observational studies such as descriptive and analytical ones.

Descriptive studies can cover basic elements of the survey and introduce the analytical study. Students can present characteristics such as frequency, incidence, prevalence and risk, as well as graphical representations, of the sample.

Analytical studies can be subdivided into case-control studies if the focus is on the disease, the exposed or non-exposed; and cohort studies if the focus is on the risk factor. The type of study will determine the subsequent steps of the protocol.

b3. Type of methods

Even if data collection is not previewed in the gaming scenario, students are expected to be able to anticipate in their research protocol, means and methods of data collection according to the type of study conducted. Also important is how they intend to collect the sample in accordance with the type of study selected, i.e. objectives, procedure, chronology, place and data collection.

Students have to mention aspects of the data collection describing how they intend to compose their sample, and what are the characteristics or factors necessary to include or exclude an individual from a sample. Students must estimate the size of the sample and the necessary number of individuals to compose each one of the groups in order to reach a significant statistical result. They have to mention where

and how they plan to collect this data in terms of the place, aiming for multicentre or mono-centre studies. They have to mention aspects of the chronology in which the data is collected and analysed, aiming for retrospective, prospective, cross-sectional or longitudinal studies. Depending on the objective of the survey, for example, in a case-control study students will have to interview patients or analyse their medical records to collect data retrospectively about the possible causes of a disease. On the other hand, in the case of exposed/non-exposed studies, students will need to interview patients and/or analyse their medical records when they arrive at the hospital. This interview material is later verified according to risk factors. If for instance, there were occurrences of the disease, data is collected prospectively.

b4. Types of Statistical Analysis

A statistical analysis in epidemiology takes the individual as the starting point of analysis and helps to overcome individual variability and sample fluctuations (Bouvier et al., 2009). Therefore, descriptive statistics enrich a descriptive study by summarizing population data through univariate analyses (distribution of frequencies [age, sex, etc.], central tendency [average, mode, mean, median] and statistical dispersion [variance, standard deviation, interquartile range and confidence intervals]. A descriptive study is also useful for elaborating hypotheses for further analytical study (Bouvier et al., 2009, p. 309). Among possible analyses of a descriptive study students can consider population health indicators as measures of risk (risk and prevalence) and incidence measures (incidence rate and mortality rate). The statistical method and analysis will depend on the type of study selected by the student. For instance, a case-control study allows odds ratio analysis but not relative risk analysis, the latter being more appropriate for an exposed/non-exposed study. Students should also mention the kinds of statistical tests they plan to use to compare the individual subgroups of their sample, for example the Chi-squared test. Students should be able to anticipate these possibilities of analysis when designing their protocol.

b5. Type of bias

The type of study also determines the type of bias students may encounter in their work, and they should be able to mention the limits of their own study in their

protocol. For example, for exposed/non-exposed studies, students may encounter difficulties to sample a population due to selection bias. In this case, patient data can be lost during the survey. Students can also encounter difficulties in obtaining relevant results due to information bias in this kind of study (see Appendix I, p. 270 for examples).

b6. Ethical considerations

The last topic of the protocol consists of a paragraph in which students should certify their survey. This must be conducted according to French and European legislation underlying surveys, researches, and experiments with human beings. They should consider laws like the French “Loi Huriet” from the public health code and French concerned authorities (DGS, CCTIMRDS, CNIL – French Information Commissioner’s Office, etc.), the European Union’s Ethics Principles from the Helsinki Declaration etc.

2.4 Conclusion

In the present chapter I introduced the project on the Laboratorium of Epidemiology, from its underlying concepts, to its design as a serious game. Following this introduction to LOE, Chapter III will introduce a study of the role of appropriation. In this chapter the epidemiologist’s professional activity will be studied in terms of the student’s role in the appropriation of the epidemiologist’s character during the proposed activities. It is an important element of the activity, experiencing what it is like to be an epidemiologist and understanding the epidemiologist’s role.

I also introduced a didactic study of the problem immersed in the LOE and I explored the main concepts of epidemiology used in my analysis. In Chapter IV, I will introduce a study on problem appropriation where both elements of the simulated scientific phenomena are developed. The element of the disease will be considered since students have to appropriate the dynamics of the disease in its complexity, in order to design a protocol analysis. Simultaneously, with the appropriation of this problem, students have to determine the problems concerning the methodology of work from a professional perspective.

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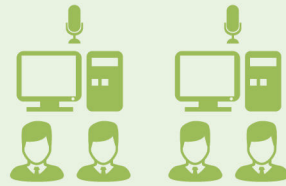
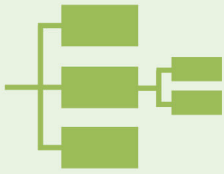
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Part 2

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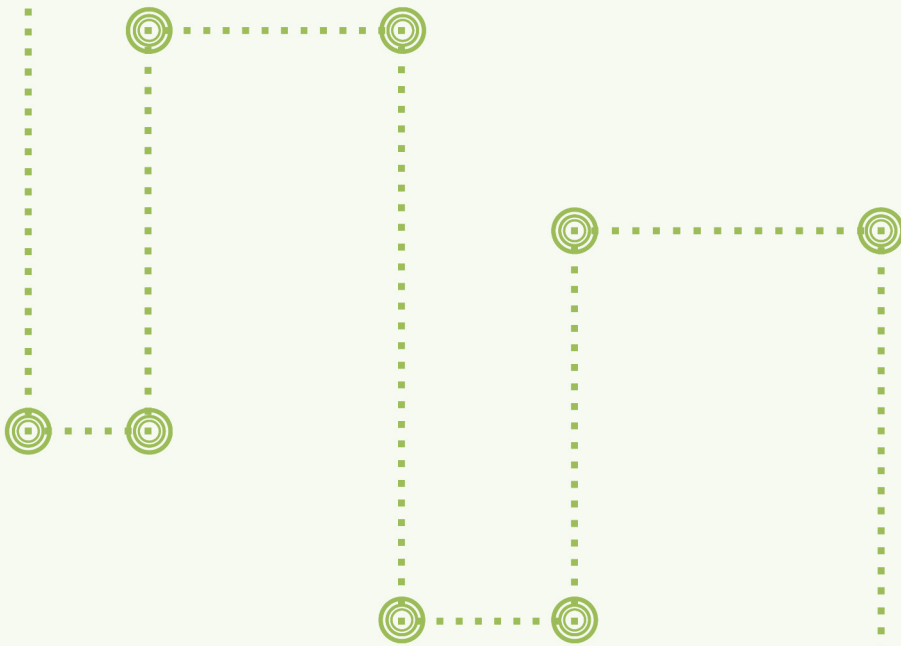
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Résumé en Français

Dans une salle d'informatique, les étudiants jouent leurs « rôle d'étudiants » habituel relatif aux attentes sociales définies dans un contrat didactique. Dans LOE, le problème n'est pas explicite, les étudiants ne sont pas défiés directement par la Biostatistique, mais par un contexte authentique. Ils doivent ainsi s'immerger dans le jeu et développer un rôle inhabituel pour résoudre le problème.

Immersion¹ : Trois types (*sensorielle*; *systémique*; et *Fictionnelle*) et degrés (*Engagement*; *Absorption*; et *L'Immersion totale*) sont identifiés dans la littérature. L'immersion fictionnelle se fractionne en 3 sous-catégories : *diégétique* — la « charge de données » qui le monde fictif produit; *narrative* — la précipitation sur son développement pour savoir se produit à la fin; et *indentification personnelle* — interaction entre joueurs et personnages.

Jeu de rôle² : LOE procure des scénarios d'apprentissage pour favoriser le développement de rôle différents chez l'étudiant : *jeu de rôle* — contextualise l'activité; *anonymat* — encourage de nouvelles méthodes; *familiarité* — favorise l'engagement; *actions d'autres joueurs* — améliore l'engagement dans un rôle.

Questions de recherche : (1) quels sont les critères pour déterminer l'appropriation du rôle par les étudiants ? (2) quels indicateurs devraient être recueillis pendant que les étudiants jouent le jeu ?

L'EXPERIENCE :

Deux moments de **validation de connaissances** : les interactions par **courrier électronique** (C-E) et par message téléphonique (M-T). Ici, les tuteurs facilitent l'appropriation par la dévolution. **L'environnement informatique** favorise l'immersion dans une expérience professionnelle. Les étudiants sont évalués par un **Comité de Protection de Personnes** (CPP) et le **Chef de Service de l'Hôpital** (CSH) qui fournissent des feedbacks adaptés au contexte. Les étudiants interagissent avec les personnages pour : communiquer un **protocole** (C-E) ou demander l'autorisation de CSHs pour interviewer des patients (M-T). Des tuteurs anonymes utilisent une interface web accéder à ces messages.

METHODOLOGIE

Deux autres collectes de données en 2010 et 2011 ont amélioré la première version de la grille.

Protocole général : *Objectif* : constater si les étudiants jouent le jeu proposé.

¹ Arsenault et Picard (2008)

² Cornelius et al, 2011

Hypothèses : (1) les étudiants s'approprièrent un rôle dans le jeu de rôles; (2) les étudiants s'approprièrent le rôle d'un médecin.

Activités analysées : (1) les étudiants envoient un C-E à un personnage du jeu. (2) les étudiants laissent un M-T sur le répondeur adressant le personnage du jeu.

Collecte de données : L'environnement informatique enregistre les traces de l'activité des étudiants.

Analyse de données : Observation asynchrone.

Collecte de données :

En 2009 — $\Delta=28$ (22 ♀; ♂ 6), 7 équipes; 3 à 4 étudiants/équipe, dirigée par 1 tuteur; N=13 C-E; N= 15 M-T.

En 2010 — $\Delta=169$ (102 ♀; ♂ 67), 6 groupes ≈ 28 étudiants/groupe, dirigé par 8 tuteurs; total de 45 équipes; 3 à 4 étudiants/équipe; N=84 C-E; N=167 M-T.

En 2011 — $\Delta=169$ (107 ♀; ♂ 62), 6 groupes ≈ 28 étudiants/groupe, dirigé par 8 tuteurs; total de 45 équipes; 3 à 4 étudiants/équipe; N=115 C-E; N=64 M-T.

ANALYSE DE DONNÉES

En 2009, une étude qualitative des messages (approche **ethnométhodologique**) a codifié et isolé critères et indicateurs, et puis défini des profils, générant la grille « **d'appropriation de rôle par l'étudiant** » (grille-ARE).

En 2010, la grille-ARE a été appliquée à un plus grand échantillon produisant de nouveaux profils, améliorant la grille et produisant une liste de critères. En 2011, les données ont été traitées automatiquement.

ANALYSE DES COURRIERS ELECTRONIQUES

Les étudiants valident leurs connaissances envoyant au personnage du jeu (CPP), des C-Es contenant un fichier joint (leurs productions). Un tuteur anonyme valide les productions des étudiants qui envoient 4 types de message : *Soumission*; *Rectification*; *Fichier manquant*; et *Demande de nouvelles*.

Analyse qualitative : Les messages sont caractérisés en nature (performance du jeu de rôle : complète ou inachevée) et forme, qui contient 4 éléments : *Eléments d'Identité* (l'introduction d'une identité par les étudiants et Contexte) ; *Attitude vers personnage* (formelle ou informelle); *Structure du Message* — Entêtes e *Texte* (Salutation, Contenu du message, Finalisation et Signature); et *Information globale* (Date et heure).

Résultat : Production de la grille-ARE pour l'analyse de jeu de rôles dans communication par C-Es.

Analyse quantitative : Attribution d'un score par prérequis satisfait. Le score maximal est 8 : personnalisation de titre C-E (+1) et document joint (+1), jouer rôle professionnel (+1) ; Dans le C-E : salutation formelle (+1), texte (+1), finalisation

Eléments d'identité joués

Professionnel

Etudiants

Soi-même

15.2 %	13.1 %	68.2 %
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Tableau. Pourcentage d'identités adoptés par les étudiants.

Nombre messages sou-mises	Messages N=198	Effectifs		Pourcentage somme score moyen et haut	Moyenne
		Score haut (5-7)	Score Bas (0-3)		
1	26	13	9	65,38	3,65
2	64	33	18	71,9%	4,41
3	66	34	20	69%	4,18
4	32	14	8	75 %	4,3
5	10	4	2	81,82%	3.8

Tableau. Scores obtenus par les messages en raison du nombre de soumission de chaque équipe

Résultats : Les scores ont eu tendance à augmenter dans le deuxième message et à diminuer sur le troisième message. Le rôle le plus joué a été : *étudiants en médecine*. Les cas de rôle *professionnel* ont concentré les scores les plus élevés (76 % 6-8). Les cas de rôle *étudiant en médecine* ont obtenu de meilleurs scores que les cas soi-même.

ANALYSE DES MESSAGES DE TELEPHONE

Les étudiants valident leurs connaissances réalisant un appel téléphonique pour demander l'autorisation au CSH pour interviewer des patients en justifiant ses objectifs. Un tuteur anonyme valide les productions des étudiants.

Analyse qualitative : Les messages sont caractérisés en nature (L'analyse de la nature de message a qualifié 4 catégories : Complet ; Non réussi – Inachevé ou Partiel; Induite en erreur ; et Message d'essai) et forme, qui contient 4 éléments : *Éléments d'Identité* (l'introduction d'une identité par les étudiants et Contexte) ; *Attitude* vers personnage (formelle ou informelle); *Information de fond* (Entêtes — message, fichier joint); et *Information globale* (Date et heure).

Résultat : Production de la grille-ARE pour l'analyse de jeu de rôles dans communication par de M-T.

Analyse quantitative :

Les Effectifs de la forme des messages (N=167)							
Eléments d'identité joués			Contenu du contexte			Attitude	
Professionnel	Etudiants	Soi-même	Employeur	Cours de Biostatistique	Référence équipe	Formelle	Informelle
0	40	96	0	20	17	115	52

Tableau. La grille-ARE appliqué à l'échantillon 2010 des messages téléphoniques.

Les messages *non réussis*, *induits en erreur* ou *messages d'essai* ont concentré 62.87 % dont *induite en erreur* et messages d'essai ont concentré 73.34 %.

Les Effectifs de la nature des messages (N=167)						
Réussi	Non réussi			Induit en erreur	Essai	
	Inachevé ou non fini	Partiel	Employeur			
62	23	5	0	46	31	

Tableau. La grille-ARE appliqué à l'échantillon 2010 des messages téléphoniques.

Résultats : Jouer le rôle d'*étudiants en médecine* était cohérent par rapport au jeu; néanmoins, la plupart des étudiants ont joué eux-mêmes, induits à l'erreur par les instructions de la boîte vocale ou gênés en assumer le rôle d'un professionnel.

Première		Deuxième	
Réussis	Induit en erreur	Réussis	Induit en erreur
15 %	60 %	50 %	10 %

Tableau. Réussite des équipes par semaine.

Le scénario du jeu en 2011 a été amélioré diminuant en 61.68 % les messages induits en erreur.

2009	2010	2011
3.57 %	23.67 %	34 %

Tableau. Progression du pourcentage d'étudiants jouant le rôle d'étudiants en médecine.

La communication par téléphone portable s'est avérée éprouvante — les messages *réussis* exigeaient en termes de forme: adaptation sociolinguistique; introduction d'une identité; capacité de résumer; justifier ces objectifs; et articuler des catégories d'information.

Aussi en termes de nature : synthétiser l'objectif principal et cibler les principaux points de l'étude.

DISCUSSION ET CONCLUSION

Immersion et jeu de rôle sont des éléments essentiels pour **l'appropriation de rôle** dans les jeux sérieux. LOE attribuée à des étudiants une mission pour mener une étude dans laquelle ils conçoivent un protocole (évalué par le CPP) et entrent en contact avec le CSHs pour demander une permission pour interviewer des patients.

L'immersion est une expérience qui appartient au joueur; la conception n'est qu'un vecteur. L'accessibilité dans la conception de LOE est structurée sur une narrative

interne cohérente destinée à encourager l'investissement personnel et l'engagement émotionnel des étudiants. Elle s'inspire des principes de l'immersion fictive — *charge de données* pour obtenir un **sens de lieu**, une quête pour atteindre la fin, et d'*interactions joueur-personnage* pour augmenter l'identification personnelle et le développement de jeu de rôle.

LOE fournit le cadre pour explorer les comportements et développer un rôle peu familier aux étudiants, celui de « *l'épidémiologiste* ». Les concepteurs ont favorisé le jeu de rôle en diversifiant les moyens de communication avec les personnages anonymes (par exemple C-E, M-T).

La grille-ARE a été conçue pour mesurer — par des critères et des indicateurs — si les étudiants se sont approprié le rôle proposé dans le jeu; également, pour analyser des incohérences dans le scénario de jeu passibles de nuire la qualité des expériences des joueurs — les améliorations mises en place dans le scénario 2011 ont amélioré **l'appropriation de rôle** des étudiants. Les actions du jeu de rôle ont amélioré l'engagement dans le rôle puisque les indicateurs de **l'appropriation de rôle** ont eu tendance à augmenter avec le temps. On s'est attendu à ce que les étudiants jouent des « *épidémiologistes* », certains d'entre eux ont fait atteignent ce but et ont concentré les points les plus élevés dans la grille-ARE. « *Étudiants en médecine* » ont obtenu de plus hauts scores que ceux jouant « *eux-mêmes* ». Le rôle « *étudiant en médecine* » est cohérent avec le contexte du jeu et a manifesté beaucoup d'indicateurs **d'appropriation de rôle**. Les difficultés pour jouer « *l'épidémiologiste* » devraient mener à plus d'améliorations. Les tuteurs, par exemple, devraient **dévoluer** un rôle, pas simplement un problème. Dans des situations de jeu sérieux, les tuteurs gèrent non seulement des questions de nature, mais de également la forme — concernant le jeu de rôle directement — ce qui facilite **l'appropriation du rôle** par les étudiants. La forme ici implique des objectifs didactiques — adaptation sociolinguistique, identité et les formalités administratives de l'hôpital —, qui soutiennent la cohérence et le réalisme de la tâche. La cohérence et le réalisme destinent plus que du développant des habilités des étudiants en épidémiologie et Biostatistique, mais un élargissement de leur conscience de la pratique professionnelle.

Quand les étudiants s'approprient un rôle, ils le font sien, par le biais d'une transformation de ce rôle. Pour les recherches dans l'avenir, les catégories du modèle-APE (chapitre 1) pourrait être appliqué aux phénomènes **d'appropriation de rôle** pour analyser comment les étudiants acceptent, testent, font des choix, prévoient et maîtrisent un rôle dans les jeux de rôles.

Measuring Role Appropriation

3.1. Introduction

At the beginning of the present study, I introduced the didactical situation and its elements, specifically the tutor, student and milieu. Chapter 1 addressed one of these elements in the didactical situation system – the student, and more specifically, the Appropriation Phenomena leading to the concept of students' problem appropriation. A general concept of appropriation was then introduced and the problem appropriation model was defined as the dual concept of the one of devolution.

Chapter 02 focused on another element of the didactical situation system – the milieu. The milieu is composed of two connected facets: a Serious Game and the knowledge promoted through this game. The Serious Game was also explained as partly a double-faced simulation, as follows:

- In its raw and internal portion, the simulation represents the emergence of a disease in hospitals;
- The first facet of the simulation is enveloped by another one – the simulation of the epidemiologists' professional activity.

The ensemble is contextualised by a situation evolving in a Serious Game, which is in turn implemented in a didactical situation. The path leading to the problem is blurred by the designers of the game, so students have to discover the problem, generally with the support of a computer environment and their own available means.

Students are in a university computer-room, playing their usual 'students' role', a role they are used to and from which they have social and personal expectations defined in a didactical contract. However, arriving at their first session, they find themselves in an unusual situation. Gradually, they become aware that they are expected to take on another role, one they are not acquainted with – that of epidemiologist. They find out that it is not the tutor who is assigning them a task, but a

Public Health Commission. They are also surprised by the tutor's role, which seems to be different: The tutor does not supervise students' work any anymore, but rather follows their work at some distance, instead providing methodological assistance. From the students' perspective, the tutor neither sets a problem nor assesses their production. Students have to do this on their own, and the tutor is actually hidden behind LOE. This new situation destabilises students, who often report feelings of 'being lost' or 'not knowing what to do' on the first day.

Students have to enter a game to solve a problem. The problem sometimes is not clear at first for them. They seem to be predisposed to play the usual role of 'student' and fulfil their usual institutional position by playing this role. LOE demands more from students in this sense. In order to access the raw problem (biostatistics), they will have to understand the enveloping problem (the pragmatics surrounding an epidemiology survey), as well as the context in which the ensemble evolves.

In order to solve the problem, students will have to understand and possibly play the role of an epidemiologist. There is an issue of appropriation in this sphere, specifically the appropriation of a role.

The goal of the LOE IT environment is to provide an authentic context for learning by means of role play. By playing the role of an epidemiologist, students have a chance to practice methodologies and the application of skills they are likely to use in their professional lives. An immersive environment supports role-playing scenarios, creating different contexts for the performance of such activities. Therefore, there is also an issue of immersion. The situation is designed to foster students' understanding of the importance of epidemiology and biostatistics in the medical context. In this chapter, I will elucidate the concept of appropriation, focusing on students' appropriation of a role in a *serious game* embedded in a specific didactical situation.

3.1.1. Immersion

"~Between the air and the water a steel wave quivers. What people call the surface is also a ceiling. A looking glass above, watered silk below. Nothing is torn on the way through. Only a few bubbles mark the diver's channel and behind him the frontier soon closes. But once the threshold is crossed you can turn back slowly and look up: that dazzling screen is the border between two worlds, as clear to the one as to the other. Behind the looking glass the sky is made of water." Philippe Diolé³

In the project, LOE designers aim to build a serious game in which students are not challenged directly by biostatics problems. Rather, they are challenged by a role-playing game in an authentic context that requires them to step into someone else's shoes. Role playing facilitates the performance of authentic tasks (e.g. Russell & Shepherd, 2010). LOE offers a problem in an authentic context, providing an 'ecological' meaning for the construction of conceptions in epidemiology and biostatistics. Students need to immerse themselves in the context and in part, by means of their role play, identify and solve a given problem.

This chapter is about the role-playing and immersion experience that students will take on in order to play the game, and by doing so, acquire the knowledge to solve a problem. Some of the first questions that came up while preparing the implementation of LOE in the field were as follows:

- Will students play the proposed game?
- How are they going to behave?
- Will students understand what we propose?
- Will they learn through playing?

These general questions and the above-mentioned difficulties observed induced the interest in appropriation phenomena concerning role appropriation.

Let us first consider students playing the game as expected. In this case, the whole process starts with the individual immersion experience in the game. This, however, raises the following question: What is immersion?

³ Diolé, P. (1953). The undersea adventure. (1st ed., p. 7). New York: J. Messner.

When one feels as though a situation is very real but knows it is not, this is immersion. An immersive digital environment is an interactive scene or ‘world’ that is partly artificial, created – for instance – by a computer and within which users can immerse themselves.

Immersion may be an *effect* of media (Gorfinkel, in Salen and Zimmerman, 2003), replicating phenomena within individuals. Different genres produce different degrees or types of immersion. LOE is a serious medical game involving role play, promoting immersion in the fictional world. As Salen and Zimmerman (2003) state, "play does not just come from the game itself, but from the way that players interact with the game"; meaningful play emerges from interaction between the game system and other players, as well as context. Players must choose, then act. LOE supports meaningful choices: the action that a player takes create new meanings. There are various definitions for immersion in the Game scientific literature. Murray (1997) defined it as “the sensation of being surrounded by a completely other reality ... that takes over all of our attention, our whole perceptual apparatus” (p. 98). Furthermore, Arsenault and Picard (2008) stated that it is ‘a phenomenon that happens when a stratum of media information data is superposed over the stratum of non-media information with such strength and spread that it momentarily prevents the awareness of the latter’. These authors proposed a model for immersion combining three types and three degrees of immersion (Figure 3.1).

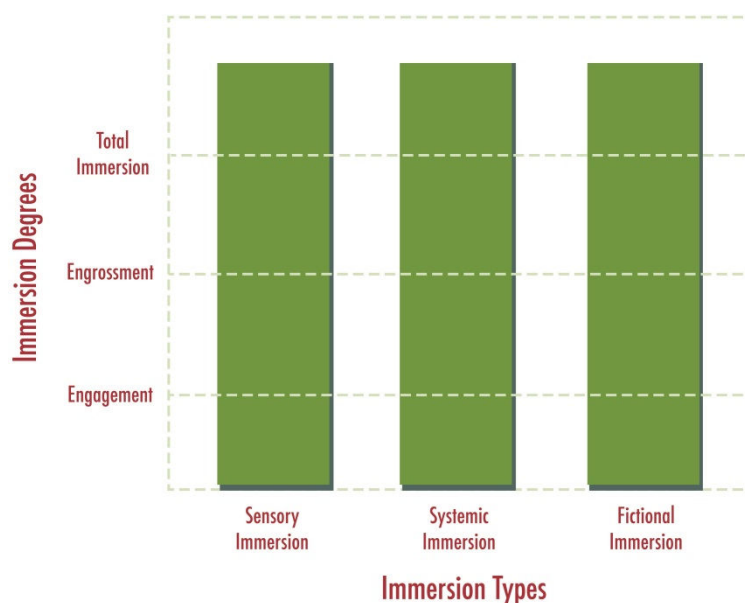


Figure 3.1. Immersion model with three types and three degrees proposed by Arsenault and Picard (2008).

Arsenault and Picard (2008) classified a set of games according to their model. Below, I briefly introduce their definition of such types and degrees of immersion; for each brief definition, I will consider LOE characteristics.

3.1.1.1. Types of Immersion

Sensory immersion tends to absorb the senses. Images, sound or a player's gestures, for example, outclass any sensory information from the real world, to the point where the player concentrates completely on the virtual world of the game and its stimuli. The design of LOE does not apply to this category if one looks at it as a whole. Nevertheless, videos covering vision and hearing used at certain moments in the game were designed with the aim of being realistic – especially those of patients in the hospital.

Systemic immersion requires active mental and physical participation from the player. However, it is about the set of rules proposed in the game, which must be discovered and learned in order to finish it. Once rules are learned, the player immerses him or herself in the game, adopting its system, elaborating tactics and strategies and forgetting the rules of the real world. In other words, the rules of the game are superposed on the rules of the real world, covering up the latter. This category of immersion was not the main concern in the design of LOE, since it is a long-lasting game. Still, players have to learn the rules of the game in order to fulfil their mission. LOE simulates the epidemiologist's work in a rather simplified reality, constraining the players' actions to a few specific conditions. It unveils only a side of the reality, and players have to adapt to this. In the first session, for instance, the game requires students to plan and schedule their survey, as well as to establish a strategy of action.

Fictional immersion describes the phenomenon where players are absorbed by the story, by the diegesis⁴ of the virtual world, or by self-identification with a character (e.g. an avatar). LOE was designed in this line; there is a story (a mission introduced in a text), students have a role, and in this context, they have to solve a

4 The set of characteristics of a virtual world experienced by the subject in the situation and as the events of a narrative.

problem that includes interacting with different people and organisations represented in the game.

I shall get into details about the fictional immersion in the next lines, but before it is necessary to describe the **degrees of immersion** (Brown & Cairns, 2004, cited in Arsenault & Picard, 2008). Next, I briefly introduce the degrees of immersion presented in Arsenault and Picard's (2008) study, each time considering LOE characteristics.

Engagement in games requires from players to invest themselves in the game (time, effort and concentration) and from games the accessibility in its designs (intelligibility, rules of manipulation and intuitive interfaces, etc.; Brown & Cairns, 2004, cited in Arsenault & Picard, 2008). By attaining this level, players engage in the game. This level can be achieved theoretically by students in LOE according to its design and its context. I consider engagement to be a consequence of 'acceptance'. Once students accept the game, they address their intentions to what is proposed, producing meaning through it and consequently engaging in the game.

Engrossment partially depends on the design of the game (Brown & Cairns, 2004, cited in Arsenault & Picard, 2008). Elements like graphics, tasks and story are very important here. Reaching this level, players become emotionally engaged in the game, addressing their attention and their emotions to it. This level considers principles of authenticity (see Chapter 5). The intention of the game design is to elicit players' attention and emotion; however, it is also necessary to consider their actual perception of such stimuli. Theoretically, LOE attains this degree, since the designers carefully considered aspects of game in relation to authenticity.

Total Immersion is a synonym of 'presence' (Nunez, 2004, cited in Arsenault & Picard, 2008). It instigates players' feelings of being present in the game world due to their identification with characters or feelings about the game. Players disconnect from reality and wire into the game, responding and being affected only by it.

LOE does not propose elements for total immersion. Students work in teams in a class. Too many factors surround them which remind them of where they are. Their role relates to themselves, their team position and their interaction with characters. Although the game suggests a role, no constraints are imposed on it other than the situation itself. Students work in-role as they go deep into the game.

Yet, they manifest high engagement in problem solving or great frustration when failing to achieve their objectives. Working on their own, their choices may not fit the expected results. Then, the tutor’s role is to assist them to make the right choices.

3.1.1.2. Degrees of Immersion

Other than the above-mentioned types of immersion, Arsenault and Picard (2008) also categorise the immersion dimension in terms of degrees and propose sub-groups of immersion degrees (Figure 3.2).

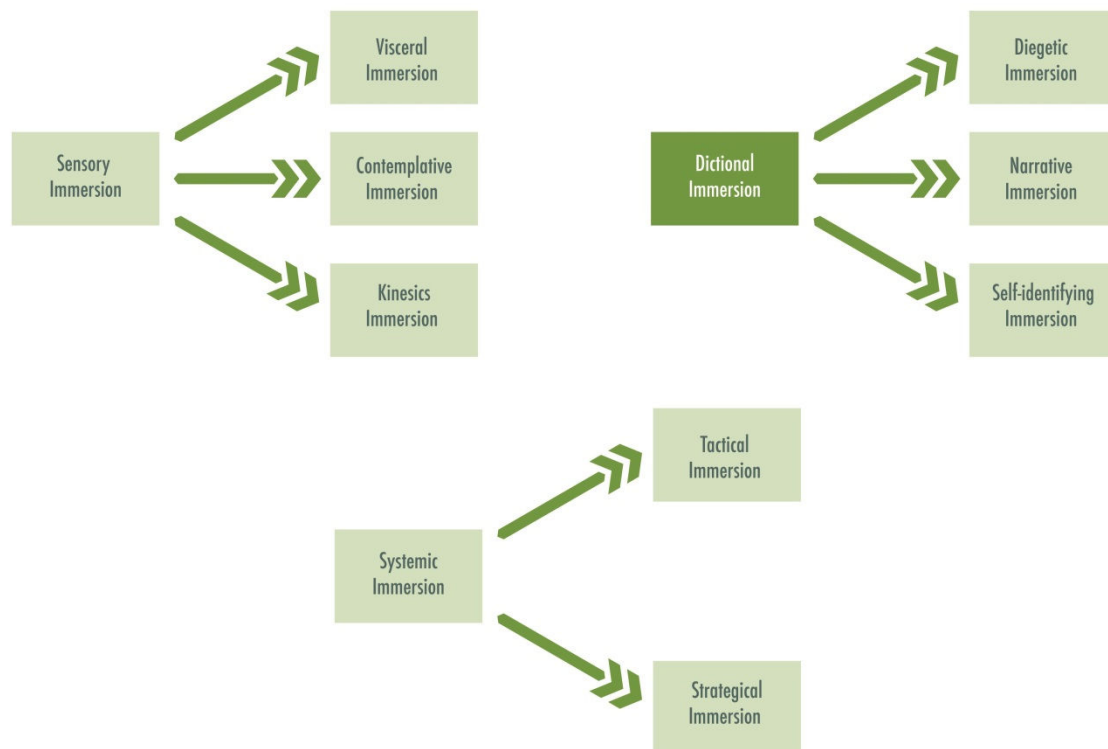


Figure 3.2. Subgroups of Fictional Immersion proposed by Arsenault and Picard (2008).

I am especially interested in the concept of Fictional Immersion, which the authors split up into Diegetic, Narrative, and Self-Identifying Immersion.

Diegetic immersion is the experience of being completely immersed in a fictional world, and relies upon the "informational load" provided by the technology that generates it (Nunez, in Arsenault and Picard, 2004). The immersive experience builds with knowledge of environmental detail; immersion is facilitated by familiar contexts. LOE introduces an unfamiliar professional activity, which could make immersion challenging. However, LOE is introduced within a familiar setting and uses familiar items such as personal mobiles and email systems. The designed en-

vironment is web-based; students can use virtual exploration to gather the information they need, understand their challenges and create a schedule.

Narrative immersion encourages players to rush to the game to become acquainted with the developments of the narrative and what happens at the end. As distinct from diegetic immersion, which tends to be spatial, narrative immersion is temporal. Here, the main strategy for immersing players in the story is to propose that they carry out a quest, as usually happens in role-playing games. In order to achieve a mission, players have to follow the development of the story and listen carefully to the tips and advice offered by game characters and the narrative. In the case of LOE, the designers conceived a story in order to organise a set of activities which reproduces facets of epidemiologists' professional activity. The common thread of this set of activities is the mission assigned to students. This mission is to conduct a survey; as students engage in this activity, the story evolves. In the story, students encounter tips on the narrative proposed in different locations of the IT environment and receive feedback from game characters as they engage in production and interaction within the context of the serious game.

Self-identifying immersion concerns players' relationships with game characters. Player self-identification is an important feature in video game environments, whether games are played in first person or third person. In some cases of simulation or role-playing games, the intensity and longstanding player-character relationship may produce deep and complex emotions in players. The designers of LOE intended to stimulate the development of self-identification in students through the player-character relationship. Some student-character interactions occur by mail or phone messages (via voice message or SMS), but the most important example may be the videos of patients in the hospitals. The patients are played by actors, where the realism of their accounts and stories is supposed to provoke emotions in medical students. This feature of LOE represents an attempt to produce self-identification in students in relation to the patients and their role as epidemiologists; students should not act as clinical doctors, since their role as epidemiologists is not to treat their patients, but rather to collect significant data.

3.1.2. Role appropriation

In this section, I consider the previous definition of immersion and the model of immersion; I restrict my focus of analysis of the experience of immersion from the users' perspective and to the characteristics of the fictional immersion. Students are given a mission to play a role-playing game in LOE, and therefore, they have to appropriate a role. The serious game they are playing is supposed to help them embark in a simulated 'world', a model of a reality (although an immersive environment could also be a complete fantasy or abstraction).

The challenge for the designer is to create learning scenarios and experiences that encourage interactions and exchanges with characters in the game. In order to favour this immersion, the designers of LOE diversified the means of communication with game characters. Students interact with the characters by email, mobile phone, webpage, video and SMS. Another design challenge is to choose tools and applications that best support these experiences, and blur the line between virtual and real experiences. Each one of these different channels of communication requires different tools, forms of communication and techniques, but also requires anticipation, planning, strategies, preparation and so on. The aim is for learners to engage in the learning experience rather than being passive recipients of information. The simulation should help students to perceive the experience as authentic, that is, relevant and useful with respect to learning goals and proximate to a scientific activity (Francis & Couture, 2003; Issenberg, McGaghie, Petrusa, Lee Gordon, & Scalese, 2005; Moher, 2006). A model addressing a concept of authenticity is introduced in Chapter 05.

Students play a role as they interact with characters from the game. According to Bell (2011), role play is 'a teaching method that provides an imaginary context in which issues and behaviours may be explored by participants who take on a specific role or character'. Cornelius, Gordon and Harris (2011) stated that role-playing activities 'provide opportunities for learners to adopt unfamiliar roles, engage in interactions with others, and get involved in realistic tasks', and that this kind of activity is 'often recommended to foster the development of soft skills and a wider perspective of the world'.

Cornelius et al. (2011) listed some factors likely to support or oppose student's role in online role playing, including the following:

- Working by means of a different role as an important element for role playing, which is significant in terms of shaping contexts for activities;
- Students' experimentation with new methods or solutions is encouraged by their anonymity;
- Familiarity an important element; students familiar with the role they play are more engaged with this role. They ask direct questions and maintain lengthy exchanges with other students;
- In a role play, the actions of others enhance role engagement amongst students, raising issues of performance and identity; lack of motivation and negative attitudes of others may also provoke disengagement in the role;
- Readymade realism is a negative aspect vis-à-vis virtual worlds because it tends to decrease students' active involvement in performing their roles. From the authors' perspective, providing an appropriate setting for role engagement is more important than readymade realism.

3.2. Research questions

With the intention of modelling and measuring the students' role appropriation, I raised the following two questions:

- What are the criteria for determining whether a student has appropriated the role or not?
- What are the indicators that can be collected by observing the students while playing the game?

3.3. The Experiment

In order to answer the research questions, I selected two main moments of knowledge validation, as I shall introduce below. These moments of validation are also moments when the role-playing characteristics of the environment are more evident. They occur during and in between the second and third sessions (see Ta-

ble 3.1). In these moments of validation, students interact with characters of the game through mail and mobile telephones.

In the next section, I will introduce the appropriation factors of the game, the implementation of the fictional immersion, the data collection methodology and the analysis of role appropriation.

3.3.1. Analysis of the potential factors in role appropriation

I identified several types of factors that can facilitate appropriation, both from the literature (Chapter 1) and from an analysis of the game presented above (Chapter 2).

3.3.1.1. The interventions of the teacher during the sessions

The appropriation of the role, which is part of the problem (simulation of the epidemiology research pragmatics), partially depends on the process by which the teacher succeeds in playing the game and placing the student as the person in charge of solving the problem, that is, the devolution process (devolution of a role and devolution of a problem). Indeed, the teacher needs to ensure that students understand the questions asked, the information given and the constraints that have been imposed. Teachers' actions can facilitate the role appropriation when they play the game using references from the universe of the game in their interactions with students. In this context, teachers can encourage discussions on the definition of the problem, supporting group work as a research consultant who summarises group discussions. By playing the game – which means playing a role, such as in the case of LOE, which of a research expert consultant, and adapting the vocabulary to the situation proposed in LOE during the interventions in the whole group or in a specific student team – teachers may encourage students to play the game. Above all, so that devolution occurs, students have to accept (category of appropriation) a system of reciprocal expectancies and responsibilities between them and the teacher in relation to the learning situations (the didactical contract; Brousseau, 1997).

During the LOE sessions, a teacher intervenes to provide methodological assistance, and it would be necessary to carefully analyse these interventions in a research for factors facilitating the appropriation of the problem (Arsac, Balacheff, &

Mante, 1992) and appropriation of the role through teachers' devolution a role, although this is beyond the scope of the present work. Another means to facilitate the students' role appropriation, as mentioned above, is to use anonymity. Teachers can hide behind characters in the game in order to interact with students through them. According to Cornelius et al. (2011), anonymity provides 'emotionally safer experiences for players' to increase 'equality of opportunity among participants, support honesty and disclosure, offer increased choice, encourage high participation rates and remove gender and cultural expectations'.

3.3.1.2. The system of interactions with characters in the game

The computer environment was designed to immerse students in a professional experience.

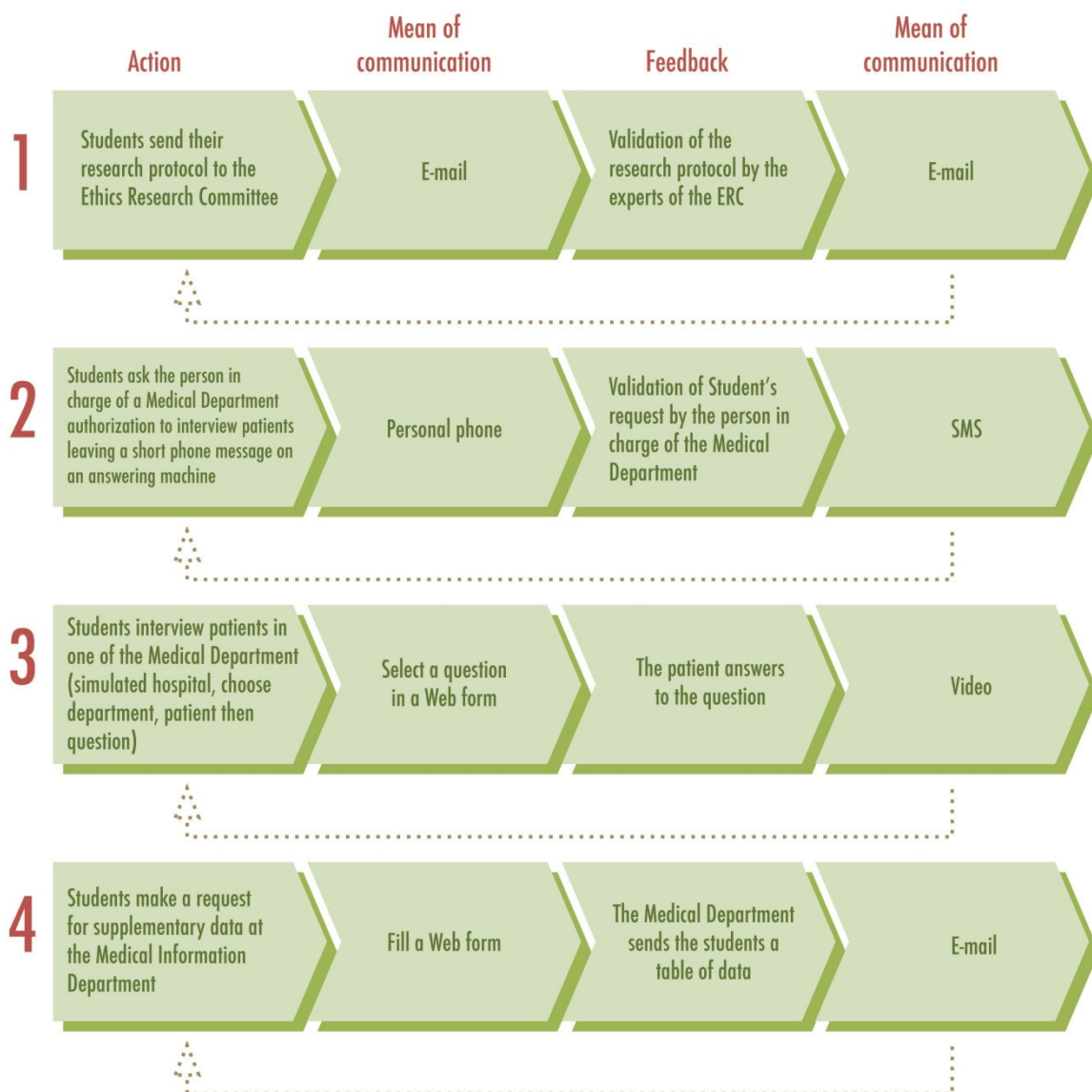


Figure 3.3. Interactions described by the action-feedback loop aiming to simulate human interactions in hospitals and related institutions.

One important characteristic of this environment which can facilitate role appropriation is the system of interactions, which is similar to that used by professionals. These interactions are described in Table 3.1. They allow students to experience conditions similar to those they would live in a real hospital, including feelings (empathy, intimidation, etc.) and constraints (leaving a brief message on an answering machine). I will investigate the extent to which some of these interactions will facilitate the appropriation of the role.

There is an important evaluation episode for the students' productions in LOE during the first classes: The validation of students' protocols is carried out by the Ethics Research Committee (ERC; see 1 in Table 3.1). The students receive these validations on behalf of the experts of the ERC and not the teacher, although it is the group of teachers who make these evaluations.

Such feedback may allow students to appropriate or re-appropriate a role in the game, positioning themselves as public health physicians solving the problem or in any other possible role, as far as they receive feedbacks adapted to the context of the game.

3.3.2. Implementation of fictional immersion

In this section, we describe how each interaction is implemented and what computer environment supports it. We also analyse a priori the learning benefits and limitations of these more or less realistic interactional experiences.

The ubiquity of mobile phones and mail applications provides the opportunity for more and more mobile game experiences, and most importantly blurs the line between the game space and real-world experience (de Freitas, 2006). An example of this is the game MAJESTIC™ (2001) from Electronic Arts™, one of the first so-called *alternate reality games*, in which players receive phone calls on their personal phones. In our case, phone calls and e-mails are both received and sent by learners; to our best knowledge, this has not been done in any other learning projects.

3.3.2.1. E-mail interactions

Students use their personal e-mail application during the game. When their protocols are ready, they send them for validation by the Ethics Research Committee

(action 1, in Table 3.1) as a .pdf file. This is compulsory, since only approved protocols can be implemented at the hospital.

For the sake of anonymity, the tutors behind all these characters use dedicated e-mail addresses and Webmail applications. As a result, we hope that students will address problems in terms of the underlying concepts and skills rather than in terms of what they think that the teacher will expect them to do (Millar, Leach, & Osborne, 2001), which occurs when the teacher is the receiver. The immersive interface that we use for tutors is a standard Webmail interface. It is immersive in the sense that it is separate from students' usual mailbox (otherwise, they might answer in their own name by mistake), and it is organised with a dedicated signature and e-mail address. Furthermore, it is accessible to tutors only from the game web platform.

The learning goals of this interaction are to learn how to address professionals in a formal way and how to present a protocol in written form (Table 3.1). In real life, people address protocols to this committee by regular mail, or more and more often, by e-mail. We choose the latter (Figure 3.4).

3.3.2.2. Phone interactions

In order to be able to interview patients (action 3, Table 3.1), students had to ask for authorisation from the head of each medical department of the hospital they wished to visit (action 2, Table 3.1). For this purpose, they had to make a phone call, and having listened to a brief message, needed to formulate their request in the way they thought would be most appropriate. Later, a tutor listened to their messages and replied by SMS. Students received the reply on their personal phone by SMS, which either gave them permission or a documented refusal. Permission allowed the team access to the patients' rooms. This phone call was thus a compulsory step to continuing the epidemiological survey. A team could make several calls, either to gain access to several departments or to repeat their request after a refusal.

The goal of this system is for students to learn to be convincing, quick and therefore prepared. It also puts them in a rather intimidating situation: They are talking to an answering machine, and they do not know who is going to listen. Apart from these learning goals, this design aims to enhance the students' feeling of immersion

by the use of their personal phone. The limitations are that although there can be several exchanges of messages, this interaction is not completely 'real', since students cannot have a synchronous dialogue with the head of the department. Furthermore, some students might not play the game, and may leave a message on the answering machine as if they were talking to their tutor.

In order to favour tutors' immersion, we designed a web interface for listening to and answering students' messages. We did not want tutors to answer in their name, and for that reason, they did not use their personal phone. On the tutor web site, they were able select the message and then they choose one of two actions, either accepting or refusing the student's request.

3.3.3. Methodology for data collection and analysis

Modelling and measuring students' role appropriation in such an original situation as that proposed in LOE was a challenge at the beginning of this study. Constant consideration of how to collect the data without being intrusive, as well as how to keep an open mind to avoid neglecting appropriation phenomena, led me to adopt an ethnomethodological⁵ approach in an initial pilot study. With such approach, I observed regularities and recurrences in the behaviour of the data collected and analysed in the pilot study. There was no previous grid or a priori analysis. Once data was collected, the regularities formed a grid which can be seen in Figures 3.6, 3.7 and 3.8.

The goal of the pilot study (2009) was to define the criteria of role appropriation and to conceive a grid with indicators. The next year, a larger data collection campaign was conducted (2010). An analysis was performed using the grid produced in the first year and improved in the second. Finally, due to changes in the IT envi-

⁵ Ethnomethodology is the study of the everyday methods and actions through which people construct social order and comprehend their world. The concept was introduced by the American sociologist, Harold Garfinkel (1967), who described it as "a member's knowledge of his ordinary affairs, of his own organised enterprises, where that knowledge is treated by us [the researchers] as part of that same context that makes it orderable". Ethnomethodology interprets all social situations as arising from the actions of the people involved, focusing on the ways in which people organise their activities cooperatively, directed by a mutual understanding of what must be done. Ethnomethodological researchers consider the participants' point of view, and draw conclusions as to how those participants' 'forms of life' can be interpreted as the result of their interactions. Garfinkel described ethnomethodology as "the investigation of the rational properties of indexical expressions and other practical actions as contingent on-going accomplishments of artful practices of everyday life" (Garfinkel, 1968).

ronment in order to favour role appropriation, a second large data collection campaign was carried out (2011).

In e-mail messages, students addressed the ethics committee expert, submitting their research protocols; in phone messages, students addressed the person in charge of the hospital department they intended to access. For both actions, students left tracks of their work in the environment. For mail messages, mails were recorded in the LOE mailbox, whilst for the phone messages, messages were recorded on the LOE answering machine. To analyse students' role appropriation, I looked at these activity tracks. This was the less intrusive means of data collection, since this was carried out during the action in an ecological context. Even if I was present in the classroom where LOE was taking place, and even if I was introduced to students as a PhD candidate and they were told that part of what was going on in the classroom was going to be subject of my studies, it was also underlined in my introduction to the class that my role in class was that of a technician giving support to students and teachers whenever there was a problem with the computing environment. This was an interesting way of making myself useful for students and teachers during the experiment; I had a role and a reason to stay in the class without causing a disruption.

Before coming to class, in one of the Biostatistics lectures of the previous semester, students were informed that in their practical classes they would conduct and participate in a survey. In the first practical class, students were given an information letter (see model in the Appendix IV, p. 283) explaining that they would participate in a survey on technology-enhanced learning, following the French deontological legislation for studies using personal data (CNIL, French Information Commissioner's Office). Students were informed that their activities in the LOE IT environment would leave recorded internet tracks. These tracks would in turn be collected for research purposes by the LOE research team. Students were given the option to participate or not and to include personal data when creating an account in the LOE IT environment. During the three years of the study, no student refused to participate in the practical class activities.

3.3.3.1. General protocol for the 'role appropriation' data collection campaign

Objective:

To collect data on role appropriation

Question:

Will students play the game?

Hypotheses:

Students will appropriate a role in the role-playing game.

Students will appropriate the role of a physician in this role-playing game.

Activity:

1. Students send an e-mail to a game character.

2. Students leave a phone message on an answering machine addressing a game character.

Data collection:

Asynchronous observation – E-mails and phone messages are recorded automatically and analysed later.

Tracking system:

Observation of activity tracks (Figure 3.3).

2009 and 2010 – Recorded material was coded manually in a spreadsheet.

2011 – An interface was designed to automatically code the recorded data in a spreadsheet.

Table 3.1. Protocol of the experiment

3.3.4. Data Collection

Three data collection campaigns were carried out over three years. First, a pilot study was conducted in 2009; then, a large-scale study occurred in 2010 and another in 2011.

3.3.4.1. Pilot study (2009)

a. Participants

The pilot study was conducted in the first semester of 2009. Students were all in the same group (N=28, 22 women, 6 men) and were allocated to this group by the administration (the 180 students enrolled in this course were distributed into six groups running in parallel). Students from the observed group worked in teams of three or four students. There were seven teams. The tutor during the pilot study was the person in charge of the biostatistics course (Prof. Jean-Luc Bosson); he participated in the game design and scenario.

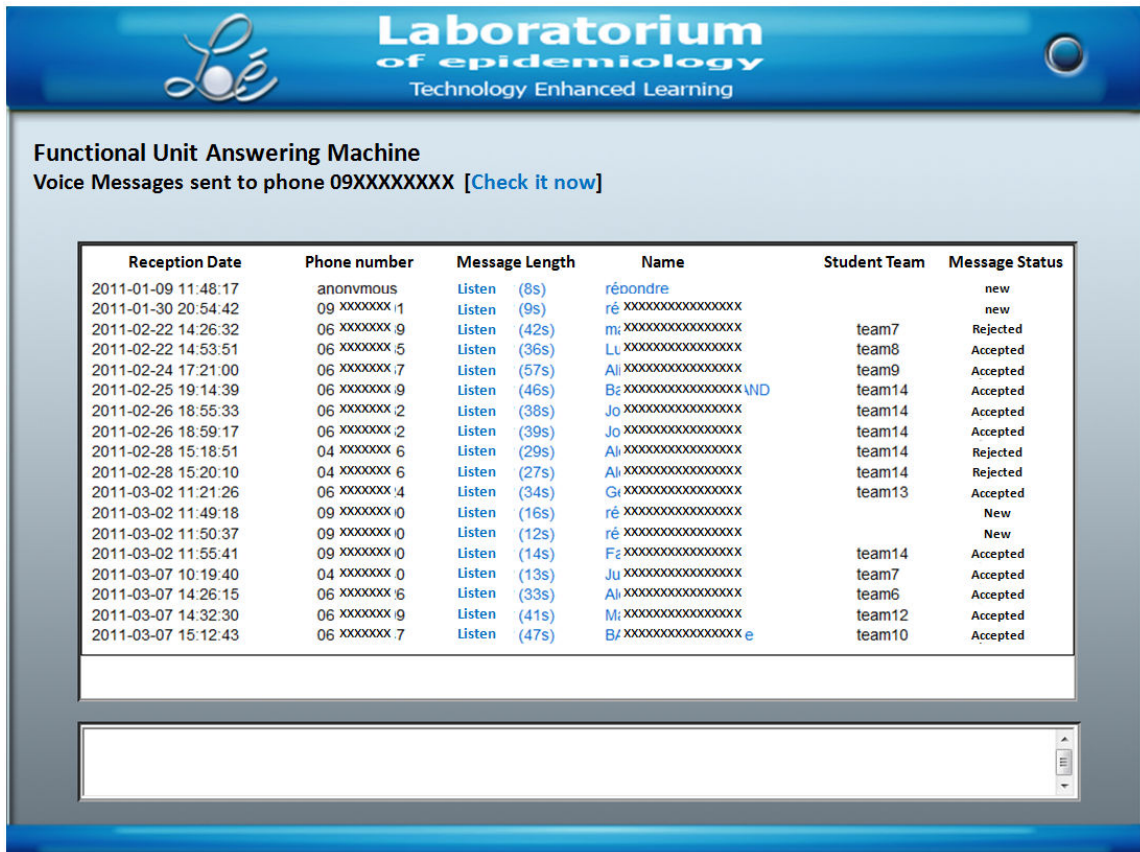


Figure 3.4. Phone message activity track. Teacher’s interface for LOE.

b. Task

Students sent their protocols to the ERC for validation when they were ready (action 1, Table 3.1). This file needed to be attached to an e-mail containing a short message.

At another time, students needed to make a phone call (action 2, Table 3.1). They listened to the following 20-second-long answering machine message:

‘You are connected with the call centre of the LOE hospitals. Please leave a message and we will answer you as soon as possible. In addition, leave your name and the name of your correspondent, as well as the name of the department and the related hospital. Thank you’⁶.

Students formulated a request in such a way that they thought it would be useful to the person in charge of the hospital department. Only one hospital was accessible;

⁶ French text: « Vous êtes en communication avec le central téléphonique des hôpitaux de LOELOE. Laissez un message et on vous répondra dans le plus bref délai. Veuillez indiquer votre nom et le nom de votre correspondant, ainsi que le nom de l'unité fonctionnelle et de l'hôpital auquel il est rattaché. Merci. »

this comprised four departments, each containing five rooms, for a total of 20 patients.

c. Sample

c.1. E-mail message sample

The experiment collected 13 messages of up to 47 words. These were sent by seven students in seven teams over a period of eight days.

c.2. Phone message sample

The dataset consisted of 15 messages of an average duration of 46 seconds (19–152 s). These messages were recorded by nine students in seven teams over a period of four weeks, during or between classes.

3.3.4.2. First large-scale study (2010)

a. Participants

The first large-scale study was conducted in the first semester of 2010. Students were distributed into six groups (N=169, 102 women, 67 men), each containing about 28 students; altogether, the groups comprised 45 teams of three or four students. A team of eight tutors conducted these practical classes (working in four dyads).

b. Task

The procedure for e-mail messages was the same as that adopted in the 2009 pilot study. The procedure for the phone messages was basically the same as in the pilot study. In 2010, three hospitals were accessible, each one comprising three departments, each of which contained five rooms; thus, 45 patients were available to be interviewed. Students were then told that they should make one phone call to request access to each department.

c. Sample

c.1. E-mail message sample

The 2010 experiment collected 84 messages. They were sent by 51 students using their personal e-mail (N=169) from 45 teams. Messages were sent over a period of approximately eight weeks, the majority (86%) being sent during Session 2 (35)

and between Sessions 2 and 3 (37), where there was an interval of 42 days between the two sessions.

c.2. Phone message sample

The experiment collected 167 phone messages. We were not able to identify the speaker in nine messages, of which eight were tryouts⁷ (details on these messages are provided below). We were able to code and score the other message, since there was an audio file produced, but we could neither hear the speaker's name nor identify the telephone number.

3.3.4.3. Second large-scale study (2011)

a. Participants

The second large-scale study was conducted in the first semester of 2011. Students were distributed into six groups (N=169, 107 women, 62 men), each containing about 28 students; the groups comprise 48 teams of three or four students. A team of 10 tutors conducted these practical classes (8 of them worked in dyads).

b. Task

The procedure for e-mail messages was the same as in the previous years. There were some changes to the phone call procedure. The principle was the same, but the LOE phone message was changed to the following 18-second-long message: *'You have reached the call centre of the LOE hospitals. Please leave your name and the reason for your call [1.25-second pause]. Furthermore, leave the name of the university hospital and the functional units in which you are interested. We will answer you as soon as possible by telephone or by SMS. Thank you'*⁸.

Students were told that they would have to leave only one phone message; in it, they needed to mention all the hospitals and functional units they intended to access. There was an incentive in the LOE call centre message asking students to explain why they wanted to access the hospitals (which was not the case for the messages in the previous years). Another new operation in the phone interaction pro-

⁷ To hung up the phone immediately after hearing the answering machine message.

⁸ French text: « Vous êtes en communication avec le central téléphonique des hôpitaux de LOELOE. Veuillez indiquer votre nom et le motif de votre appel [pause de 1,25 second]. Indiquez également le nom des CHU et des unités fonctionnelles auxquels vous vous intéressez. Nous vous répondrons dans le plus bref délais, soit par téléphone soit par SMS. Merci. »

cedure was that refusal messages now asked students to call another number, that of the hospital Clinical Research Associate (CRA). The CRA department is in charge of monitoring clinical trials. The students who were asked to call this department (13 phone calls) were not aware they would interact with real human operators. These operators were real CRAs from the Grenoble University Hospital, and in the context of LOE, they were prepared to interview and support students in their request for access, that is, to help the students properly express their research goals.

c. Sample

c.1. E-mail message sample

The 2011 experiment collected 115 messages. They were sent by 58 students using their personal e-mails (N=169) from 48 teams. Messages were sent over a period of approximately seven weeks, the majority (67%) being sent during the session and 33% of the messages sent out of the session time.

c.2. Phone message sample

The 2011 experiment collected 64 phone messages due to the change in the answering machine message.

3.4. Data Analysis

In 2009, I applied an ethnomethodological approach in my qualitative study to analyse the data. No theoretical background was used as analytical support. Nevertheless, a research protocol presented the question and two hypotheses (see Table 3.2.). Data were transposed and coded in a Microsoft Excel spreadsheet. Phone messages collected during the pilot study were transcribed through the Elan annotation software (a professional tool for the creation of complex annotations on video and audio resources) and analysed. The intention of the message analysis was to explore the collected data by observing, coding and isolating possible criteria. In a second stage, profiles were defined from the data. This two-stage process resulted in the development of a grid, which was able to describe and explain the findings through activity tracks, students' behaviours and attitudes expressed in the messages. I will discuss this in more detail below.

In 2010, the previous grid was applied to a larger sample and new profiles were made available. In this year, the aim of message analysis intended to evaluate the grid by applying it to a greater sample and make use of a double analysis through the inclusion of two researchers from different fields. This time, the collected messages were coded by a PhD candidate in Cognitive Sciences and a PhD in Applied Mathematics. This collaboration resulted in an adjustment of the criteria to the data collected through trials using 15 phone messages. Later, the researchers compared the results of 43 messages in order to check for incongruities. Finally, they double-checked 167 messages and discussed a few inconsistencies, especially concerning the characterisation of some messages. These messages were characterised in order to assess students' role appropriation in the game in each team (details are given below). In this way, criteria were listed and each message was listened to and then coded according to these criteria. This work concerned only voice messages; later, I applied this grid to the e-mail messages collected in the same year.

In 2011, data were treated automatically, as the messages were recorded through a designed interface in the researcher's platform. The grids for e-mail and phone messages were re-applied in order to obtain a larger sample.

3.4.1. Analysis of e-mail messages

As explained above, the grid emerged from the identification of profiles of messages, and the profiles were characterised by certain criteria. E-mail messages were characterised according to their nature and form.

In a serious game, e-mail can be used as an asynchronous way of communicating with a character in the game. Exchanging e-mail messages with a game character may be considered a knowledge validation moment. In this case, one of the possible uses of this device can be sending and receiving attached files. These files are subject to knowledge validation, since they contain students' productions. Students then exchange an e-mail message that follows an attached file with their productions.

Tutors have to validate students' productions, and from this perspective, there are only two types of messages: *successful* and *unsuccessful* ones. Successful messages contain students' production (an attached document) and fully correspond to ex-

pectations according to what the task demands (i.e. an accomplished protocol). Unsuccessful messages demand review of the document (protocol).

From another perspective, it is not the case that students only use message exchanges for the above-mentioned goal. There are four categories of messages which can be sent by students, as follows:

- **Submission messages:** Students submit their productions to the character;
- **Rectification messages:** A second message is sent in order to make some corrections to a previous message. This category is split into the following two subcategories:
 - o **Document rectification messages:** Messages containing some rectifications in the attached document;
 - o **Rectification missing file messages:** These follow a message where the student forgot to attach a file.
- **Missing file messages:** Submission messages missing an attached file;
- **Requiring news message:** Motivated by game characters' delay in answering the message, students may contact them in order to obtain news about their previous request.

Since students are playing a game, they may not consider only the knowledge validation aspect of this mail exchanging. They are both players and users of this environment. As users, they may appropriate the instrument proposed and enrich its properties by employing it differently according to the situation. Students can make innovations in the use of the message device in the context proposed by the role-playing game, communicating with the game character in a way they were not expected to do.

3.4.1.1. Role-playing game messages

Tutors do not usually consider students' role playing in mail messages, since this does not contain any data about production. These are presupposed peripheral data, and therefore tutors prefer to consider only the attached file. Consequently, e-mails that do not contain any role-playing messages can be 'successful' if tutors estimate the attached document to be acceptable. Considering our research question, the very gaming aspect of this activity is located in the e-mail message. The

following qualitative analysis presents a grid for mail message analysis in a role-playing game.

a. Qualitative analysis

a.1. E-Mails Message Categories

From the perspective of a role-playing game, there are two categories of messages: complete and incomplete (Figure 3.5). Complete messages correspond to the researchers' expectations of what is an acceptable role-playing performance and incomplete messages fail to do so.

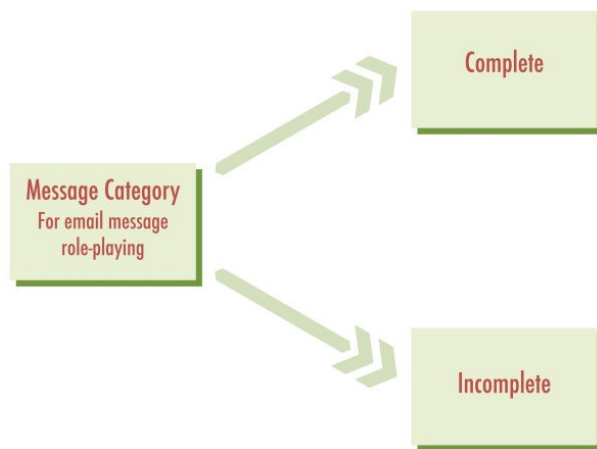


Figure 3.5. Categories of e-mail messages in role-playing games.

The criteria used to evaluate the quality of the role-playing performance were based on the form of the message.

a.2. E-mail Message Form

The form of the mail message qualified students' elements of identity, attitude and the structure of the message text. Background and global information were other useful data collected with the messages.

a.2.1. Elements of identity

a.2.1.1. Introduction of identity

Students appropriate a role when they play the game. This role can be that of a professional (physician, investigator, etc.), but students can also play the role of students in the role-playing game, since this is a role they probably feel more comfortable with. They can also play themselves, without adopting any other characteristics.

a.2.1.2. Context

In terms of elements of identity, the context in which the student is immersed is very important. Information on this context can help to understand students' role appropriation. Students may mention they are working in groups, they can use their own names, they can name their employer in the situation, and they can mention details about their present job.

a.2.2. Attitude

Students can manifest formal or informal attitudes in their e-mail messages. This criterion gives hints about the students' attitude towards the character in the game. In the game, students should address the Ethics Committee formally (e.g. 'Madame/Monsieur'), since they are dealing with a chain of command. Their attitude is one of the markers of role appropriation, since it can give a sign of whether students are playing the game or not.

a.2.2. Message

Students need to send an e-mail to the ERC. This e-mail is supposed to contain a message addressing the experts. They are supposed to send an attached file to be validated. Therefore, the message is characterised by a heading and the text of the message.

a.2.2.1. Headings

The headings of the message contain a message title and an attached file.

a.2.2.1.1. Message title

When students send the message to the ERC in the context of the game, they are sending it to someone that ignores their survey and probably evaluate many others surveys. Students play the game if they are able to *personalise* the title of their message, giving information about their own survey, so that their message can be easily identified. For example, it could be named '*Request to conduct a survey on the effects of the duration confinement to bed on the occurrence of thromboembolic diseases*'. When students do not role play in the situation as expected, they usually

just play the role of a student in the classroom. In this case, they send the message to their teacher, and the message tends *not to be personalised*, entitled something like '*Biostatistics protocol*' or just '*Protocol*'.

b.3.1.2. Attached file title

The same issues are relevant for the attached file title. Students should personalise the name of the file to make it easily recognisable by the ERC experts (e.g. '*Deep venous thrombosis in pregnancy*'). Students titling the file '*Protocol*' would not be playing the role as expected, although it must be considered that such behaviour could also denote students' lack of professional instincts.

b.3.1.2. Attached file heading

The heading of the attached file is actually the heading of a 'professional' research protocol. Students should personalise the heading of their protocol by giving a title identifying their objectives. Students not playing the role as expected would simply introduce their protocol as '*Biostatistics protocol*', '*Report on biostatistics*' or anything alluding to class activities.

b.3.2. Text

The text of the message should be properly adapted to the situation. This activity demands some skill from the student in terms of the form of written communication they are supposed to use when addressing people professionally. The message should be structured according to the elements listed below.

b.3.2.1. Greeting

The message should start with a formal greeting (e.g. 'Dear Mr/Mrs') if students are playing the game or at least taking the activity seriously. An example of an informal greeting would be 'Hello'.

b.3.2.2. Message content

The message should explain the aim of the communication in a few words.

b.3.2.3. Closing

The message should present a formal closing (e.g. 'Yours faithfully'), as is usually done in formal or business letter writing. An example of an informal closing would be 'Thank you'.

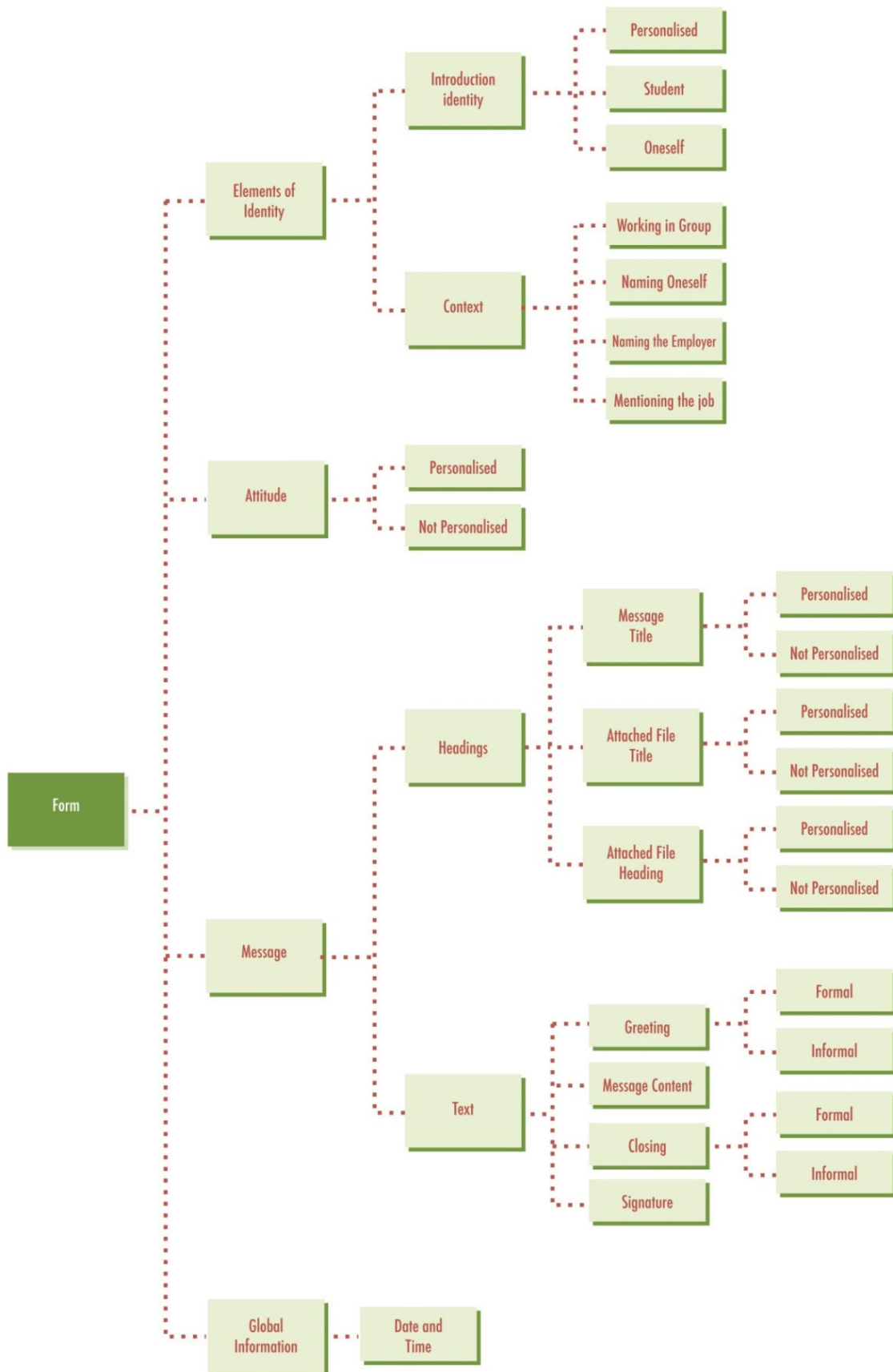


Figure 3.6. Grid for mail message analysis in serious games (Role Appropriation Grid).

b.3.2.4. Signature

Students must identify themselves at the end of the message according to their team composition by giving their own names. Since they are working in a team, the ideal would be to introduce all the names in the signature, not just one, or give any kind of allusion to their group or tutor.

b.4. Global information (time and date)

Global information is data offered automatically by the tracking system, such as time and date. With this information, it is possible to identify precisely when students performed their actions, whether in class or elsewhere; if more than one message is sent on the same day or at roughly the same time, it is possible to classify the communications in the proper order.

c. Results

As a result of this qualitative analysis, I propose the following grid for mail message analysis for role playing in serious games using message communication with characters (Figure 3.6).

3.4.1.2- Quantitative analysis

In order to evaluate students' attitudes and behaviours, I applied the grid shown above, attributing one point each time one of the prerequisites were satisfied. Although almost all the messages were incomplete, one remarkable thing is that the students still did write messages and did play along with this activity, even though the important thing for knowledge validation was the attached file and not the mail message itself.

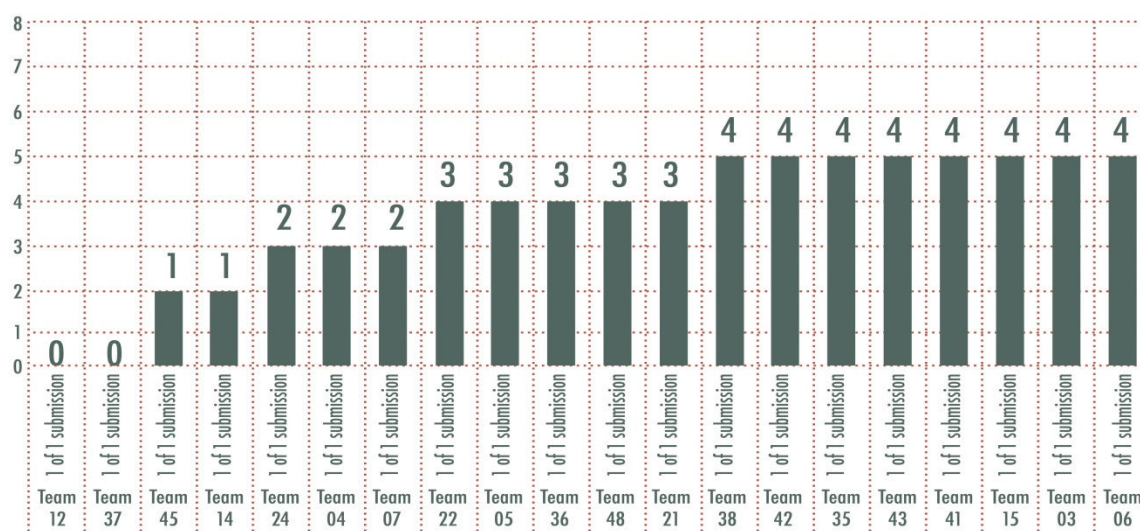
There were up to 198 collected messages. About 109 students used their webmail to play the game (55.1%) and only 12 students (4 in 2010, 8 in 2011) did not send a message with the attached file. Thirty students (15.2%) took on the identity of a professional; 26 (13.1%) students assumed the role of a medical student; and the majority (135, 68.2%) played themselves, which means that they did not identify themselves as professionals or students, but only gave their names. Seven (3.54%) messages were empty, so that no elements were available to assess the students' role-play identity.

a. Students' scores

An ideal e-mail message could achieve a score of 8. In such a message, students would introduce themselves as a professional (+1; playing the role of a student or themselves is scored as 0), personalise the titles of the e-mail (+1) and document (+1) and present a mail message containing a formal greeting (+1), text (+1), formal closing (+1), signature (+1) and list of group members (+1).

No student obtained a score of 8. Twenty-eight (14.1%) students personalised the mail title, while 16 (8.1%) students personalised the document title.

Messages submitted once

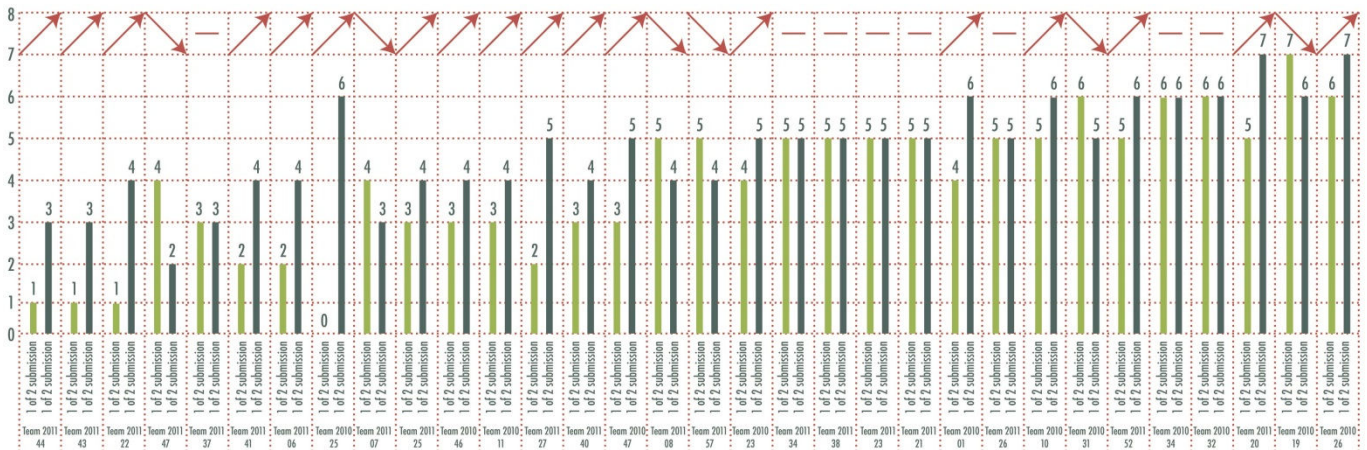


Graphic 3.1. Scores and frequencies of messages submitted only once.

In the set of teams submitting e-mail only once in order to have their protocol accepted by the ERC, two cases of a score of 0 for role appropriation were considered acceptable by tutors – probably because although no message was produced in the e-mail and no personalisation was observed, the content of the attached file fitted the tutor's expectations. Nine students (34.6%) had a low score (under 4). Thirteen out of 26 (50%) obtained a score 5; among these, 10 played themselves and 3 played the role of a student. Only one student playing the role of a professional was given a score of 4. The set of messages submitted once presented a general mean score of 3.65.

Messages submitted twice

The database shows that 32 teams submitted mail messages twice in order to validate their protocol. In a set of 64 mail messages, 32 communications containing a protocol (attached file) were initially rejected, so that 32 revised protocols needed to be submitted. There was one case of a score of 0 on role appropriation in the first message sent, although the second message was given a score of 6.



Graphic 3.2. Scores and frequencies of messages submitted twice.

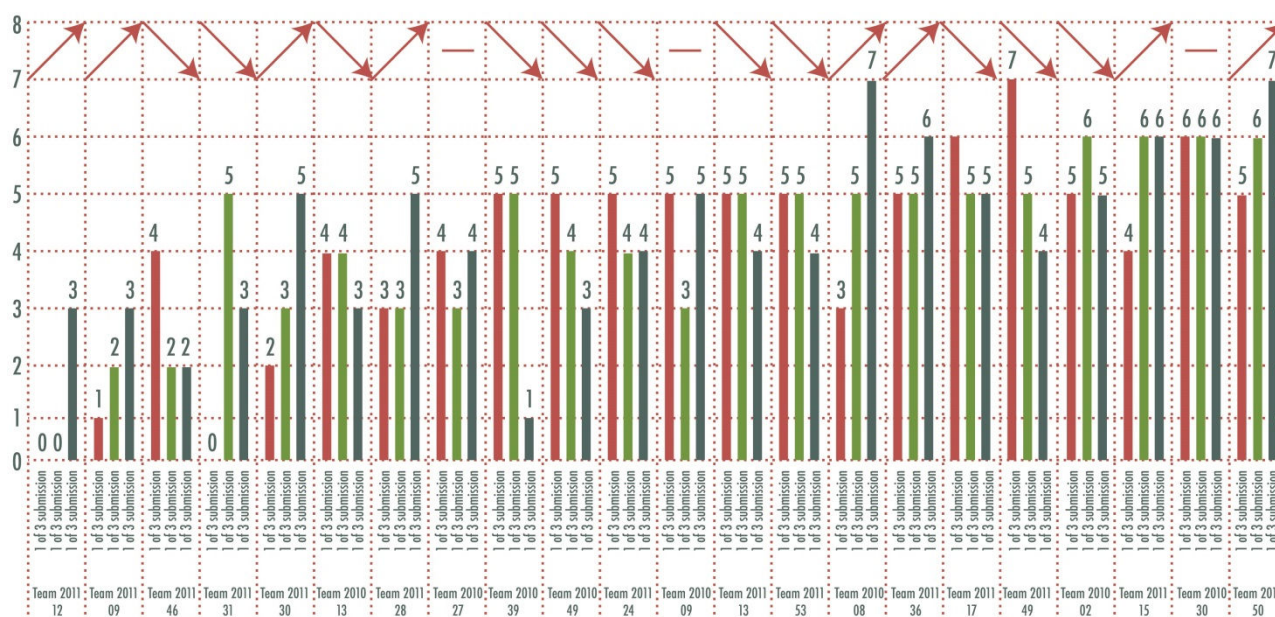
Most of the messages obtained an acceptable score on role appropriation: 33 (51.6%) messages reached high scores (5–7), while 13 (20.3%) reached a medium score (4). Eighteen (28.1%) had a low score (0–3). Thus, 71.9% of messages received a good score. The set of messages submitted twice presented a general mean score of 4.41.

Scores tended to rise in the second e-mail, where 18 (56.3%) teams increased their score from one message to the other, 6 (18.8%) decreased their score and 8 (25%) received the same score. Among the teams who maintained the same score, only one had a low score.

Messages submitted three times

The database shows that 22 teams sent three e-mails to the ERC. From this set of 22 teams, only 6 (27.3% of the messages) really had to submit their protocol three times (revising it twice). The other 16 (72.7% of the messages) teams submitted their twice protocol (revising it once), but sent a third e-mail for the following reasons: one team had the same message sent by a co-worker around the same time; one team sent a third message with a ‘Patient information letter’ attached; one team submitted the same message a second time, probably due to delay issues; six teams forgot to attach a file in one of the e-mails; three teams sent a third message

requesting news from the ERC because of the delay in receiving an answer; four teams were constrained to send a third message after receiving a request from the ERC to give details like the names of participants and so on in the mail messages.



Graphic 3.3. Scores and frequencies of messages submitted three times.

In the set, 22 messages containing a protocol (attached file) were initially rejected; another 22 messages were then submitted with corrections. Finally, six messages were sent to submit the protocol a third time.

No scores of zero were recorded in the subgroup submitting the protocol three times (6 teams); however, two cases of zero scores were recorded in the subgroup sending three messages (16 teams). The latter received a message from the ERC requiring a detailed message.

Most of the messages obtained acceptable scores on role appropriation, as 34 (51.5%) messages received high scores (5–7) and 12 (18.2%) received a medium score (4). Twenty (30.3%) were given a low score (0–3). Thus, 69.7% of the messages received a good score. The set of messages submitted three times presented a general mean score of 4.18.

Scores tended to high, although more concentrated, in the subgroup submitting the protocol three times. In the subgroup of 16 teams sending three messages, nine decreased, six increased and one remained the same. The mode score was 5 (16 records) followed by scores of 3 and 4 (10 and 9 records, respectively).

Twenty (41.7%) messages received high scores (5–7), 9 (18.8%) were given a medium score (4) and 19 (39.6%) had a low score (0–3). Twenty-nine out of 48 messages had a good score.

In the subgroup of six teams sending three protocols, two increased, two decreased and two remained the same. The mode score was 6 (7 records) followed by a score of 5 (6 records).

Fourteen (77.8%) messages received high scores (5–7), 3 (16.7%) were given a medium score (4) and 1 (5.6%) had a low score (0–3). Seventeen of 18 messages received a good score.

In general, the scores – and thus the students' e-mail communication skills – tended to improve as the game progresses.

Messages submitted four and five times

The database shows that eight teams submitted e-mail messages four times, while two teams submitted mail messages five times in order to validate their protocol.

In the group which submitted four times, in a set of 32 mail messages, 8 containing a protocol (attached file) were initially rejected. No protocol was submitted four times; seven teams submitted three times and two teams submitted two times. On the other hand, six teams produced duplicate messages sent by the same student or two students; three teams forgot to attach a file in one of the e-mails; two teams sent a third message requesting news from the ERC due to the delay in receiving an answer.

There was one case of score of zero on role appropriation

Most of the messages obtained good scores on role appropriation: 14 (43.8%) messages received high scores (5–7) and 10 (31.3%) were given a medium score (4). Eight (25%) received a low score (0–3). Seventy-five per cent of the messages were given a good score. The set of messages submitted twice presented a general mean score of 4.3. The mode score is 4.41.

For the group sending five messages, in a set of 10 e-mail messages, two containing a protocol (attached file) were initially rejected. No teams submitted the protocol five times. They actually made only two submissions to validate the protocol. One

message was sent with the same protocol but with a different type of file (.pdf), one e-mail asked for news from the ERC, one thanked the ERC for its response, one message noted that the previous was sent to the wrong address and one message was missing a file.

Three of 10 messages obtained a high score, 5 messages received a medium score and two were given a low score. The set of messages submitted twice presented a general mean score of 3.8. The mode score was 4 (five records).

b. Analysis of results

Although students did not receive any specific assignment concerning the composition of the message, most of them did it naturally as they usually do in real life. The scores on the messages tend to rise on the second message; demonstrating students tend to improve their communication quality, thus their role-playing in the second message. However scores tend to decrease on the third message, mainly because the third tend to be a continuation of previous messages, indeed students also do it as they would do in their real life.

According to the type of identity assumed (professional, student, oneself)

		Type of identity played by the student: Professional (Pro); Student (Stu); oneself (self)			Total
		Self	Pro	Stu	
Total scores of messages	1	1,0%			1,0%
	2	3,1%		1,6%	4,7%
	3	9,9%	,5%	1,0%	11,5%
	4	20,4%		2,6%	23,0%
	5	25,7%	3,7%	7,9%	37,2%
	6	9,4%	8,4%	,5%	18,3%
	7	1,0%	2,6%		3,7%
	8		,5%		,5%
Total		70,7%	15,7%	13,6%	100,0%

Table 3.2. Relation between identity played by students in the e-mails and the obtained scores in the messages according to the grid of role appropriation

Most of the students played the role of themselves. Students playing professionals concentrated highest scores on their share (76% between 6 and 8). Therefore students playing the role of professionals tended to have higher scores on role appropriation according to the role appropriation grid (Figure 3.6). Students playing the role of students (medical students) concentrated better scores than the students

playing themselves. Indeed, in the role playing situation it was very important to take seriously the interaction with the game character. In this context, a student playing the role of a medical student was still a coherent role in the context of the game, which can explain their better overall performance comparing to the students playing themselves.

3.4.2. Analysis of phone messages

In this section, I describe the criteria for classification of the types of phone messages; in the second section, I describe the criteria determined for categorising the form and the content of the phone messages.

3.4.2.1. Qualitative analysis

In the section 3.3.3 of chapter 3, the methodology for present analysis was described. As distinct from the e-mail messages, where students' productions were separated from their role playing, the phone messages put both aspects together. Instead of writing, students had to speak on their own. I assume that this action is much more dynamic and demands much more acting in role playing than the action with e-mail. In some of the recordings, it was possible to detect tension in the students' voices and this was confirmed in some of the interviews (see Chapter 5). The validation came with students' capability to argue on behalf of their group when requesting authorisation to access a hospital department.

a. Phone Message Categories

I expected students to give information about the objectives of their survey. Mentioning that they had been assigned by a public health commission to conduct this survey or that they had had their research protocol evaluated by an ethics committee would also show role appropriation.

In order to analyse the content of these messages, the recordings were classified into four types, as described below.

a.1. Complete messages

Complete messages requested authorisation by giving the main objective of the survey or at least mentioning that the survey had to do with thromboembolic disease.

a.2. Incomplete or partial messages

a.2.1. Incomplete messages

Incomplete messages were divided into three types, as described below.

a.2.1.1. Unfinished messages

If students hung up the phone before the end of the message, they were considered unfinished.

a.2.1.2. Fragmented messages

If students failed to identify themselves or their group, the messages were considered fragmented.

a.2.1.3. Ineffective messages

In ineffective messages, despite requesting authorisation, the students failed to report the survey's main objective, mentioning only risk factors, the authorisation from the ERC or specifying the need to interview patients for a survey without giving any details about it.

a.2.2. Partial messages

Partial messages were divided into the two specific situations described below.

a.2.2.1. Rectification partial messages

If the phone call concerned a rectification, whether the student made a mistake in a previous phone call or if the hospital department they were authorised to visit was not the one they requested, the messages were categorised as rectification partial messages. Under these circumstances, students did not state the survey's main objective.

a.2.2.2. New authorisation request partial messages

When in a subsequent message, students asked for authorisation to access another hospital department without giving details of their survey, often referring to a previous message, this was seen as a new authorisation request partial message.

a.3. Misled messages

Misled messages were identified when students adapted their messages to the instructions suggested by the answering machine. These messages presented an authorisation request at best.

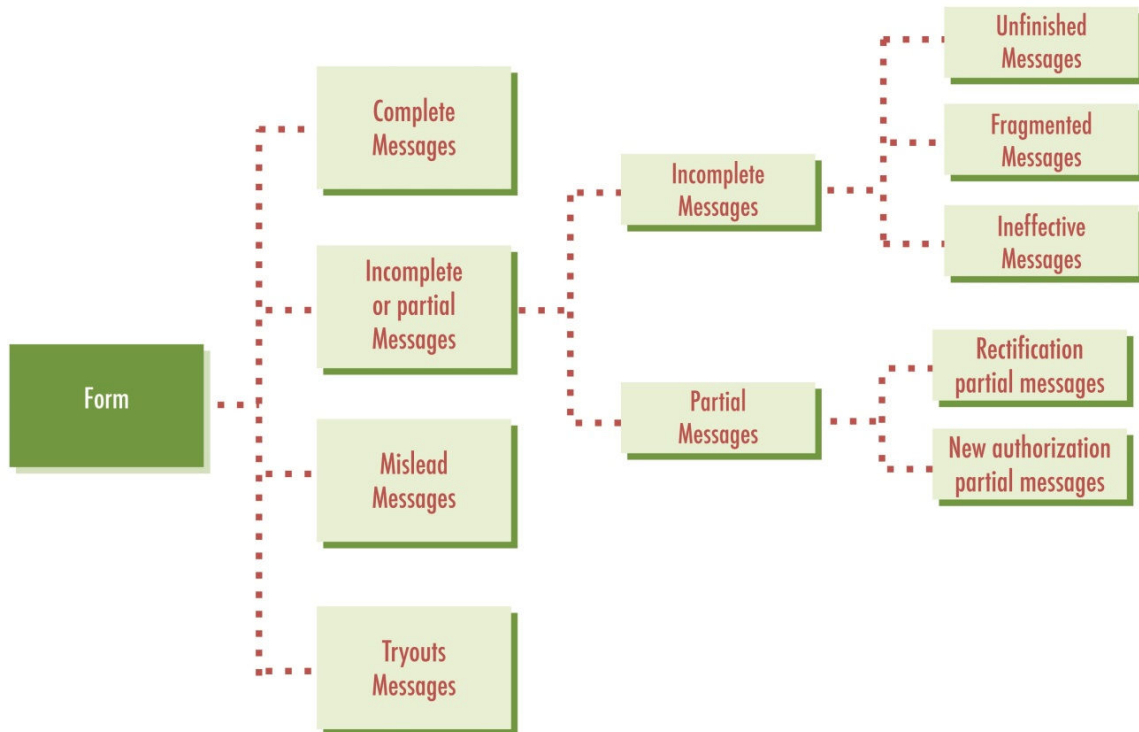


Figure 3.7. Categories for phone messages in role-playing games.

a.4. Tryout messages

Messages were classified as tryout messages when the students hung up the phone immediately after hearing the answering machine message. Some of these were recorded, but we believe others were not, since students could still hang up the phone before the machine started to record their message.

We expected students to provide information about the objective of their survey. In order to analyse the nature of these messages, we classified them into four major groups: Successful, Unsuccessful or Partial, Misled and Tryout messages.

b. Phone message form

b.1. Elements of identity

The name and role in which students introduced themselves (*Physician, Medical Student or Themselves*) were identified as the elements of identity.

b.1.1. Introduction of identity

Students appropriate a role when they play the game. This role can be that of a professional (physician, investigator, etc.), but students can also play the role of students in the role-playing game, since this is a role they probably feel more comfortable with. They can also play themselves, without adopting any other characteristics.

b.1.2. Context

In terms of elements of identity, the context in which the student is immersed is very important. Information on this context can help to understand students' role appropriation. Students may mention they are working in groups, they can use their own names, they can name their employer in the situation and they can mention details about their present job.

b.2. Attitude

Attitude refers to students' comportment towards the head of the hospital department (*Formal or Informal*).

b.3. Background information

Background information included references to the tutor's name or the team's number as if the person they were addressing in the message would know the circumstances under which the game takes place. It also comprised information about being assigned by a Public Health Commission to carry out this survey or the students having had research protocol evaluated by an ethics committee.

b.4. Global information

The global information was the *time* and *date* of the phone call.

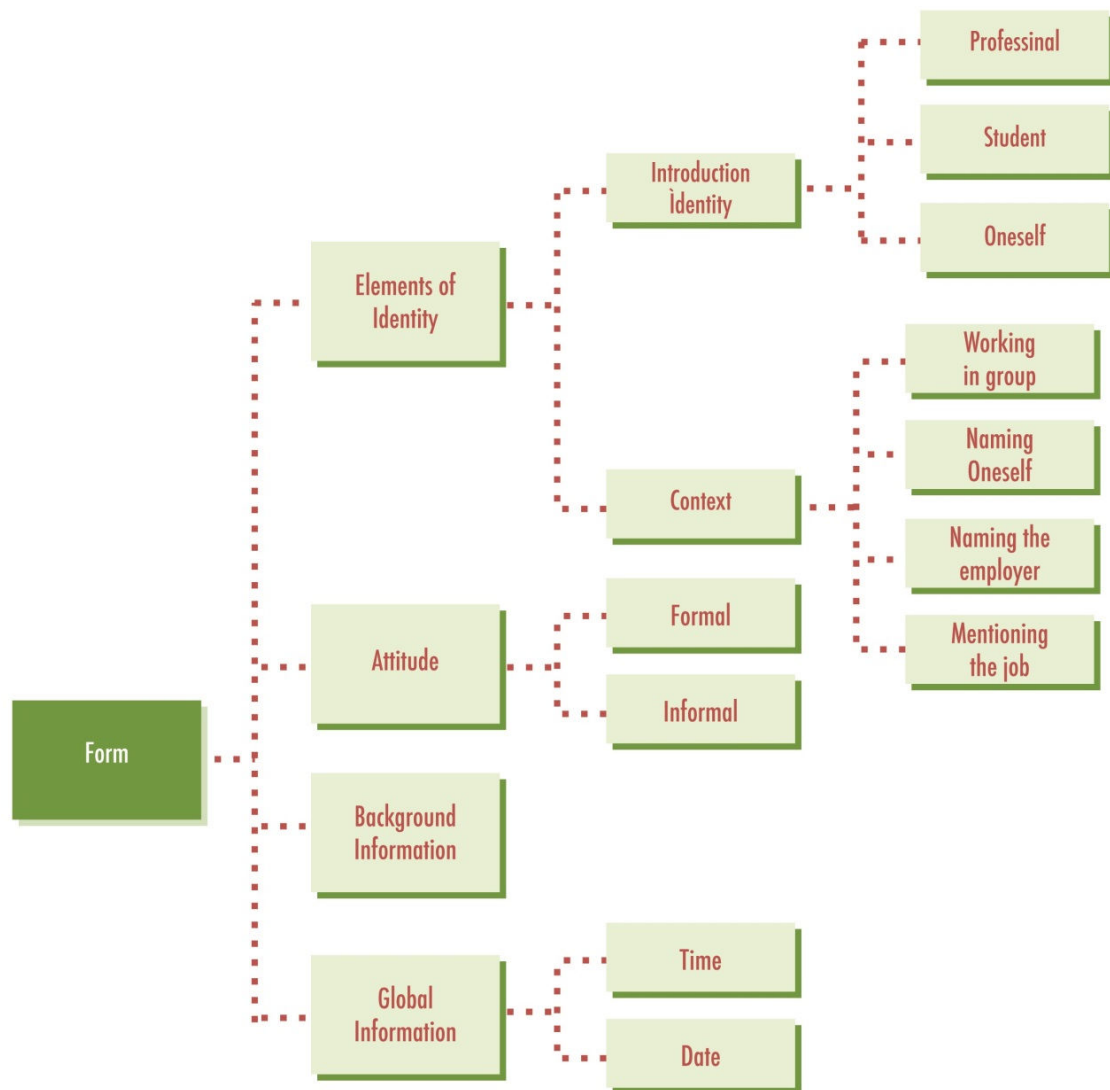


Figure 3.8. Grid for phone message analysis in serious games.

3.4.2.2. Quantitative analysis

The grid above was applied to students' data and the qualifier 'complete' was attributed to some of its attributes each time one of the pre-requisites was satisfied. In this serious game, students played the role of a public health physician conducting a survey. As they had been assigned by the Public Health Commission as a professional, I expected students to introduce themselves as such in their phone calls. This is important background information and a reference they are supposed to give when they make such a phone call.

Students worked in teams of three or four; it was almost always the same phone that was used and the same speaker, not necessarily the owner of the phone. The same thing happened with the e-mail. Hence, these teams quite spontaneously attributed the role of spokesperson to one of their members.

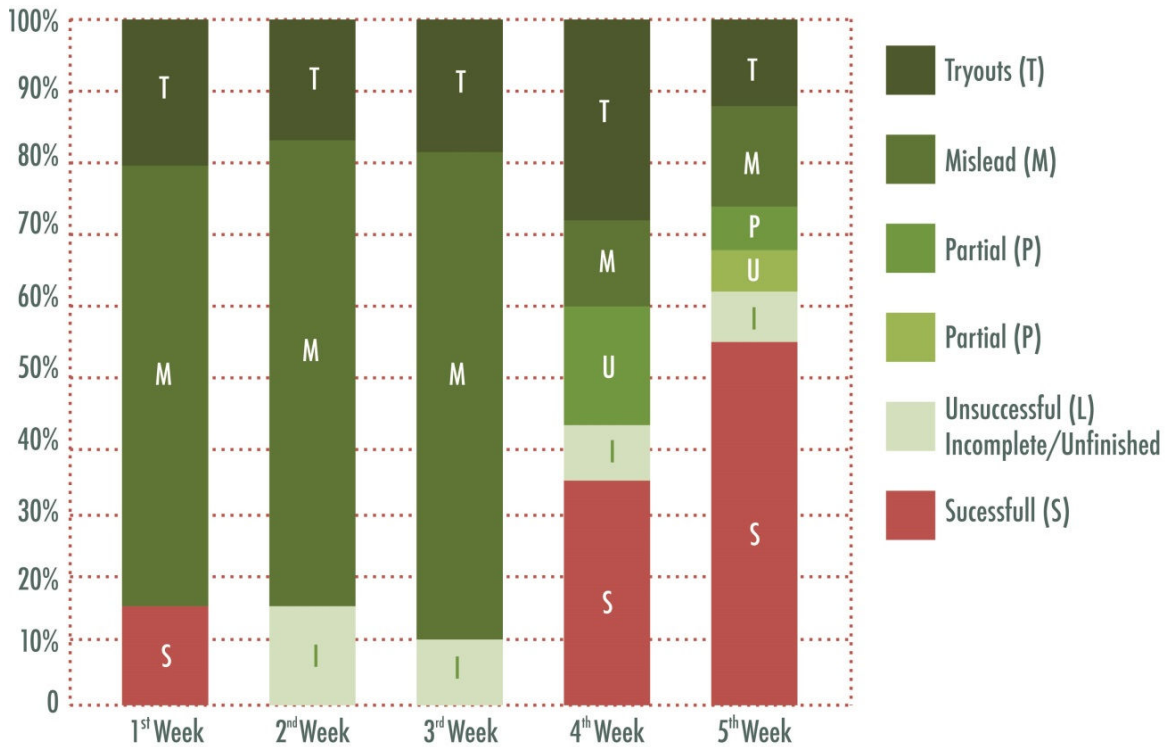
In 2010, no student played the role of a public health physician; this result is different from that of the pilot study conducted the previous year, when there was a recorded a case of 'professional role'. In the same way, despite the introduction of the game, in which the Public Health Commission assigned the students their mission, the students failed to mention that their survey was being conducted due to a mandate by the Public Health Commission. I observed that in some messages (40 out of 167 messages that were not coded as tryout messages), students introduced themselves as medical students. Even if the students were not playing the role of a professional, they referenced a role whose status could justify and back up their initiative. In contrast, most of the teams (96/136-167 messages) introduced themselves without adopting a role: It seems that they were not aware that a hospital is not going to open its doors to anybody wanting to visit its patients. Indeed, in asking for a name, the answering machine sometimes influenced students' answers. Moreover, calling a real hospital may have embarrassed students, making them unsure of whether they were supposed to 'lie' and present themselves as doctors. Whatever the case, most messages (115/136-167) addressed the person in charge of the hospital department in a formal way.

Twenty messages from 13 different teams made reference to their biostatistics course. In 17 of these messages from 10 different teams, students entered gave details about their team number (administrative data which students did not need to know).

What seemed in the beginning to be a simple phone call turned out to be a challenging learning situation. In terms of form, students had to adapt their communication sociolinguistically to the proper language stratum. They had to identify themselves, providing an identity and status that could justify and back up their request. Since they were learning about the proper procedures involved in conducting a survey in a hospital, it was important for them to discover who they are supposed to address and permissions for such studies are requested and received.

This stage of the game asked students to justify their intentions in terms of why they were conducting their survey. They needed to be able to summarise their main objective, which implies previous work on the design of a research protocol, clearly setting up the objectives of the research. In addition to the factors concern-

ing the form of the message, students were supposed to articulate their objectives in the proper way to produce a complete message.



Graphic 3.4. Distribution of the phone messages types across five weeks (There is a 15-day break between week 3 and 4).

Among the 167 messages recorded, 62 were successful, which means that 105 (62.87%) were 'globally' unsuccessful, misled or tryouts. It becomes evident that most of the teams called more than once, three times on average up to 17 times for one team! Students made tryouts before the effective phone call (18.56%) and 46 messages (27.54%) were misled. Only five messages (2.99%) gave rectification partial messages or new authorisation request partial messages. As a result, many of the messages were successful, a few were unsuccessful or unfinished (13.78%), but most of them (77 messages) were misled or tryouts (46.10%).

Looking at the evolution of the types of messages over the weeks, we see (Graphic 3.4) that the teams tended to succeed. Whereas the proportion of successful messages was 15% for the first week, it rose to more than 50% in the fifth week. In contrast, misled messages were the most common at the beginning, with 60% of the first messages being misled, while at the end, only 10% of the messages fit this category.

In order to generate a successful message, students had to be able to sum up their project in a few words and be very clear about the main objective of their survey. Such communication requires great effort and demands a certain discernment of the content to articulate the form and categories of the information while recording a phone message. Via adapted SMS feedback, tutors fostered most students' capacity to master the four didactical stakes underlying the phone calls, in other words, the form (adapting sociolinguistics, identity and hospital administrative formalities) and type (to synthesise the objectives and target the important point of a study) of the message.

In 2011, there is only 1 empty message over a total of 64 messages and 34 % of students introduced themselves as "student". Therefore, the changes in the scenario reached the aimed purpose.

3.5- Conclusion

In this chapter, I raised issues of immersion and role appropriation in the context of a serious game implemented in a Biostatistics course at a medical school. In this context, students were assigned a mission, and were supposed to design a research protocol to submit to an ethics committee and contact a department head at the hospital in order to obtain his or her permission to interview patients. LOE was designed following certain principles of fictional immersion in order to offer a coherent narrative and facilitate students' engagement in the game. The design of LOE, the context of role playing surrounding it was also geared towards fostering students' engagement in the activity. The design being a vector of immersion, the experience of immersion is very important from the point of view of players' experience of the game. Role playing thus creates a context for problem solving. There was an issue of problem appropriation in this case, in which individuals had to interact 'in role' with characters in the game through phone calls and e-mail. They needed to develop the role that was proposed to them and engage in it. The characters in the game were accessible through communication media, but their real identity was kept anonymous.

Interested in the students' natural reactions and initiatives, I adopted a non-intrusive method in order to avoid influencing their behaviour as players. I de-

signed a pilot study to develop a model with specific criteria to evaluate student appropriation of their roles in role-playing situations involving communication through webmail and cell phones. I expected students to play the role of an epidemiologist in order to access a problem of epidemiology as they engaged in the game. Preliminary analysis of the data collected through the Student role appropriation grid shows most of the students did not play the role of the professional, however, the group playing the role of professional concentrated higher scores than the other groups. The group playing the role of “medical students” had a better performance than the group playing themselves. Indeed the role of medical student was coherent to the game narrative and playing this role student gave more elements of role appropriation.

Role appropriation concerns the immersion in the game and corresponds to the first access to the serious game, which is the simulation of a professional activity. The structure of the environment and the internal narrative provided by the elements of fictional immersion gave students a chance to play a game seriously, and students did play it. Playing the game students encounter the problem, the epidemiology survey leading to the analysis of the emergence of a disease. A problem which will concern the use and development of biostatistics instruments to solve it. Student then come to the issue of the appropriation of the problem which is a relevant issue for the learning objectives of their practical classes.

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Résumé en Français

Dans ce chapitre, je décris l'adaptation du modèle d'appropriation de problème par l'étudiant (modèle-APE) à un contexte de travail d'équipe.

La structuration du milieu (modèle-SM) fournit le cadre analytique des systèmes de situations didactiques. Le modèle-APE ajoute une couche à l'interaction agent-milieu au cours de laquelle un procédé d'appropriation de problème s'opère.

Il est complété par le modèle de résolution coopératif de problèmes de Baker (modèle-RCP). Je crois que l'appropriation par une équipe a lieu dans les moments de collaboration, lorsque ses membres co-argumentent et co-construisent ensemble des connaissances. Je considère l'alignement (issu du modèle-RCP) comme un principe fondamental lors de l'appropriation, et le juste reflet du degré avec lequel les étudiants collaborent vraiment.

Les étudiants contribuent à élaborer un discours partagé, considérant que les suppositions sous-jacentes à leurs propositions sont connues de tous. En cas de malentendus, l'équipe négocie des significations graduellement, afin de se comprendre et créer une base sémantique commune (processus de grounding).

QUESTIONS DE RECHERCHES

[1] Les étudiants s'approprient-ils le problème posé ? [2] Comment s'approprient-ils le problème individuellement ? [3] Comment s'approprient-ils le problème dans le travail d'équipe ?

Contexte : Les sujets étaient des étudiants dans un cours de travaux pratiques sur l'épidémiologie et la biostatistique.

MÉTHODOLOGIE

Il est difficile d'observer l'appropriation individuelle d'un problème, les étudiants n'exprimant pas chacune de leurs pensées ; des repères de l'appropriation de problèmes (AP) sont mieux constatés dans des configurations d'équipe. J'ai enregistré mes observations en plaçant des dictaphones face à des étudiants volontaires, et ajouté mes commentaires à ma transcription des interactions verbales des étudiants.

Protocole général : *Objectif :* rassembler des données sur l'AP.

Hypothèse : (i) Les étudiants s'approprient le problème individuellement.

(ii) L'appropriation individuelle dans le cadre du travail d'équipe se produit dans des moments de collaboration. (iii) L'appropriation par l'équipe se produit dans des moments de collaboration.

Activité analysée : conception d'un protocole de recherches.

Collecte de données et analyse : enregistrement audio, transcription.

Traces d'activité : enregistrements audio, cahiers de bords, protocoles de recherches.

J'ai choisi une équipe de quatre étudiants afin de conserver une bonne qualité d'enregistrement et d'obtenir un maximum de discussions.

Analyse d'interaction

L'enregistrement audio est difficile à analyser : il peut y avoir du bruit, les étudiants peuvent parler en même temps, et leurs raisonnements peuvent ne pas être linéaires. Le protocole était donc :

Marquage – Par le biais du logiciel ELAN, marquage des transcriptions par un système de mots-clés et d'emboîtement des blocs de conversation.

Codage – Les énoncés ont été codés conformément aux modèles de RCP, SM et APE. Le modèle-RCP utilise trois dimensions codées avec des indicateurs, le modèle-SM comporte un cadre pour comprendre les interactions par le biais d'analyses *a priori* et *a posteriori*. Le modèle-APE utilise cinq indicateurs.

Analyse tripartite – Le corpus fut codifié en trois phases : modèles (a) RCP (b) SM et (c) APE.

ANALYSE DE DONNÉES

L'équipe observée comportait quatre étudiants (Yves, Gaspard, Arnaud et Bruno) et deux tuteurs (Patricia et Laurent). Ce qui suit est ma reconstitution des événements, enrichie de mes commentaires.

Illustration — analyse de l'interaction

Un tuteur a introduit LOE aux étudiants par des instructions générales. Les membres de l'équipe ont lu leur mission et exploré l'environnement informatique. Ils se divisèrent en deux binômes : Yves/Gaspard et Arnaud/Bruno, et alternèrent travail individuel, en binômes et en équipe. Ils coordonnèrent leurs actions pour la résolution de problèmes et improvisèrent un protocole. Douze unités de conversation furent recueillies pour l'analyse.

Illustration de la catégorie « tester » — entre les énoncés 4 et 52, les étudiants ont décodé les messages du tuteur et de l'environnement informatique. Ils ont commencé à construire un discours commun et à articuler l'objet-connaissance « étude de cas-témoins » (ECT), concept élémentaire pour la formulation de l'objectif principal de l'enquête. Les étudiants ont pris différentes positions, Arnaud en particulier introduisant une difficulté (énoncés 6-32). Chaque étudiant produisit une signification différente de l'objet-connaissance et s'est trouvé en désaccord explicite ou implicite, mais juste en opposant des positions, et sans beaucoup de formulations. Les interactions entre pensée-langage et pensée-activité ont produit des changements de signification des mots et de sens de l'activité. Ainsi, l'acte de tester, par l'interaction des mots et du contexte, a mis à leur disposition des significations et du sens— bien que la signification réelle produite ne correspondait pas à la signification formelle attendue. À ce stade, les étudiants manquaient toujours de précision quant aux résultats attendus. Ils semblaient avoir produit une représentation de ce qu'ils devaient faire.

Illustration de la catégorie « anticiper » — pour concevoir leur protocole, les étudiants ont dû définir des objectifs principaux et secondaires. Bien que leurs désaccords aient compliqué leur tâche, ils l'ont improvisée avec des idées générales (énoncés 839, 861, 875). Au cours d'une discussion animée (énoncés 839-922) les étudiants ont remarqué leur non-alignement. La situation les a naturellement contraints de choisir entre études prospectives ou rétrospectives, favorisant ainsi la formulation.

Dans les énoncés 899, 907, 909, 913 et 917, Bruno introduisit une proposition dans le discours commun et produisit une appropriation individuelle par anticipation — une stratégie pour atteindre l'objectif principal et identifier des éléments passibles d'affecter des variables et des résultats. Bruno, en recueillant et reformulant des informations du discours commun, a rendu explicite son modèle implicite. En agissant dans le milieu, il provoqua un processus de grounding qui permit la formation d'une base sémantique commune que l'équipe put s'approprier.

Illustration de la catégorie « accepter » — Gaspard eut des difficultés pour abandonner son modèle implicite. Sa perception de ressemblance avec le réel divergeait de sa perception de la cohérence interne de jeu. Sa réponse fut de briser le contrat didactique et de déclarer l'activité inutile. Pour lui, le jeu n'avait plus de sens par rapport à ses objectifs d'apprentissage, et ses nécessités subjectives n'étaient plus satisfaites. Il devint résistant au jeu (énoncés 1078, 1084, 1086, 1092-1094).

Bruno a soutenu le procédé de production de signification et recentré la situation. Selon le modèle-SM, Gaspard et Bruno étaient dans la position de l'étudiant réflexif, contemplant des objets appris, jugeant et remettant en cause les intentions didactiques de la situation. Le travail d'équipe a contraint le regard à mesure que Bruno s'appuyait sur le contrat didactique pour souligner l'utilité du jeu — celle d'encourager des réflexions sur la conception de protocoles scientifiques.

DISCUSSION

Cette illustration du modèle-APE affina les catégories et la définition d'indicateurs. Pour des raisons méthodologiques, cette étude se concentra sur l'observation du travail d'équipe et l'analyse de l'interaction, alors que les questions de recherches concernaient le rapport dialectique entre l'AP individuelle et collective, et les procédés de l'appropriation individuelle et collective.

Appropriation individuelle de problèmes : Les problèmes sont appropriés dans des contextes définis et changeants. La production de significations et leur utilisation pratique sont graduellement combinées dans une activité dialogique langagière.

Dans les situations didactiques, le processus d'APE a lieu par le biais de l'interaction étudiant-milieu. Les individus s'approprient un problème en transformant l'objet cible proposé par le milieu matériel. Ils emploient leurs propres modèles pour y accéder et construire des objets-connaissance.

Appropriation collective de problèmes : Lors d'un apprentissage en équipe, les décisions sont généralement discutées. Les désaccords mènent à la formulation de modèles internes ; les étudiants expriment des significations et partagent leurs nécessités subjectives provoquant alors l'apparition d'inadéquations dans les actions internes de l'équipe. Les processus de grounding comblent ces écarts, permettent aux membres de l'équipe de s'aligner et soutiennent l'appropriation collective par le biais du partage d'une base sémantique commune.

Appropriation individuelle et collective : L'appropriation, par définition acte privé, se produit aux niveaux individuel et collectif. C'est la co-construction et la co-argumentation qui déterminent ce qui contribue à l'appropriation collective ou à des processus de grounding pour produire une base sémantique. À mesure que l'équipe va dans cette direction, les étudiants partagent des significations et des sens développés individuellement. Réciproquement, dans le mouvement de l'appropriation collective vers l'individuelle, le discours collaboratif ajoute de nouveaux éléments à la connaissance individuelle.

Structuration du milieu & appropriation de problèmes : Les situations de référence et les situations didactiques d'apprentissage mènent les individus à formuler des modèles implicites et à négocier des significations avec des leurs co-équipiers, encourageant l'appropriation collective.

Alignement : Les étudiants alignés partagent la même base, car ils se sont approprié le même problème ou ont achevé un processus de grounding. Le travail d'équipe fournit une zone dans laquelle les stratégies sont partagées et négociées. Les discussions aident les étudiants à permuter l'information requise pour l'appropriation individuelle, ce qui favorise alternativement l'appropriation collective. Les chercheurs peuvent observer l'AP pendant ces processus, et déterminer si les étudiants se sont collectivement appropriés un problème similaire ou différent.

CONCLUSION

Cette illustration du modèle-APE affiche des comportements d'appropriation à mesure que les étudiants construisent des objets-connaissance. Les comportements observés concernent les catégories « Accepter », « Tester » et « Anticiper ». Cette analyse est assistée par trois modèles : RCP, SM et APE.

Les étudiants doivent recueillir des informations pour s'approprier des objets et leur donner un sens bien à eux. Ces contenus personnels sont échangés et discutés dans le cadre des travaux d'équipe et mes analyses montrent comment les catégories du modèle-APE réfléchissent ceci. Si certaines catégories n'ont pu être observées, pour des questions de temps ou autres, la situation a toutefois fourni une source riche en comportements.

Tous ces processus ont lieu dans le cadre d'une situation didactique dans laquelle un problème complexe est dévolu aux étudiants. L'utilisation judicieuse de l'ingénierie didactique, par exemple dans un jeu sérieux, peut offrir à des étudiants des compétences essentielles par le moyen d'une expérience authentique.

An illustration of Problem Appropriation

4.1- Introduction

In Chapter 3, I presented a study analysing students' role appropriation in a context of immersion in a serious game addressing the aspect of the activities of an epidemiologist, and therefore addressing one facet of the simulation. In Chapter 4, I introduce the students' appropriation of a problem, addressing the other facet of the simulation proposed in LoE. Here, I illustrate the students' problem appropriation by applying the SPA model introduced in Chapter 1 to an illustration, adapting it to a teamwork context, and then analysing the data collected. By doing so, I intend to highlight appropriation phenomena through students' interaction among themselves and the technology. The technology provides a stable influence on the individual and teamwork but the individual and group actions are the essence of the learning process. From a constructivist perspective, students' actions and thoughts may be shaped by the technology, but the meaning and the effects of the technology are shaped by the students' actions (Overdijk et al. 2006).

4.1.1-Appropriation

In the last topic of the Introduction chapter, I present the a priori analysis of the milieu proposed by Margolinas from levels -3 to level 1. This structuration of the milieu provides the analytical framework by establishing the frames of the situation, to preview different moments and different types of relationships the agent (student) establishes with the milieu in a didactical situation. A model of student problem appropriation adds a layer involving the agent in this structuration. While agents interact with different milieus (Material, Objective, Reference, Learning and Didactic), acting and receiving feedback from the milieu through different situations (Objective, Reference, Adidactical, Didactical and Project Situation), a process of problem appropriation takes place. Whilst appropriation concerns individuals and their own interactions with an object, students are also working in a team and will have to overcome their individuality in order to achieve objectives together, and perform collaborative problem solving.

Appropriation as meaning making

As mentioned in Chapter 1, language is the basis of appropriation and an essential tool in meaning making. Everything starts with the appropriation of words, because words are tools used to express concepts and ideas in a discourse. According to Bakhtin (1981), words are charged and contextualised by individual intentions, which presupposes then a constant opposition of intentions belonging to one's own words and belonging to the others' words. This dialectic between individual appropriation and others' appropriation is emphasised in the present illustration. I observe this struggle between one's own words and others' words in the context of teamwork.

Appropriation in collaborative teamwork

Baker (2002) proposes a Cooperative Problem-solving model (CPS) providing a description of students' interactions that helps to understand the development of students' appropriation as they cooperate. The comprehension of students' problem appropriation on a cooperative problem-solving activity will permit the development of a Students' Problem Appropriation model (SPA).

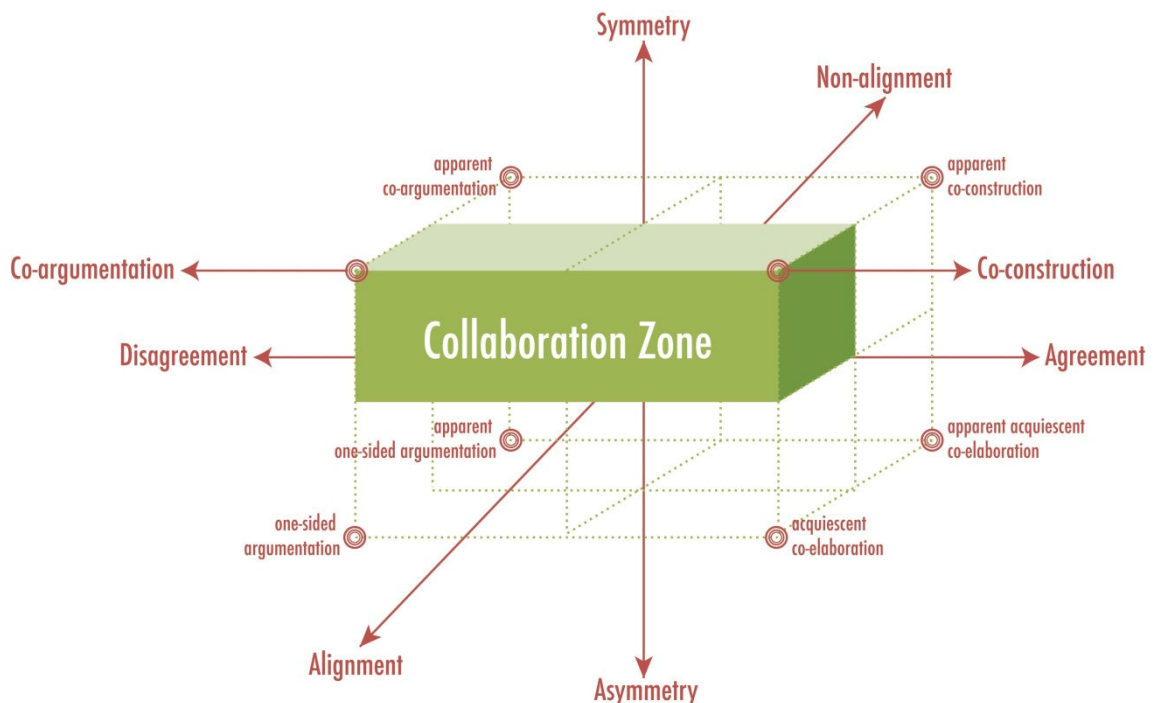
Furthermore, Baker (2002) proposes a tool for interaction analysis in learning situations, conceptualising properties inherent in the dialogue analysis. I use the author's CPS model to analyse students' interactions while they appropriate the problem. I postulate that there is group appropriation when there is collaboration, following Baker's model. I consider that appropriation happens in groups when there is co-construction and co-argumentation (see Graphic 4.1) among peers.

One very important problem students have to solve during the first sessions is the definition of their study question. In other words, they need to establish the context and perspective under which they will investigate disease in hospitals. The definition of this question guides students through the first 3 sessions. We expect this definition to evolve with time, and this evolution is determined by appropriation.

As Bakhtin (1981) notes, we expect to see a tension between dynamics of the individual (internal forces) and the group (external forces) in the interactions that

are going to determine the research problem, and thus appropriation of the problem.

Baker (2002) says that “in a cooperative problem-solving situation, the participants must each attempt to achieve two tasks: problem-solving, and cooperating – in problem-solving”. Students have to interact in order to communicate, which means they have to achieve mutual understanding, mutual knowledge, mutual agreement so they can finally achieve cooperation (in defining the research objective, in the present case). According to the author, three fundamental dimensions can describe this activity: symmetry, alignment, and agreement (see Graphic 4.1).



Graphic 4.1. Baker’s (2002) three fundamental dimensions of cooperation activities and subsequent eight basic forms of cooperation in cooperative problem-solving activities.

Next I describe specifically the dimension Alignment which I consider to be closely connected to appropriation phenomena. Details about the other dimensions of collaborative problem-solving model are introduced in section 4.3.2.2 (b.1.1).

Alignment

According to Baker (2002), problem-solving “can be viewed as the process of constructing a representation of the problem to be solved, applying operators to the representation in order to explore a space of possible solutions, using heuristic choice, and verifying the solution to check that the problem-solving goal is

achieved”. In this context, the dimension of alignment “captures the extent to which participants are genuinely working together”. To be aligned (Figure 4.1), students must share the same phase of the activity (moment of the activity and/or the same objectives) and the same ground.

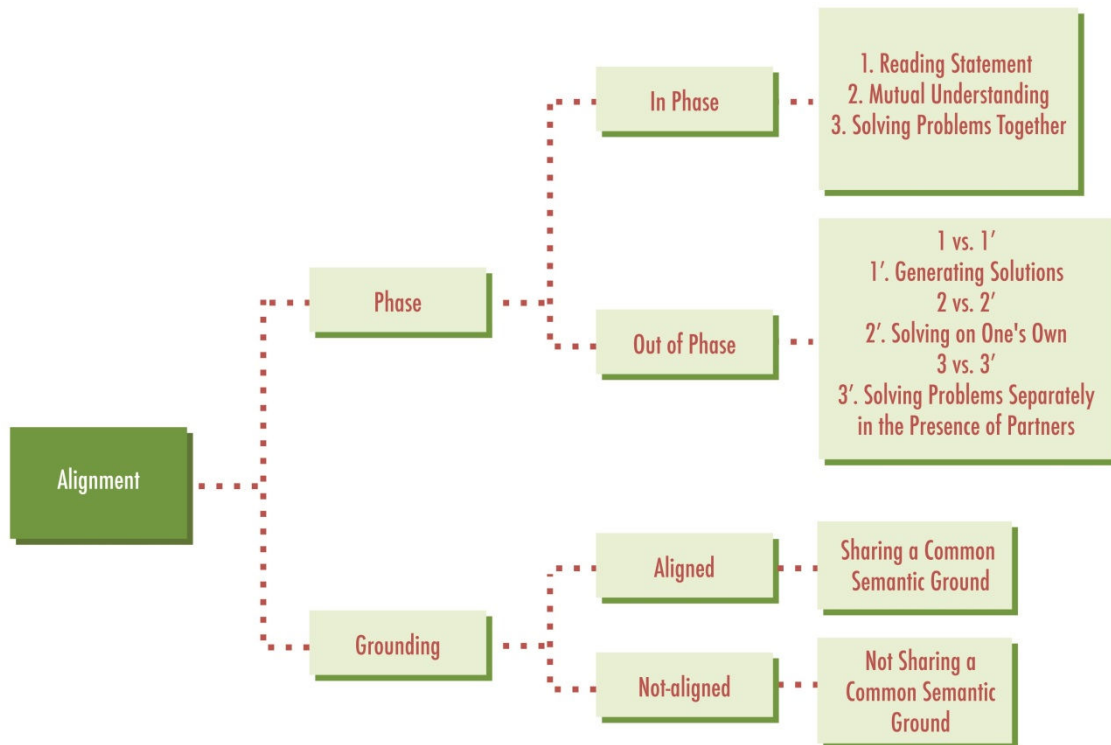


Table 4.1. Aspects of the alignment dimension according to Baker’s CPS model.

In the dimension of Alignment, element Grounding is strongly connected to the problem appropriation phenomena, in the following I get into more details. For more details about the Alignment dimension as a whole, section 4.3.2.2 (b.1.1).

Grounding

In a **cooperative problem-solving** situation, students take part in a conversation aiming to contribute to a **discourse**. The discourse in this case “is a sequence of **utterances** produced as the participants proceed **turn by turn**” (Clark & Schaffer, 1989). There is the **accumulation of propositions** uttered by participants in the course of a discourse. These propositions are accepted or not by other participants, and imply **presuppositions**. According to Stalnaker (1978), speakers’ presuppositions “are propositions whose truth [they take] for granted as part of the background of the conversation. ... Presuppositions are what is taken by the speaker to be the **common ground** of the participants in the conversation, what is treated as their **common knowledge** or **mutual knowledge**”. The common

ground accumulates in the discourse, but it does not happen automatically. According to Clark & Schaffer (1989), sometimes there are misunderstandings in terms of these presuppositions. Therefore, both speaker and other participants will try “to establish a mutual belief that [they have] understood what [the speaker] meant to a criterion sufficient for current purposes”. The authors name this process in which participants gradually believe they understand what the contributor meant **Grounding**. Consequently, grounding “enables common ground to accumulate in an orderly way” (Clark & Schaffer, 1989).

4.2 – Research Question

LoE was designed to offer students a gaming situation in which a problem was immersed. Aspects of role-playing were discussed in the previous chapter. In addition to the role appropriated, students appropriate a problem and work in groups in order to solve this problem. Appropriation was defined and characterised in Chapter 1. The research question in this chapter concerns the dialectics between the individual and the group, and how appropriation occurs in such a context.

- I - Do students appropriate the problem posed?
- II - How do they appropriate the problem individually?
- III - How do they appropriate the problem in teamwork?

4.3-Experiment

In order to answer the above-mentioned research questions (4.2 – Research Question), I selected the first session of the eight practical classes. In terms of serious gaming, these classes concern actions 1, 2, and 3 from Figure 3.3 in Chapter 3 (p. 140). In terms of didactical objectives, these sessions concern appropriation of the problems mentioned above in the student’s problem analysis.

In this section, I shall introduce an analysis of the potential factors that inform of problem appropriation, the implementation of the computer environment for this purpose, and the methodology for data collection and analysis adopted for the case I illustrate.

4.3.1-Analysis of the potential factors of the problem appropriation

Several factors from the didactical situation in which LoE situates are liable to facilitate appropriation. Essentially, these factors find support from the LoE IT environment, the tutor, and the students' team.

4.3.1.1. The IT environment

The IT environment contributes to problem appropriation by contextualising sources of information and sources of assessment.

a. Sources of Information:

The main sources of information for the first session are the Public Health Commission, the Library, and the Medical Information Department.

The Public Health Commission provides the text of the mission, the job journal, and a video of a board meeting of the commission.

The Library provides a bibliographic resource about thromboembolic (TED) disease and a statistical tool for measuring the number of individuals necessary for a prognostic survey.

The Medical Information Department provides a list of risk factors of thromboembolic disease (TED) likely to help students in defining study questions and objectives, as well as a protocol template providing some hints likely to assist students in developing their survey and organising it in different steps.

b. Sources of assessment:

The main sources of assessment are the Ethics Committee and the Medical Departments in the hospitals.

The Ethics Committee's experts assess the students' protocol.

4.3.1.2. Tutor's support

In the class or through the LoE forum in the Library, the tutor, who is a research expert consultant, supports the student team, which plays the role of a group of investigators.

4.3.1.3. Student team support

Another factor in problem appropriation is the student team itself. Students find support from other students' knowledge. I shall go into the details of this kind of support in the analysis of the case-study in section 4.4.

4.3.2-Methodology for data collection and analysis

Observing students' problem appropriation is a challenge. One cannot directly observe students' individual problem appropriation because individuals simply do not usually verbalise every thought, their private and personal experience, during this process. Asking students to formulate every thought they have during this process would be one way of identifying appropriation markers but it would not be natural or spontaneous and obviously require a high cognitive load.

An interesting way of observing markers of problem appropriation is to observe students working in teams. While working in teams, students exchange ideas and by doing so they formulate the content they have appropriated. The advantage is that these utterances can be obtained naturally while students debate. In addition, these utterances are obtained in the context of a didactical situation and can be linked to activity tracks. Therefore, recording students' interactions in an ecological situation while they naturally discuss issues while solving a problem is one very instructive way of observing problem appropriation.

Students are introduced to the Technology Enhanced Learning research (this study) by an information letter (each student is given one copy) and by a brief presentation from one researcher. Students are invited to participate as volunteers and are given some time to decide as they form their teams whether they wish to participate or not.

The volunteers have a digital recorder placed on their desktop. The audio recordings can produce a rich audio corpus with detailed information about students' interactions and can be transcribed with all the advantages of recorded material. These advantages are for instance the possibility for researchers to play the situation back and forth, replay it, select interesting moments, transcribe it, compare different moments of interaction, and reconstruct the path that led students to problem appropriation. Another advantage is it is weakly intrusive; if

students give their agreement to participate in the experiment, once students are engaged in serious discussion, the presence of the recorder tends to be easily forgotten and the students act naturally.

General protocol for “problem appropriation” data collection campaign

Objective: Collect data on problem appropriation

Questions:

- I-Do students appropriate the problem individually or in groups?
- II-How do they appropriate the problem individually?
- III-How do they appropriate the problem in a group?

Work Hypothesis:

Students appropriate the problem individually.

Individual appropriation in teamwork contexts happens when students are in a collaboration zone, when they are aligned.

There is team appropriation in this collaboration zone.

Activity:

1-Students design a research protocol.

Data collection and observation: The collection of data and observation take place mainly asynchronously. Students' interactions are audio-recorded during the session and later transcribed and analysed.

Track system: Observation of activity tracks is done through audio recording and in this case, students' job journals and the research protocol.

Table 4.2. Data collection protocol.

4.3.2.1. Data Collection

I selected 1 team of 4 students for the qualitative analysis. This analysis illustrated the model for problem appropriation I introduced in Chapter 1. Criteria for this choice were based in the quality of the audio material collected and on the quality of the students' interactions.

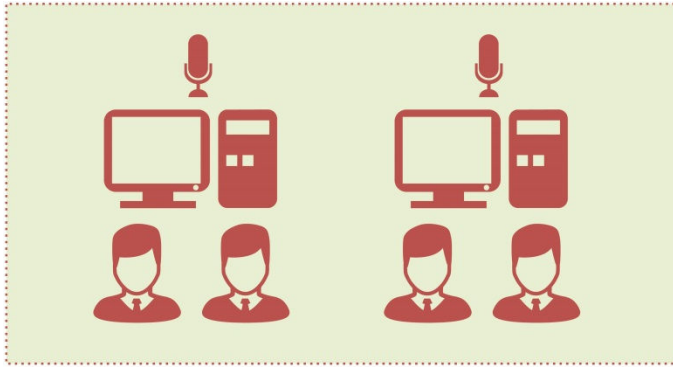


Figure 4.1. Representation of students' desktop and arrangement of the team and recorders.

Indeed, to observe students' appropriation, I needed groups in which students produced as much debate as they could in order to manifest their problem appropriation. Audio recorders were placed over students' desktops or sellotaped to the computer monitors. Since students were about 28 in the classes. It was usually very noisy so it was important that students would also naturally speak up in their teams during the audio collection. To have a fair idea of students' interactions, I placed two audio recorders per team; since they tended naturally to alternate teamwork, pair work and individual work (the class local environment also induced this choice since students usually have two screens available per team). Audio recordings collected are synchronised and analysed with the software Elan (<http://www.latmpi.eu/tools/elan/>) – a professional tool for the creation of complex annotations on video and audio resources.

Next, I proposed a protocol for analysis of individual appropriation and team appropriation using the softer Elan.

4.3.2.2. Protocol for interaction analysis

Analysing audio interactions is a difficult task. In the recordings, there are four students working on an assignment, overlapping each other's utterances, in a noisy environment, among 25 other students. In the development of their activities, students do not follow linear reasoning but instead they change activities, change opinions about objects, and sometimes they even contradict themselves without realising it. Therefore, it is important to have a global idea of the students' recorded session before starting to analyse it. Here I present the steps I followed to analyse student interactions through ELAN.

a. Marking

While listening to the recordings through ELAN, I marked the moments when keywords I estimated to be important were uttered. Words like “prospective”, “retrospective”, “case-control”, “cohort”, “main objective” etc. (Figure 4.4).

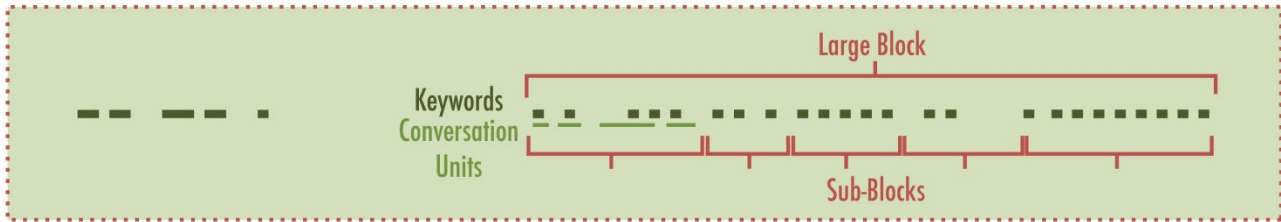


Figure 4.2. Representation of the disposition of keywords and the marking of blocks and discussions.

After marking the uttered keywords, it was possible to mark large blocks, in which such keywords were recurring. A large block is a longer length of time concentrating on uttered keywords. It can take up to 20 minutes. Inside large blocks, there are sub-blocks representing different activities the team develops such as designing a protocol or debate over a definition of a type of study. It can take from 2 to 8 minutes. Inside sub-blocks, there are discussions or conversation units on different subjects. Conversation units are composed by utterances exchanged by individuals and can go from 2 utterances like question and answer, up to 32 utterances in a lively debate. The transcription of utterances takes place during the marking of the sub-blocks. A transcription in a four-student debate is a challenge. It is important to know who is speaking and the speaker must speak close to the recorder. Since students are aligned side by side on their desktop (Figure 4.3), it is important to have their disposition mapped in order to be able to situate the speaker in the space during the listening of the recording files. Another important issue is to know to whom the speaker is addressing the utterance.

b. Coding

The coding of students’ utterances finds support in the models introduced in the present work, which are the structuration of the milieu (Margolinas, 2004), the Cooperative Problem Solving model (Baker, 2002) and the model for Students’ Problem Appropriation introduced in the first chapter.

b.1 Cooperative Problem Solving Model – CPS

The CPS consists of 3 fundamental dimensions: symmetry, agreement, and alignment. Each of these 3 dimensions must be separately coded (in the respective order presented above). The symmetry is coded according to students’ “role”, the

agreement according to the type of "feedback", and the alignment according to the "phase" and "grounding".

b.1.1 CPS indicators

Role: Proposer, Reactor and Proposer & Reactor

Two elementary roles characterise this dimension: the "Proposer" (the one who states a partial proposition for problem solving) and the "Reactor" (the one who reacts to the partial proposition). Thus, in a sequence of interactions among students aiming to solve a problem, every statement is coded proposition or reaction. Sometimes the statement can be at once a reaction to a previous student's proposition and a complementary proposition, in this case the utterance is coded "Proposer & Reactor".

Agreement: Feedbacks (positive-implicit, positive-explicit, negative-implicit and negative-explicit).

The agreement dimension is characterised by two kinds of feedback: Positive and Negative. Each one of these feedbacks manifests implicitly or explicitly. The content of the student's utterance is coded in terms of role (proposer/reactor) and carries feedback to previous propositions. A positive-implicit feedback is an utterance complementing a previous one. Its meaning is similar and demonstrates implicitly that students agree with their peers. A positive-explicit feedback is a positive reaction to a previous proposition demonstrated explicitly (for instance "Yes, it's definitely true"). A negative-implicit feedback is an utterance denying a previous one by asserting the opposite without a negative form. A negative-explicit feedback is a negative reaction to a previous proposition demonstrated explicitly (for instance "No. No way").

Alignment: Phase (In phase, Out of phase); Grounding (Aligned, Not-aligned)

The alignment dimension is characterised by the students' phase in the activity of problem solving and students' grounding in terms of common semantic basis and mutual knowledge. *The phase*: One of the prerequisites of being in alignment is to be "in phase", which means performing the same activity, the same moment of the activity or sharing the same objectives in the performed activity. Not sharing the same objectives, or not performing the same part of an activity for instance, is to be

“out of phase” and therefore not in alignment. *The ground*: another prerequisite of being in alignment is “grounding”, which means sharing a common semantic basis. Students are “aligned” when they share the same ground and mutual knowledge, and they are “not aligned” when they do not share a common semantic and knowledge basis.

Differently from the role and agreement dimensions that code single utterances, alignment codes units of discourse presenting possibly various turns of participants’ propositions and reactions. It classifies units of discourse in terms of markers – “in phase” or “out of phase” and “aligned” or “not-aligned” – determining whether students are genuinely working together. Alignment is an important dimension in teamwork to observe individual and collective appropriation; therefore, special attention is paid to the propositions in a grounding process.

b2. Structuration of the Milieu – SM

The CPS model offers a framework for the analysis of interaction and unveils the students’ knowledge sharing in terms of grounding. The structuration of the milieu offers a frame for understanding the interaction student-milieu and knowledge building.

The *a priori* analysis models the different types of interaction the student establishes with the milieu forming different situations. Based on didactical engineering, it describes how “knowledge of reference” is devolved to students by the interactions they establish with the milieu.

The *a posteriori* analysis supports comprehension of the learning produced and articulated by students during their interaction with the milieu.

In terms of students’ interaction analysis, the milieu students are interacting with is a common discourse they are building collaboratively. While building the common discourse, students bring elements of information gathered and produced through the computer interface, the protocol they are drafting in a sheet of paper, previous utterances from the common discourse (students’ and tutors’ utterances), previous notes taken in other classes and the knowledge they have available at the moment.

By considering students’ utterances in the interaction analysis, it is possible to:

- Understand the types of interactions (S-3, S-2, S-1, S0, S1) they are establishing with the milieu (common discourse),
- Identify which agent (E-3, E-2, E-1, E0, E1) students are vesting,
- Identify which milieu they are interacting with (M, M-3, M-2, M-1, M0)
- Maintain a reference of what they are expected to learn and what they actually build and articulate

b3. Students' Problem Appropriation Model – SPA

The model for SPA consists of five indicators introduced in Chapter 1: to Accept, to Test, to Make Choices, to Anticipate and to Master. The indicators are behaviours students manifest in the process in which they appropriate a problem. The analyses of conversation units identify characteristics of such behaviours in the students' utterances.

b.3.1 SPA indicators

The indicator to **accept** concerns the didactical contract and manifests in the students' intention to invest in the problem solving.

The indicator to **test** concerns the students' action in the milieu without a clear expectation of what it is possible to obtain by such actions. It is an action motivated by the desire to explore, to discover, or to find out what happens.

The indicator to **make choices** concerns the actions students perform while being conscious of other possibilities to perform a given activity but still without having a clear idea of the results of such actions. When they make a choice, their intention is to spot the result of a specific action among others.

The indicator to **anticipate** concerns the students' action in the milieu conscious of the possibilities of action and the possibilities of results. Students are able to elaborate on the hypothesis and evaluate the impact of their choices.

The indicator to **Master** concerns the students' ability to identify intuitively different groups of problems having common characteristics and strategies of problem solving in different situations.

When students propose a new element to the team, they introduce the element into a common discourse they build collaboratively. Such common discourse is the milieu students interact with and is composed in their own words and the words of

others. The words from the common discourse are tools students use to build and articulate knowledge-objects.

c. Analysing with the models (CPS, SM and SPA)

The coding of the interaction corpus proceeds in three moments. First, by applying the CPS model, I analyse the discourse units separately, highlight the state of students' alignment and reach the students' common discourse. Second, by applying the SM model to the common discourse I identify the agent student characteristics as well as the knowledge being built and articulated. Finally, by applying the SPA model, I identify the behaviours underlying the students' problem appropriation. Then it is possible to identify moments in which students manifest their conceptual points of view. Their perceptions expressed in their utterances offer elements to identify indicators of individual appropriation and group appropriation.

4.4-Data Analysis

The data analysis concerns the study of one case and provides a qualitative description illustrating the SPA model. In the next section, I present the analysis of a corpus of audio transcriptions to illustrate the methodology and support the discussion on the development of the SPA model.

The data collected belongs to the 2010 data collecting campaign and comes from the first session of the Biostatistics Practical Class illustrated in Figure 4.5. The session time takes 4 hours from 14 o'clock to 18 o'clock. The recording starts at 14 hours and 53 minutes and finishes at 17 hours and 51 minutes when the student team leaves the room (recording time). The whole audio file takes 2 hours and 58 minutes (178 minutes). The extract selected for this study (extract time) starts at minute one of the audio recording and takes 1 hour and 41 minutes and 26 seconds (108 minutes).

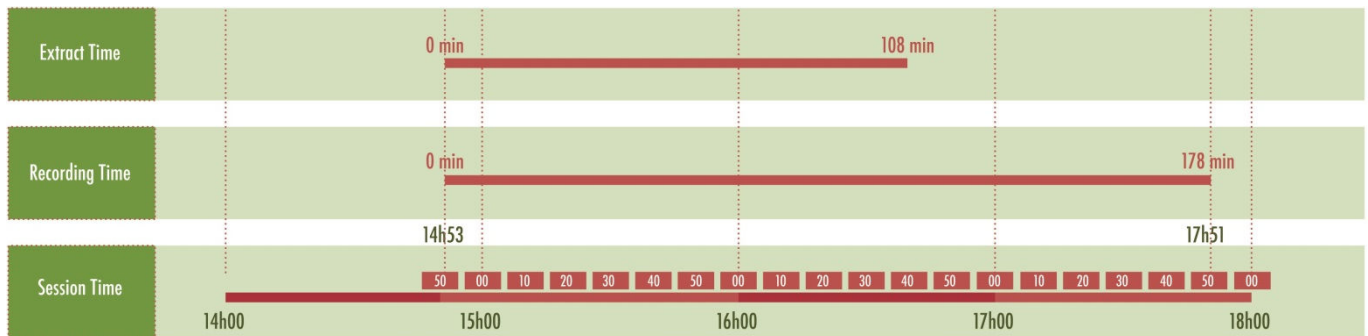


Figure 4.3. Timeline of the extract used for the case study.

The transcription of students' interactions from this extract of audio file composes a corpus of about 1194 utterances stated by students and tutors. The whole corpus is in Appendix V p. 284. These utterances form conversation units going from two utterances between two individuals to several utterances involving up to five individuals.

The observed team is composed of 4 students hereby named Yves, Gaspard, Arnaud and Bruno (Figure 4.5) and two tutors named Patricia and Laurent. For privacy reasons the names presented in this study are fictitious and any profane language is censored by asterisks followed by a statement between square brackets explaining what the individual really intended to say in non-profane language.

In this section, I reconstruct the students' situation punctuating it and illustrating individual and team appropriation.

4.4.1- Illustration – Interaction Analysis

In the first 50 minutes of class, students are introduced briefly to LoE by the tutor who gives them some general instructions. They are also introduced to the technology enhanced learning research and invited to participate as volunteers. They are asked to organise themselves in teams of three or four students. They register the team in the LoE webpage filling in a form with their respective first names, last names and a cell phone number. They receive an SMS message from LoE containing their personal password (each student is given a password).



Figure 4.4. LOE carousel desktop

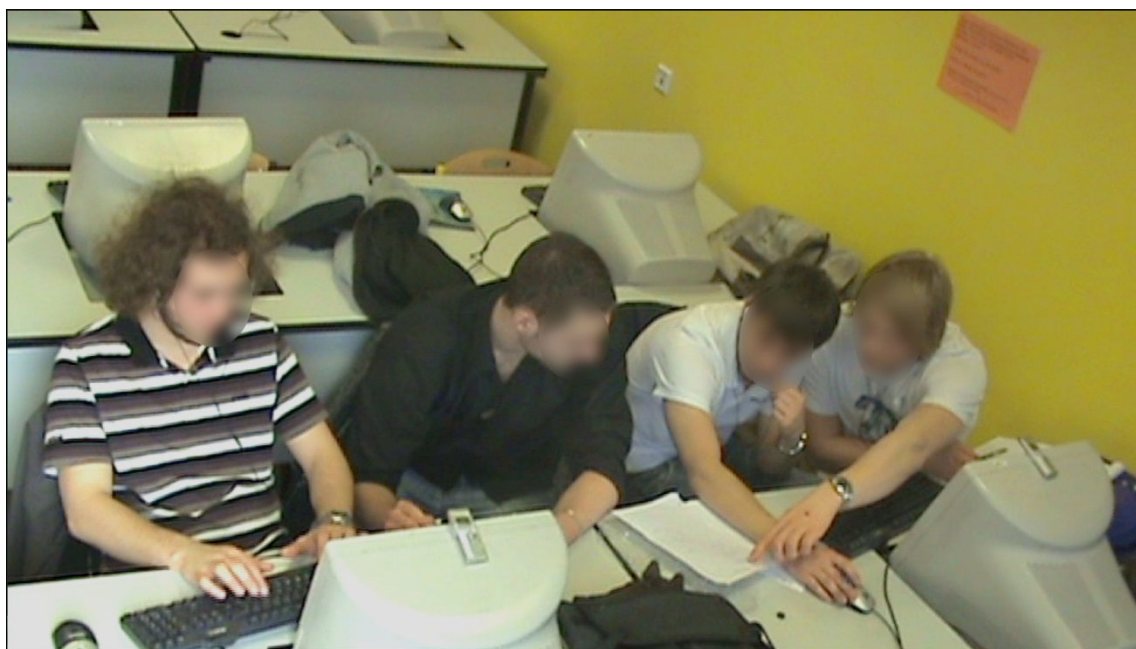


Figure 4.5. Teamwork in the first session.

Before the login page, the team reads the text proposed by the Public Health Commission giving some brief instructions. They login and access the LoE Desktop for the first time and a carousel (Figure 4.4) of images presents the Health Commission, the Ethics Committee, the Library webpage and the various hospitals.

For instance, the team observed in the present illustration explores the environment by clicking on the different pictures of a carousel and decides to read the details of the text from the public health commission webpage. Here, among different information, a video of a board meeting is proposed and they decide to watch this 8-minute video. After watching the video, the team volunteers to participate in the technology-enhanced learning research.

The team has two computers juxtaposed over a desktop and naturally split into two pairs, Yves and Gaspard (pair one) on one computer and Arnaud and Bruno (pair two) on the other computer. During the whole class, the team alternates between moments of work in pairs and open discussion among three or four individuals.

In this first 6 minutes, I identify a subject that will constitute a difficulty for students and will periodically come up in discussions during the 108-minute extract. The subject is the study design they chose for their survey. According to the problem analysis (Chapter 2, section 2.3.5.1), students try to answer intuitively the question “Why”, defining the main objective of the mission, their “study question”. When they start to discuss their design study, they are trying to answer the question “How”; in other words, how they intend to proceed with their study. The difficulties concerning answering “How” include the study design (the way they will investigate the causes of a disease), the rationale (to state some evidence of the interest in conducting such a survey), and general methodology (the way they intend to collect data and its quality control).

I selected every conversation unit (see Section 4.3.2.2-A.) presenting the following keywords: case-control, “exposed-non-exposed”¹, cohort, cross-sectional, prospective, and retrospective. I also checked the other conversation units in which the given keywords were not present to ensure that similar discussions had not taken place with the same subjects without mentioning the keywords. As a result, I selected about 12 conversation units for the interactional analysis.

¹ Exposé non-exposé: French term to designate cohort or prospective studies.

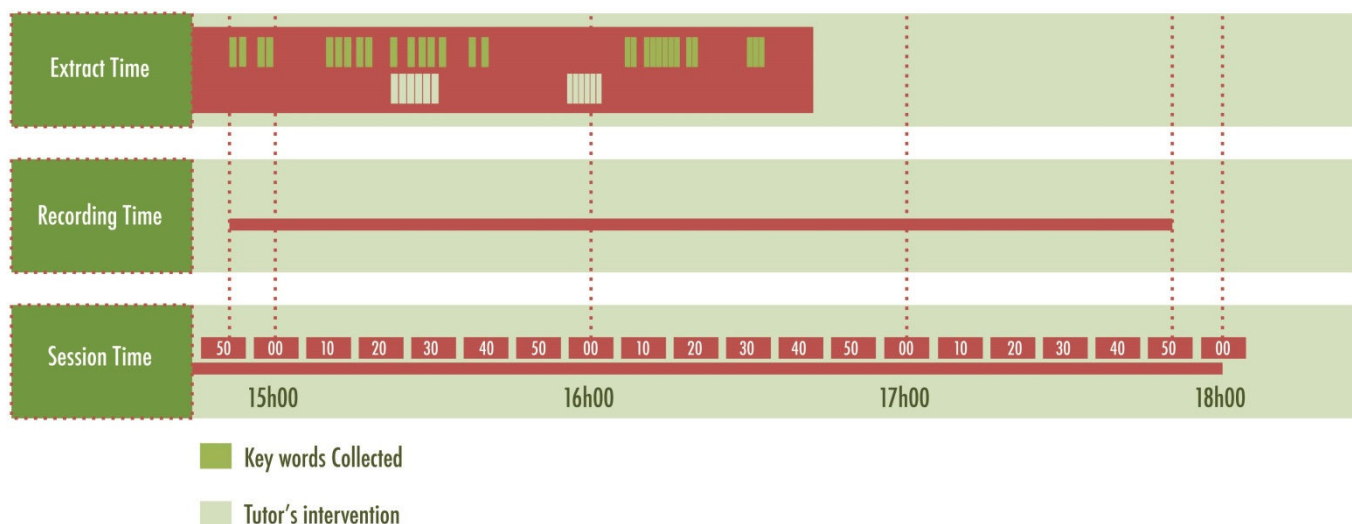


Figure 4.6. Zoom over the timeline of the extract and representation inside the “extract time” of the annotation of the design study related keywords and tutors’ interventions.

Utterances 5 through 85

When the recording starts, students have already had a first glimpse of the mission and formulated an idea of what they are supposed to do. Then, from utterance 5 until utterance 85 (about 6 minutes – see Appendix V, pp. 278-280), students coordinate their actions listing what they have to do and what decisions they have to make in order to solve the problem proposed. Students have not visibly drawn a schedule yet. They act unaware that they have to design a research protocol; however, they start improvising one with their own means.

4.4.1.1. Extract 1 – Illustration of Appropriation by Test

The present extract is a sub-block containing 4 conversation units, from utterance 6 until utterance 52. Here, students decode the message contained in the teacher’s assignment and in the IT environment (see Chapter 2, Table 2.2). They do not have the whole picture yet; besides this is one of the objectives of the first session, that is, having students discover their mission and plan a schedule for the next sessions.

In the first utterances (1 to 38), students work on the construction of a common discourse. They build, select, and articulate knowledge-objects for a given purpose, especially the knowledge-object “case-control study”. This is an elementary concept to be considered for the formulation of the main objective, which in turn is a fundamental element in a research protocol.

Arnaud plays the role of the spokesperson and tests keywords I assumed to come from the material available in the IT environment, such as texts and videos, previous Biostatics or Epidemiology sessions, and utterances from the tutor and team workers before the recording time.

Conversation Unit 1 (utts. 6 - 19)

[...] 6	Arnaud	so, number one is 'prevalence', and number two is 'finding specific and sensitive signs', okay?
7 [...]	Arnaud	I think that this [hesitation] this is kind of about the objective [pause] this is a thing for every...well, it's something that concerns the principal objective of 'finding specific and sensitive signs' [reads what is written in his notebook] Do you agree?
9 [...]	Arnaud	with a good definition of the symptoms
13	Arnaud	and classify the patients according to the symptoms...
14	Arnaud	thirdly, we need to involve the context and risk factors in some way we need to compare either the criterion, in terms of the surgery or the risk factors, I mean like in surgery involving elderly people.
15 [...]	Arnaud	what else about elderly people? [writes something down] there's also tromboprophylaxis, okay? thrombo - pro - phy - laxis. [writes again] Okay?
17 [...]	Arnaud	Cancers... [writes]
19 [...]	Arnaud	For item number four, we're going also to use the differential diagnostic framework.

Conversation Unit 2 (utts. 15 - 32)

[...] 15	Arnaud	what else about elderly people? [writes something down] there's also tromboprophylaxis, okay? Thrombo - pro - phy - laxis [writes again] Okay?
16	Bruno	there are cancers, leukaemia, myeloproliferative disorders, bulimia, we've got the whole package
17	Arnaud	cancers... [writes]
18 [...]	Bruno	inflammatory disease, medicines, cardiovascular diseases, venous insufficiency, obesity, stress
29 [...]	Arnaud	well, to be honest, I'm just saying ***** [vulgar term to say stupidity] you see, if you make it like, for instance, if you've done surgery before, then you get a score of five points, and if you haven't you get zero points, then, you see, as your score raises, so do your risks.
30	Bruno	Yes but actually, it depends on the risk factors
31 [...]	Arnaud	sure, you're right about that
[...] 32 [...]	Arnaud	now, concerning the differential diagnosis... [reads his notes in a notebook] 'You need to look at prevalence, in terms of the best semiotics, risk factors, general population, cancer, surgery, etc...how many patients...[reading of his notes on the notebook]methodology...a lot of requests as usual'. [mumbles as he reads] 'Case-control studies...prospective cohort at the patients on arrival'. So, what we're going to design, we...we're going to design a study...a case-control study? You agree?

Conversation Unit 3 (utts. 27 - 37)

27	Arnaud	Now, the tutor also told us that the objective is to design an exam request containing some key questions according to rank, right? Or, alternatively, a score with the risk factors' accumulated values, if you know what I mean. Which means we would take, you know, different scores for a risk factor and additionally the fact...for instance, you know, for individuals under the age of fifty years we give them zero points, over the age of fifty, we then add one point, you see
28	Yves	Yeah, yeah, yeah, all right. [agrees impatiently]
29	Arnaud	Well, to be honest, I'm just saying ***** [vulgar term to say stupidity] you see, if you make it like, for instance, if you've done surgery before, then you get a score of five points, and if you haven't you get zero points, then, you see, as your score raises, so do your risks.
30	Bruno	Yes but actually, it depends on the risk factors.
31	Arnaud	Sure, you're right about that.
32	Arnaud	Now, concerning the differential diagnosis... [reads his notes in a notebook] 'You need to look at prevalence, in terms of the best semiotics, risk factors, general population, cancer, surgery, etc...how many patients...[reading of his notes on the notebook]methodology...a lot of requests as usual'. [mumbles as he reads] 'Case-control studies...prospective cohort at the patients on arrival'. So, what we're going to design, we...we're going to design a study...a case-control study? You agree?
33	Yves	Okay.

34	Arnaud	Case-controls. [writes on a sheet of paper]. A case-control study. [writes again] Well, do you follow? Here we have to find which ones will be cases and which are controls.
35	Bruno	Hmm?
36	Arnaud	We have to find out which ones will be cases and which are controls.
37	Bruno	Well, the cases are thromboembolic...

Conversation Unit 4 (utts. 38 - 52)

38	Arnaud	Yeah but, where should we find them?
39	Gaspard	You'll definitely find them in hospital departments.
40	Bruno	Okay, but this is a prospective study.
41	Arnaud	It is prospective.
42	Yves	But before all of that, which department should we select? Because there's surgery, cancer research, he (Arnaud) mentioned elderly subjects!
43	Gaspard	Hmm? What?
44	Yves	So, do we need these three, the ones you were talking about?
45	Arnaud	Yeah, I said we can certainly consider the emergency, surgery, and medicine (departments).
46	Gaspard	Yeah, that's it! Another reason why we should check before at the emergency department.
47	Bruno	In the prospective studies, don't you usually define the categories according to risk factor? (makes doubtful expression toward Gaspard)
48	Gaspard	No, but what wouldn't be a bad idea would be to check among different hospital centres, as to whether there are differences or not, or at least different departments.
49	Arnaud	Yes, but first we have to finalise the methodology in order to know what we are going to do.
50	Gaspard	For sure! We're doing a multi-centric study in order to...
51	Bruno	But do we have any data collected? (again makes doubtful expression toward Gaspard)
52	Gaspard	I think it's needed... (inaudible)

Conversation Unit 1 (utts. 6-19)

SM model (utts. 6-19)

In his propositions, Arnaud is awkwardly trying to give a purpose to these knowledge-objects, the one of “defining a main objective” (utt. 7). He is almost entering a situation of reference. His purpose is not very clear (utt. 7); up to utterance 19, Arnaud and Bruno only introduce keywords or “codes” in their common discourse without formulating their meaning. Students work on the research methodology by listing elements. They do not formulate the content underlying the codes but they are apparently aiming to attain the formulation of a “main objective” (see Chapter 2, section 2.3.5).

The team is trying to give a form to a descriptive study, especially Arnaud, who is the one who externalises his thoughts (utts. 6, 7, 9, 13, 14, 15, and 19). They are supposed to design a protocol, but they will not realise this task before utterance 129.

[...]129[...]Arnaud Ah! You see this? We need to get a research protocol approved.

Meanwhile, Arnaud suggests this task be considered “something for the main objective” (utt. 7).

Conversation Unit 2 (utts. 15-32)

CPS Model (utts. 15-32)

In this conversation unit and in terms of the CPS model, students’ role performing is for the most part asymmetrical. Arnaud is mainly the proposer, Yves mainly the reactor, Bruno sometimes the proposer too, and Gaspard only expresses himself once. Yves and Bruno agree with Arnaud’s propositions in general. Arnaud and Bruno are manifestly aligned and in the same phase (utterances 15, 16, 17, 18, 29, 30, 31) elaborating co-construction of knowledge.

SM Model (utts. 15-32)

In terms of the SM model, Arnaud and Bruno are engaging their own knowledge to interact with the common discourse, and building knowledge-objects such as prevalence, sensitivity and specificity signs, risk factors, and differential diagnosis (see Chapter 2, sections 2.3.1.3 and 2.3.1.4). To a certain extent, they are in an “objective situation” (see Introduction, Analysis of the Milieu, Level -2). The “objective students” are interacting with parts of a “material milieu” establishing relations with familiar objects and giving form to knowledge-objects (Margolinas, 2004).

Conversation Unit 3 (utts. 27-37)

Students then start to elaborate elements to give form to an “Etiology study” and towards a “case-control study” (see Chapter 2, section 2.3.1.5).

CPS Model (Utts. 27-37)

Students are mainly asymmetrical. In this conversation unit, Arnaud is still the spokesperson of the team (utts. 27, 29, 32, 34, 36), Yves reacts to his propositions (utts. 28, 33), though Bruno tends to symmetry by making propositions to the common discourse (utts. 30, 37). Still, Arnaud's contributions are more extensive.

SM Model (Utts. 27-37)

Bruno and Arnaud seem to co-construct and are likely to attain a situation of reference, since their discussion tends to be epistemological (Margolinas, 2004). Arnaud introduces another purpose for their activity; in addition to the "main objective" (utt. 7), he also suggests the designing of an Analysis Request (utt. 27) and articulates the knowledge-objects aiming to adapt the activity to this new purpose. While articulating the set of knowledge-objects selected (utts. 27, 29, 32) Arnaud proposes a type of "Etiology study", the "case-control study" (utt. 32). He also introduces the challenge (utts. 34, 36) "to find cases and controls" while Bruno collaborates in introducing elements for a solution to the common discourse, which now takes the form of an objective milieu. According to Bruno (utt. 37), the "cases" are patients affected by thromboembolic disease. One may consider then that Bruno's statement suggests that "controls" are patients non-affected by thromboembolic disease. Bruno's formulation corresponds to the formal definition of case-control studies. However, his formulation is very close to the context of the discussion. The hesitation expressed in his utterance is probably a reflexion of the implicit character of the knowledge he is articulating. Arnaud and Bruno actually get out of phase. Arnaud introduces the term "case-control" in his proposition (utt. 32). If the team accepts it, they will have to discern the cases from the controls (utts. 34, 36). Bruno's answer suggests the team classify their sample in terms of affected and non-affected patients (utt. 37), corresponding to the formal definition of case-control studies. Arnaud (utt. 38) wants to know where they are going to gather this data and gives signs of intentions of going back to an objective situation, to interact with a material milieu. Both students at this stage do not share the same objectives.

Conversation Unit 4 (utts. 38-52)

CPS Model (utts. 38-52)

In this conversation unit, Yves makes propositions (utts. 42, 44) but he tends to be asymmetrical vis-à-vis the team in the conversation unit as a whole. There is symmetry between Gaspard (utts. 39, 46, 50, 48, 52) and Bruno (utts. 40, 47, 51). They are out of phase and producing an apparent co-argumentation. Bruno reacts mainly with implicit negative feedbacks. Their disagreement relies on the fact that their objectives are different. Gaspard seeks to explore the limits of the situation while Bruno seeks an epistemological discussion. There is also apparent co-construction between Bruno and Arnaud (utts. 40, 41) since Arnaud proposed a retrospective study in utterances 32, 34 and 36, but as I shall expose in some lines, both students are not aware they are not talking about the same thing yet (utts. 32, 34, 40, 47); they act as they were aligned.

SM model (utts. 38-52)

In terms of the SM model, Arnaud and Bruno seem to be in a situation of reference. As “acting students”, Arnaud and Bruno are articulating knowledge-objects, which are here the type of study and the question of how to conduct the survey. The disagreement with Gaspard leads Bruno to produce a formulation (utt. 47) but the model is still implicit and Bruno does not go any further. Gaspard, on the other hand, wants to perform an action in the material milieu in order to gather information to build an object (utts. 39, 46, 48).

SPA Model

Conversation units 1 and 2 (utts. 6-32)

Arnaud introduces utterances in a common discourse intending to collaborate with his team. This common discourse constitutes the milieu in which individuals from the team act by testing keywords. It is possible to perceive that there is an intention to get to know the object. Arnaud is manifesting characteristics of an appropriation by testing and the same for Bruno who is manifestly in phase and aligned with his co-worker (utts. 16, 18, and 30). They act interacting with elements from the common discourse proposing words (concepts) without justifying their propositions, and the team seem to positively support such actions.

The action of introducing the term in the common discourse produces a sense that characterises the appropriation by testing. Students' testing takes place by the proposition of words without formulation of definitions or justifications or expression of a clear idea of what kind of feedback they expect to get from such propositions (utterance 32).

Arnaud introduces the element "case-control" associated with another element "prospective cohort" (utt. 32). This association will generate confusion in the following utterances because a "prospective cohort" is an antagonist "type of study" from one of "case-control" (see Chapter 2, Section 2.3.1.5-b). This association may also be symptomatic of a confusion Arnaud carries with him about the signification of the concept of "case-control study". This confusion may be either implicit given the crystallised knowledge available from his memory (issued from previous experiences) or the result of a meaning making process of appropriation by testing he performed while proposing the element "case-control". In other words, the form it acquired, and the sense it produced in the action of introducing the element into the common discourse.

Throughout the session, such confusion generated discussions in which the students who were either not aligned or not in phase would have difficulties comprehending each other. Nevertheless, they established grounding processes in order to assure an alignment of presuppositions underlying the knowledge-objects they were articulating (for instance utterance 925).

Conversation units 3(utts. 27-37)

As a process of appropriation, students (especially Arnaud) internalised in a first moment some objectives of this activity and formulated some propositions to conduct it. However, they were not yet sure of the limits of the situation and its constraints, so they tested such limits to find out how to perform an action, and whether or not they could perform certain actions. These constraints may help students to orientate their activity towards the expected problem and its solution.

Conversation units 4 (utts. 38-52)

In this conversation unit, students try to develop the problem proposed by Arnaud in utterances 32, 34, and 36.

Gaspard proposed finding cases and controls in the hospital services (utt. 39).

Bruno manifested the confusion introduced by Arnaud (utt. 32) by considering the study they were planning to be prospective (utt. 40) and surprisingly, Arnaud seemed to agree with it (utt. 41).

The student's problem appropriation by testing up to now led the team towards a general misunderstanding concerning the knowledge of reference, the formal definition of the concepts. The action of testing produced an idea of the type of study case-control, but its underlying meaning does not correspond to the knowledge of reference.

Yves proposition (utt. 42) added another layer of confusion. While appropriating the words available in the common discourse, he elaborated on a proposition taking the idea of hospital services from Gaspard (utt. 39) and the risk factors proposed by Arnaud (utts. 14, 27, 32).

Similarly, Arnaud found support in utterances from the common discourse and elaborated on another proposition not using risk factors, nor affected or non-affected patients, but the very hospital services as parameters (utt. 45) for their case-control study.

Bruno isolated in his position, formulated a definition for prospective studies by categories according to risk factors (utt. 47) getting closer to the knowledge of reference.

General analysis of appropriation in the whole extract

In the process of appropriation, the problem proposed by Arnaud in utterances 34, 36 and 38 became a challenge to the team. The team members in the other segments were not very talkative between utterances 1 and 38, as they tried to make their contributions towards the solution of this problem.

Each student took a position from a different perspective, producing a different meaning out of the knowledge-object constructed with which students establish an interaction.

They are most of the time in explicit or implicit disagreement, but there is not too much formulation, just opposition of positions. Since students are manifesting

behaviours of testing through their actions, the formal meaning of the term “case-control study” acquires a “real meaning” in this friction with the context.

The real meaning is the one produced by the students. The interaction between thought, language, and activity produce changes in the signification of the word and the sense of the activity. It produces changes in the appropriated content. Students actively and creatively transform in order to appropriate.

The meaning of the word was not clear in the first moments. Testing produced a meaning and a sense through the interaction of the word with the context. This new meaning was not yet the one liable to lead the students’ appropriation towards the expected problem, but it is the meaning the students made their own.

In this extract from utterances 1 to 52, the indicator of behaviours of appropriation by making choices did not manifest clearly. Though the choice for a specific type of study emerged, they punctuate such options in relation to others. In addition, students do not manifest what they expect to obtain with this option. They seem to have produced a representation of the activity they have to perform, probably through the tutor assignments and the assignments present in the IT environment, especially the ones proposed by the Health Commission. They seem to be trying to reproduce representation of what justifies the behaviours of testing.

4.4.1.2. Extract 2 – Illustration of individual appropriation by anticipating

In this extract, students are now aware they are supposed to submit a protocol and plan a schedule for their survey. Some details were adjusted after an intervention by Patricia (the tutor 1, see appendix utts. 765-893) concerning the population and risk factors. After a little discussion, they finally decided to fill the job journal (the schedule), where some elements of the protocol must be mentioned, namely the main and the secondary objectives. They have difficulties in establishing and refining the study question, and coming to an agreement, but they start by filling the blank of the main objective with a general idea (for instance utterances 839, 861, 875) of what their mission should be, but without giving specific details of the disease. Bruno enters the data in the computer.

There is a 4.5-minute intervention by Laurent (the tutor 02) between utterances 433 and 471, approximately 30 minutes after the recording time started. At that

moment, students were intending to conduct two studies. The first one, a retrospective study, in order to target risk factors and then a second one, a prospective study with the risk factors found in the first study. Laurent then suggests (utt. 434):

434 Laurent Yeah, the retrospective part ... you should look for it in the documentation [a web site containing all the information they need] ... there is a lot of information about the disease ... and about the focus of this assignment [what they are supposed to do that day in class]. It shows you plenty of things ... the aim is to start right away on establishing a definitive [research] protocol; thus, [you should develop] a single protocol.

After that, Laurent suggests where to gather information (utt. 441):

441 Laurent [...] but in the library, there is already a lot of resources [...] and we decided [...] after all, to select the information for you, so that you don't get distracted [...] the point is not that you must become specialists on thromboembolic disease all at once ...

Laurent does not suggest directly which type of study students should choose but he points out negative aspects of the case-control study (utt. 453):

453 Laurent One of the big flaws of case control studies is that if you take unwell people [with a tone of irony], those who are very ill, such as the ones suffering from cancer and so on, as cases, and at the same time, you use the young students at a bus stop as controls [laughter from the group] ... [now with a serious tone] take any parameter and you are going to find differences; thus, it is necessary to find controls ...

In addition, Laurent comments about the analysis request (utts. 467-471) in which the students are supposed to introduce the main risk factors:

467 Laurent Tell me then which are the risk factors and which are the clinical signs? What you are supposed to do is to fill the blank page [exam request] with ideas that will help your future colleagues [professional doctors who would hypothetically benefit from the results of the students' survey].

468 Arnaud So then, like, in the end, we develop a small questionnaire containing four clinical questions, like Does the patient have this and this? And then we can rate the answers, such as for risk factors ... and that's it.

469 That's it. That is called a score, and it enables you to rank [data]. It is exactly what we are asking you to do next ... it

470 Laurent can be based on themes like the elderly, young people, women, men, post-surgery patients, patients with cancer, and

471 so on ... all of this is your responsibility for developing a coherent project in a given field, you know.

Students then come to an animated debate about utterances 839 (1h22min50sec) to 922 (1h27min50sec). At this point, they realise they are not aligned in various aspects but mainly not in phase in terms of what direction to take. The constraints of the situation put students in a position in which they have to make a choice: towards a prospective study or a retrospective study. During the debate, Bruno raises elements that illustrate an appropriation of the problem by anticipation.

He points out where to search for elements to find risk factors, instead of performing a retrospective study (utt. 890) and he justifies the importance of such an option using information from the tutors' intervention mentioned above (utts. 434, 441 453, 467, 468, 479, 470 and 471) as support.

890 Bruno That is the question we asked him [the teacher] a moment ago, and he said "No, you analyse the data and design a prospective study." We are not making a retrospective study ...

[...] 892	Bruno	No, but we have just asked him [the teacher] this question, and he said “No, you [students] are not doing this.” He said, “you should design a prospective study ... eh [hesitation] ... studying the risk factors and the probability of developing thromboembolic disease.” That is what he said a few moments ago when we asked him [the teacher].
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What is interesting is that for the first time in the recording, a participant of the team formulates an answer to what prospective and retrospective studies are, and establishes a difference between them in the context of the formulation of the main objective. To choose whether the main objective will contemplate patients suffering from TED or patients suspected of suffering such a disease, is to determine whether the study will be prospective or retrospective.

896	Arnaud	But I want to say, you know ... look [read on the screen] ... “the population of patients who we suspect have TED [thromboembolic disease]” ... and guys! We are not even sure that they will have a TED [develop the disease]. How are we going to study a risk factor when we are not even sure that they have it [TED]?
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Arnaud (see Appendix utt. 895) and Gaspard (see next topic utts. 1057 to 1060) do not agree with a prospective study because they are not able to consider a prospective study, which is an obstacle they are not yet able to overcome.

1056	Gaspard	But, ah! [he feels like he has found a solution], but in that case, we cannot know it [if a given individual will develop a TED], given that the person did not have [the disease], so that means you cannot know it.
1057	Bruno	But this is a prospective study! We wait for the appearance of the disease and we look to see if there are any risk factors.
1058	Gaspard	But, we will never have the results.
1059	Bruno	In your cohort, the study could take years, but we will get results ... [interrupted by Gaspard]
1060	Gaspard	In your cohort, the study could take years, but we will get results ... [interrupted by Gaspard]

However, Bruno has already understood and formulates the reason why they should opt for a prospective study and how to propose it. In this “micro-activity” (defining a main objective), the result is the formulation of a sentence that concerns the following utterances:

839	Yves	The main objective is “to discern the unwell people at high risk of developing the disease from the ones with a low risk of developing TED” [dictates to the group] ...
[...] 861	Yves	“By the implementation of a score” [keeps on dictating] ...
[...] 875	Yves	Thus, the population is the patients hospitalized whom we suspect have developed TED.

The anticipation here is a formulation in which the student presents a strategy to justify the propositions from utterances 839, 861 and 875. Such propositions are in the meantime, in the form of the main objective and therefore the expected result of the action in process. Bruno proposes in utterances 899, 907, 909, 913 and 917 a strategy to attain the main objective proposed, identify some elements likely to have an incidence over the variables and finally affect the results.

[...] 899	Bruno	But, as it is a prospective study, we are going to see the appearance of thromboembolic disease.
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[...] 907	Bruno	Exactly guys! we look for the most significant risk factors.
909	Bruno	And we know the risk factors, so we take three of them and determine those that are the most significant and that ...
[...] 913	Bruno	... eh [hesitation] ... look at the appearance of thromboembolic disease with regard to the risk factors. We choose a patient cohort with the risk factors that we are able to determine and then check appearance and probability according to which ... eh ... [hesitation] do you understand?
[...] 917	Bruno	Check this out, Gaspard! We study a cohort of patients exposed to the risk factors that we have determined and then study the risk factor that will be the most likely to produce thromboembolic disease and thus the complementary examinations that we [overlapped by the following utterance]

Bruno is also able to formulate the difference between prospective and retrospective studies urging the team to overcome the obstacle faced during this action and giving the elements for elaborating on the hypothesis for possible future events.

[...] 922	Bruno	Ah well, no! In a prospective study, you know the risk factors and you study their influence on the appearance of the disease. On the other hand, in a retrospective study, you study the disease and the probability and ... eh [hesitation] ... and the respective risk factors. But in our case, we know the risk factors; thus, we are developing a prospective study. We choose the cohort according to the risk factors [he gestures to explain the differences between the types of studies].
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In the above-mentioned case, Bruno anticipates individually the results in this action without producing a result or previewing the future. He articulates the representation of the result he has produced as cognitive planning (see Chapter 1, section 1.2.2.3-b) and preparing a future action. The elements for cognitive planning come partly from the common discourse. The form “anticipation over information” emerges here when the student makes references for instance from the tutor’s intervention to formulate his proposition (utts. 890, 892). Also by taking references from the common discourse, he had been building with the team, specifically Yves’ proposition, which constitutes the representation of the result. In another form of anticipation he manifests the “anticipation over reasoning.” He is anticipating individually the result, by producing anticipation very early; it is possible to observe that he is still struggling to render explicit his implicit model, by hesitating to develop his reasoning until the end of this formulation (utt. 922). Possibly, in the realisation of his thoughts and words, the latter still do not fit with the totality of what is implicit. If proposing an utterance to the collaborative discourse is considered as the activity, the misfit between thoughts and words is a part of the activity of formulation that slips from individual control and provokes the emergence of new subjective needs for formulation. Bruno then struggled to formulate the appropriated content by anticipation in different utterances (utts. 899, 907, 909, 913, 922).

Acting on the common discourse, Bruno was in a process of collaborative problem solving trying to provoke a grounding process within the team. The intention here was to produce a collective appropriation in which once aligned on the same ground students could work over an agreement co-arguing or co-constructing in the designing of a main objective.

4.4.1.3. Extract 03 – Illustration of Appropriation by Acceptance

In the Utterances 1034 until 1059, Gaspard and Bruno are apparently not aligned on the methodology to be applied.

1034[...]	Gaspard	... we need different populations, those that have the disease and those that do not
1036	Bruno	I disagree, we need populations exposed to the risk factors and others which are not ...
1037	Gaspard	the disease will definitely be caught by some people ...
1038	Bruno	who “will be caught by”! [overlaps repeating Gaspard’s statement] but the likelihood of catching the disease is not the criterion based on which we select populations ...
1039	Gaspard	but uh::: [hesitation] then how do we identify the people the people who did not catch the disease? ‘cause if the people didn’t catch it, then you cannot know it ...
1040	Bruno	[overlaps] ‘cause it’s prospective! we wait for the disease to break out and determine whether there is a specific risk factor ...
1041	Gaspard	but it is unlikely that we would obtain valid results ...
1042	Bruno	in cohort [studies] we may need a couple of years to complete the research but ...
1043	Gaspard	but then [hesitation] yes! [hesitation] no! we may say you know “for this one [a patient at random], there is a possibility he catches one [disease], but we would never know for sure if they caught it or not

At first, the discussion seemed to demonstrate a lack of common ground about the concepts underlying a given study design. However, the gap between them is much deeper than it seems. Gaspard was actually in a paradox derived from the implicit model he had built. It is not just about the meaning underlying the different concepts such as types of study, but the whole sense of the activity was different because of the way he perceived the internal coherence of the game diverging from his perceived likeness with a real life reference. I shall get into details about authenticity in the next chapter.

Absent for a while, Yves is back on the team and Bruno (utt. 1051 and 1053) involves him in the discussion. Yves tries to help (utt. 1061).

1051[...] 1053[...]	Bruno	[...]Gaspard disagrees with us [Yves asks why] oh::: [mild protest] regarding retrospective-prospective [studies], the use of populations who already have the disease from the start of the study ...
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1057[...] 1059	Gaspard	[...]I 'cause it may be worthwhile identifying potential risk factors on populations , that's ok, but as you cannot tell for sure if the people will catch the disease or not ...
1060	Yves	[overlap] precisely! you do not! then you look [prospectively] the number of people who will catch the disease ...
1061	Gaspard	[overlap] precisely! how are you going to ascertain the number of people likely to catch the disease if you cannot know if people are likely to catch it [the disease] or not?

Finally, Bruno (utt. 1062, 1067 and 1071) and Yves (utt. 1070) identify the gap between them and Gaspard is and try to help the teammate solve the paradox.

1062	Bruno	Bruno [laughter] **** [offensive reaction]! but this is a long-term study, an epidemiological study ...
1063	Gaspard	But [hesitation] a four-months-long-term-study!? [reminding the length of the discipline and the impossibility of design such study]
1064[...]	Bruno	of course not ! not over four months you may do it over twenty-five years if you want. Definitely not! not over four months you may take more than 25 years to complete it if you wish! [with a tone of irony]
1066	Gaspard	surely we are not conducting it for more than 25 years! [with a tone of indignation]
1067[...]	Bruno	we are not conducting it at all!
1069	Gaspard	certainly we are! [surprised]
1070	Yves	this is a fictitious study!
1071	Bruno	of course it is! we will produce only an introduction to it, but it will not be an actual study! [laughter] twenty-five years from now, we will not be still working on this discipline!

After his teammates' intervention, Gaspard ends up realising what they mean (utt. 1072), though by admitting their premises, by changing his mind, the model he has built loses its sense according to the activity he was planning to execute (utt. 1078 and 1084). Arnaud supports Gaspard by expressing the same disappointment (utt. 1085). Gaspard tries the paradox proposition one last time, displaying difficulties leaving his model (utt. 1086, 1092 and 1094). In conclusion, Bruno seems to give a solution for it (1095).

1072[...] 1074[...]	Gaspard	... It is pointless! ... It is pointless! [with a tone of frustration]
1076[...]	Bruno	at any rate, I think that our subject has been studied already
1078[...]	Gaspard	Only frustrated people can approach this subject [laughs from Yves and Gaspard]
1082[...]	Bruno	right you are! that's what he [Laurent] stated, that the actual research, and not the reality, is the objective. there is no reality, so we cannot be given grades according to it
1084	Gaspard	we are in for a defeat!
1085	Arnaud	It is irritating because we have expectations that things you know will happen, but...
1086[...]	Gaspard	our dilemma will never be solved.
1088[...]	Bruno	we set the protocol the goal here is to propose a protocol ! not to get results, conclusions and write a paper! [hitting the computer screen with a pen] we are not

		getting published, guys ! the aim here is to devise a protocol! the aim is not to obtain results, draw conclusions and write the study, because it is not getting published!	
1092[...]	Gaspard	then it is pointless!	
1094 1095	Bruno	it is not pointless! this biostatistics course! look interesting it is interesting to think logically and apply... [inaudible]	we learn

This is an example of refocusing in the situation (utts. 1072 to 1095). Gaspard breaks the didactical contract by finding out that the exercise they are executing is useless for a biostatistics course. The activity can only make him frustrated since he will not be able to apply the survey the group is developing.

As for loss of sense, for Gaspard there is loss of coherence. The game he is playing becomes incoherent with the didactical objectives he expects from the discipline. Gaspard built a representation of the activity too realistic for the one he is performing with his colleagues. His subjective needs are not satisfied, and he realises he was addressing his intentions to another activity; therefore, he breaks the relationship he had established with the object and by doing so he breaks the didactical contract and leaves the category of acceptance as being resistant towards the proposed situation (utts. 1078, 1084, 1086, 1092-1094).

Still, in terms of structuration of the milieu, Gaspard and Bruno assumed the position of reflexive students in a project situation (Margolinas, 2004). They were contemplating the learned-objects produced in the didactical situation and considering with some distance what they could or could not learn in the didactical situation expressed here in the context of a game in which they have to produce a research protocol. They are judging consciously the didactical situation, and questioning the didactical intentions of the situation.

Gaspard abandoned his intention to get involved with the game. Again, the constraint of the group played an important role. Bruno finding support in the didactical contract refocused the attention of the team towards the utility of the game, since it encouraged the team to develop a long reflection on the development of a protocol. To accept is to drive one's behaviour towards the intention of appropriating something. Without acceptance, no intention to appropriate is manifested, and the individual gives up.

4.5-Discussion

In this chapter, I proposed to illustrate the SPA model in the study of one case. The illustration supported refinement of the categories and defined indicators for some of them.

The emergence of methodological difficulties in observing individuals' problem appropriation associated with practical ecological issues led me to opt for teamwork observation and interaction analysis.

To appropriate a problem, students genuinely take responsibility over it. Research questions underlying this chapter concerned then the dialectic relation between individual and collective problem appropriation, the process under which individual appropriation and collective appropriation happens.

Individual problem appropriation

Problem appropriation takes place in the situated action and in the transforming development in which events evolve. Problem appropriation is a process that gradually combines meaning making and its deployment in activity operations, in a dialogical language activity in the arena of a discourse.

In a didactical situation, following the structuration of the milieu, the process of students' problem appropriation happens in the interaction student-milieu. In the game LOE, students chose types of studies according to the case of diseases they investigated. Thus, based on their interest and on the study of their own problems, students opted for a given type of study. The definition of the type of study is simultaneously the solution to the question of the problem posed: the answer to the question "how" (Chapter 02, section 2.3.5.1-a2). The material milieu proposes to students an object they are expected to interact with. Students access this object by using knowledge they already have available. Students transform the proposed object by applying their own available models, in order to appropriate it. Students then build a knowledge-object. Therefore, students appropriate a problem individually by transforming the target object they intend to appropriate.

Collective problem appropriation in a team

Collaborative problem solving situations often favour students' discussions about actions and decisions to take. Agreement among students becomes an important element in the teamwork. Disagreements lead to co-argumentations in which students produce utterances articulating knowledge and formulating internal models. In such contexts, students externalise produced meanings and act according to their own subjective needs and cognitive planning eventually provoking the emergence of a misfit in the internal actions of the team.

Every utterance is dialogic. Thus, the dialogism is the real mode of functioning of the language; it is the constitutive principle of the utterance. Every utterance is constituted by another utterance, as a reply to another utterance. Therefore, in an utterance it is always possible to hear at least two voices: its own voice and the voice against which it builds itself (see Chapter 1, section 1.2.2.3).

A need for a grounding process becomes imperative to bridge the gap among individuals and establish a collective appropriation. This grounding process enables the alignment of individuals in a team, establishing a common ground for appropriation and synchronising the students' activity.

Individual or collective appropriation

In the context of teamwork, problem appropriation happens at the individual and collective levels. At the individual level, there is always appropriation of something since by definition appropriation is a personal and individual activity. The individual must transform proposed objects in order to appropriate them.

At the collective level, it is the co-construction or co-argumentation of individuals that formulates what they have appropriated in order to contribute to the collective appropriation or grounding process students establish in order to form a semantic basis.

From the individual towards the collective, co-workers share significations and senses developed individually in the form of words and signs. From the collective to the individual, collaborative discourse provides new elements to enrich the knowledge from the individual who actively appropriates it.

Individual problem appropriation happens in the interaction between the individual and the milieu. Such activity may be the action of introducing an utterance in a collaborative discourse. The production of the utterance engenders sense making because the meaning acquires a function in a context. However, the words individuals internalise are the words of the other. Individual appropriation takes place, dialogically in the border of one's own words and the other's. It happens individually in the close and private interaction students establish with a specific object or milieu.

Structuration of the Milieu & Problem Appropriation

In objective and reference situations, individuals interact with material and objective milieus (Margolinas, 2004). In both cases, individuals are in a situation of action in which meaning making processes and symbolic mediated activities lead individuals to produce implicit models. Reference situations and didactical situations of learning are situations in which individuals are led to formulate implicit models and negotiate meanings with co-workers. Such situations favour collective appropriation given the alignment and grounding process individuals are likely to establish within the group.

Alignment & Problem Appropriation

The Alignment dimension in the teamwork is an important factor for collective appropriation.

When individuals are aligned it means they have a common ground either because both have appropriated the problem or because they have gone through a grounding process, established a common ground, and therefore appropriated the same problem. In such a learning situation, different individuals appropriate different problems from which they develop different strategies to solve.

When individuals are not aligned in a collaborative problem-solving situation, they may find themselves in a given moment of the activity in a discussion in which implicit elements of the non-alignment are likely to emerge. If individuals become aware of the non-alignment then they can opt for establishing a grounding process. This process leads individuals to alignment when they eventually operate in the

same phase or produce a semantic basis they will share henceforth. Teamwork here provides a space where different strategies are introduced and negotiated.

The interactions in which individuals struggle to share the same ground and the same phase may lead them to formulate what they have in mind, their internal models, the knowledge-objects produced, and their underlying signification. Such moments of formulation give individuals a chance to understand what underlies the other's conception and favours individual appropriation of new content or rectification of previous content. These discussions help students exchange the information necessary for individual problem appropriation, which in turn brings students to collective appropriation if they manage to align their semantic basis.

It is possible to perceive the individual problem appropriation through the unfolding of the above-mentioned process. It is also possible to determine whether students collectively appropriate the same problem or not.

The reconstruction of the discourse retrospectively starting from the grounding process towards previous propositions helps determine that at a certain moment in the past individuals were actually not aligned and had appropriated different problems.

4.6-Conclusion

In this chapter, I intended to illustrate the Students' Problem Appropriation model introduced in Chapter 1. The illustration shows individuals manifesting behaviours of appropriation while they act in a milieu, interacting with knowledge-objects. These behaviours observed with the SPA model were: to accept, to test, and to anticipate. The analysis of problem appropriation in the context of teamwork finds support in three models: Collaborative Problem Solving, Structuration of the Milieu and Students' Problem Appropriation.

Students have to gather information, in order to appropriate objects, in other words to give their own sense to objects, to make objects their own. The personal investment in this learning exercise switches with a teamwork in which personal content confronts others' personal content.

The analysis illustrates how some of the categories of the problem appropriation model take place. Some categories could not be illustrated either because the sample used for analysis takes place in the very first class – too early to observe behaviours of Mastery – or because I was incapable to find in the recorded material moments of discussion on the subject of Types of Study in which behaviours of making choices were clearly distinguishable and traceable. On the other hand, the situation observed was very rich in terms of behaviours of testing for the same reason.

These processes are contextualised in a didactical situation in which a complex and multifaceted problem is devolved to students. The didactical engineering uses various resources to facilitate the appropriation of this problem through a website using video, texts, interaction with characters etc. Promoting learning by doing, the serious game provides students with an opportunity to develop competences in the critical reading of scientific papers. A model for problem appropriation from the student's perspective contributes to a better understanding of a student's learning process under such conditions.

The IT environment is designed to facilitate problem appropriation by contextualising it. The serious game then aims to offer students an authentic experience of learning, as I shall present in the next chapter. Next, students play a serious game appropriating a role, as they appropriate a problem contextualised in a simulation. Now, the research addresses questions about students' perception of the authenticity introduced in the game.

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Résumé en français

L'authenticité de l'expérience d'apprentissage est cruciale dans une simulation didactique. Un compromis doit être trouvé entre apprentissage, jeu et réalisme.

Des jeux trop réalistes deviennent complexes, ce qui peut compromettre l'apprentissage. Atteindre le juste degré d'authenticité pour atteindre l'objectif constitue le véritable défi et demande une bonne connaissance des processus de perception et d'information humaines.

Les concepts : Les nouvelles technologies génèrent de nouvelles définitions de l'authenticité (en particulier sur les plans du réalisme et de l'immersion), qui sont fondamentales pour appréhender l'authenticité dans les jeux d'apprentissage. Les moyens d'engagement des joueurs varient, mais l'implication/l'appropriation est l'indicateur clé de l'immersion. Dans ce chapitre, je me suis concentré sur les immersions interactionnelles dans des contextes de jeux.

La crédibilité et les évaluations fournies par les environnements d'apprentissage affectent leur authenticité. Les deux sont intimement liés au concept de confiance, traduits en des termes tels que « crédible, véridique, objective, fiable et bien intentionnée ». Lorsque les joueurs n'ont pas expérimenté une situation de simulation, la crédibilité reflète leur intention de croire. Le non-réalisme peut compromettre l'authenticité, et particulièrement dans les formes d'une réalité fictionnelle, extérieure et narrative. La perception de la réalité dans le contenu des médias, ou celle d'autres critères (possibilité, probabilité, existence actuelle et caractère construit) sont à ce titre édifiantes.

MODELE D'AUTHEENTICITE

Les jeux d'apprentissage sont authentiques en trois sens. Tout d'abord, ils nécessitent d'être réalistes, afin de refléter de vrais contextes dans lesquels les étudiants pourront réagir. Ensuite, ils doivent être cohérents ; les étudiants sont plus malléables dans un contexte narratif. Enfin, ils doivent être pertinents, afin de motiver les étudiants à s'approprier et résoudre le problème. Je propose l'ajout d'une dimension didactique, permettant la production d'un modèle d'authenticité applicable à la conception d'un jeu et à l'étude des perceptions d'authenticité.

Question de recherche :

[1] Les étudiants perçoivent-ils le jeu comme authentique ? Comment interagissent-ils avec les personnages ? [2] Quels indices affectent ce jugement d'authenticité, et comment ?

MÉTHODE

Les attributs du jeu dans le modèle d'authenticité : Après avoir passé en revue les écrits sur le sujet, j'ai compilé une liste d'attributs liés à l'authenticité dans les jeux de simulation et susceptibles d'affecter l'apprentissage. J'ai essayé en vain de satisfaire les trois dimensions du modèle d'authenticité. Dans la mesure où l'objectif principal est

l'apprentissage, la dimension didactique prend toujours le pas. Neuf attributs d'authenticité étaient néanmoins présents dans LOE, couvrant quatre domaines.

Domaines du jeu sérieux	Lien avec le modèle DAPA	Attributs d'authenticité
Mission	Réalisme	Données originales Contenu de la mission et ressources
Liberté de l'utilisateur	Pertinence Réalisme	Contrainte de l'interaction Niveau de contrôle de l'utilisateur
Mise en scène	Relevance Cohérence	Représentation graphique Structure de l'environnement
Interaction avec les personnages	Pertinence Cohérence Réalisme	Contenu du caractère et du comportement des personnages Personnification des personnages Mode et moyen de communication

Tableau. Attributs d'authenticité

MÉTHODOLOGIE

Collecte des données, méthode : 170 étudiants en seconde année de médecine, lors d'un cours obligatoire de Biostatistique, furent répartis en 45 équipes.

Une étude empirique exploratoire a rassemblé les commentaires des étudiants. Trois questions furent posées par téléphone après chaque session à environ un étudiant par équipe : [1] Qu'avez-vous produit aujourd'hui ? [2] D'un point de vue professionnel, des événements d'aujourd'hui vous ont-ils paru étranges ou intuitivement crédibles ? [3] Ce que vous aviez fait aujourd'hui vous a-t-il paru utile pour votre apprentissage professionnel ?

ANALYSE DES DONNÉES

Interviews téléphoniques : Quatre sessions ont été identifiées et 8 heures d'entretiens téléphoniques ont été retranscrites. Les unités de sens communiquées par chaque étudiant furent réparties entre les neuf attributs. L'objectif était d'identifier des perspectives, des indices affectant la perception de l'authenticité et des variations entre les individus.

RÉSULTATS

Analyse des entretiens téléphoniques

- *Mission – ressources et données originales :* l'importance accordée à tel ou tel indice particulier varia selon les individus, tout comme l'évaluation de l'authenticité du jeu. Deux indices furent mentionnés à plusieurs reprises et considérés comme authentiques : les statistiques présentes dans les documents et le modèle du protocole. La vidéo d'une réunion entre médecins fut aussi citée. Certains élèves ont noté quelques contradictions, par exemple le fait qu'ils étaient censés mener une enquête dont ils connaissaient déjà les résultats, et/ou le fait qu'ils devaient rédiger un protocole de collecte de données tout en sachant

pertinemment que les données leur seraient communiquées. Le tableau de données était pourtant réel, mais ils ne le savaient pas.

- *Liberté de l'utilisateur – limites et niveau de contrôle* : plusieurs participants ont remarqué instantanément les limites et certains leur ont attribué une dimension authentique. L'un d'eux remarqua que l'accès aux patients n'était possible qu'avec une autorisation et que « plus tôt ils demanderaient les données, plus grand serait le nombre de dossiers de patients qu'ils obtiendraient ». Pour certains étudiants, la rapidité avec laquelle les données leur étaient fournies les fit remettre en cause le côté réaliste de l'interaction. D'autres soulevèrent le problème de l'impossibilité pour eux de demander des informations aux patients plus d'une fois, mais sans voir la valeur didactique de cette contrainte. Les étudiants sentirent qu'ils bénéficiaient de plus d'aide que dans la vraie vie et que cela rendait l'expérience moins réaliste. Ils reconnurent l'intérêt didactique des formulaires, même s'ils étaient remis par des personnages du jeu. Cependant, ce ne fut pas vu comme un facteur de désengagement de leur part ni même comme une incohérence. Apparemment, le compromis entre réalisme et pertinence fut une réussite.
- *Mise en scène – attributs visuels et graphiques* : la structure ou la conception du site ne souleva aucun commentaire ; peut-être les étudiants ne mobilisent-ils pas ces éléments pour juger ou non de l'authenticité.
- *Interactions avec les personnages – personnification, mode et moyen de communication* : les étudiants ont considéré comme réalistes les vidéos de patients, alors qu'il était clairement visible qu'il s'agissait d'acteurs. Les étudiants ont pourtant cité de nombreux indices d'authenticité : « les patients ne disent pas ce que nous leur demandons de dire », « on trouve des personnes âgées racontant leur vie ». Un étudiant fit remarquer que toute une gamme de patients était représentée, et un autre compara l'épisode à celui d'un entretien avec un vrai patient. Certains remarquèrent que les échanges d'e-mails avec les experts du comité d'éthique ressemblaient aux conversations qu'ils avaient avec les tuteurs, car les « experts » demandaient des modifications et/ou disaient la même chose à plusieurs étudiants. Cependant, les étudiants n'ayant jamais eu de réels échanges avec un comité d'éthique, leur comparaison n'était que théorique.

La majorité ne trouva pas l'interaction avec les hôpitaux authentique, réaliste ni pertinente. L'envoi de SMS, le fait de répondre à une machine plutôt qu'à de vraies personnes au téléphone, l'utilisation du même numéro pour tous les hôpitaux, tous ces éléments ne faisaient pas « réaliste ».

Pour finir, j'ai examiné la perception des interactions avec chaque département hospitalier. Les étudiants émirent une demande de donnée à l'hôpital virtuel et ils reçurent en réponse un court fichier de données par e-mail. Certains trouvèrent cela réaliste, mais la plupart ne se souvinrent pas du processus, même s'ils avaient posé des questions dessus deux heures avant, et seul un étudiant a réfléchi sur ce système d'interaction.

CONCLUSION

J'ai présenté un modèle pour étudier la perception de l'authenticité par les étudiants lors d'un jeu de simulation, qui décrit les paramètres à manipuler durant la phase de conception, et ce afin d'optimiser les perceptions. Le modèle comprend trois dimensions d'authenticité : externe, interne et didactique.

Les résultats suggèrent que les jugements d'authenticité des étudiants dans les jeux de LOE peuvent être complexes et spécifiques. Ils ont réagi de manière nettement différente, voire opposée, aux mêmes indices. Il serait intéressant de regarder de plus près les caractéristiques individuelles qui influencent ces comportements. Un autre aspect frappant fut la découverte que les indices spécialement proposés par les concepteurs pour créer de l'authenticité ont généralement provoqué des évaluations défavorables.

L'authenticité externe (réalisme) fut évaluée en partant du principe que les comportements des étudiants reflétaient le comportement qu'ils auraient adopté dans la vraie vie. L'authenticité interne fut analysée au travers des entretiens et des discussions. L'authenticité didactique fut évaluée en fonction de la reconnaissance (ou non) du problème ciblé et de l'utilisation d'une stratégie pour le résoudre.

Durant les trois années de mon implication dans la mise en œuvre de LOE, je suis parvenu avec succès à modifier les interactions avec les hôpitaux en fonction de ces trois dimensions de l'authenticité, afin de minimiser la perte de consistance interne, rendre le problème cible explicite et améliorer le réalisme des communications.

J'ai montré de quelle manière le modèle d'authenticité peut être utilisé pour étudier l'authenticité perçue, et d'autres applications doivent pouvoir lui être trouvées.

L'authenticité didactique d'un jeu d'apprentissage peut être évaluée par des enseignants, qui peuvent décider de leur degré de tolérance entre les perceptions désirées et les perceptions réelles d'authenticité. Les enseignants doivent défendre la délégation d'un problème, autrement dit faciliter la prise de responsabilité d'un problème par les étudiants, qui apprennent en retour à le résoudre. L'authenticité didactique permet de s'assurer que les apprenants ont identifié ledit problème.

La conception d'un jeu de simulation nécessite un compromis entre les trois dimensions d'authenticité. Ce point est particulièrement important lorsque les cours semblent éloignés des principaux objectifs d'apprentissage des étudiants, à savoir la Biostatistique pour l'usage des médecins.

Measuring and Modelling Authenticity¹

5.1 Chapter Introduction

My interest in this thesis addresses the learning experience in the context of the serious game LOE introduced in a didactic situation. Designers intended to provide a compromise between the requirements of a professional situation and the constraints of a learning situation in an institutional context. Designed as an embedded phenomenon, LOE intends to provide an authentic learning experience. Authentic learning experience is an important issue in the use of serious games and simulations in learning situations; it is about finding a compromise amongst learning, playing and realism. In the present chapter, I develop a reflection over such compromise and propose a model for Authenticity.

5.1.1 Towards Authenticity

Learning games play an important role in training people in real-world situations. However, an entirely realistic simulation is neither practical nor desirable. On one hand, game designers introduce realism in a situation by adding more and more elements, thus bringing complexity to it. On the other hand, when students spend too much time getting familiar with too many details, they may skip the main learning goals. In a learning context, a key concern is thus the level of authenticity the game requires to match accurately what learners can expect in the real world with what they need to learn. Therefore, authenticity does not mean a perfect reproduction of reality. What needs to be authentic are the main characteristics of the type of situations at stake, that is, those characteristics that require learners to mobilise the targeted knowledge to be successful in the game. High-fidelity simulators do not always lead to better performance in learning; therefore, when designing a learning situation, one must

¹ Chapter 5 is based on four complementary studies conducted in 2009, 2010 and 2011 and published in conference proceedings and journals. The first study, "Phone, Email and Video Interactions with Characters in an Epidemiology Game: Towards Authenticity" was published in the journal, *Lecture Notes in Computer Science: Transactions on Edutainment*. The second study, "Authenticity in learning game: how it is designed and perceived" was published for the European Conference on Technology Enhanced Learning, held in Barcelona, Spain in 2010. The third study, "Authenticité d'un jeu sérieux: un modèle pour la conception et pour l'analyse" was published in 2011 in the French journal, *Intelligence Artificielle*. The fourth study is under revision for the journal, *IEEE: Transactions on Learning Technologies*.

consider an analysis of human perception and the information process (Scerbo & Dawson, 2007). Authenticity is both a function of the game and the perceiver, and I shall define them in the following sections, starting from a brief overview of related concepts.

5.1.2 Concepts Underlying Authenticity

Research in education started problematising authenticity about a century ago, including the work of John Dewey, who studied the relationship between learning and experience.

In order to define authenticity in the context of learning games, I consider recent research on new technologies (Francis & Couture, 2003): video game research on the immersion and engagement of players, human-computer interaction research on the credibility of various computer environments, and communication research on the perception of television content (Figure 5.1.).

First, in video game research, many terms have been developed to try to account for these experiences, such as perceived realism (Shapiro, Pena-Herborn, & Hancock, 2006) and immersion (Arsenault & Picard, 2008; Björk & Holopaine, 2004; Brown & Cairns, 2004). Immersion is one means to create authenticity in learning games, making learners feel a certain situation to be real, although they know it is not. According to Brown (Brown & Cairns, 2004) the main indicator of immersion from the user's perspective is the player's degree of involvement (engrossment). Game designers know that players may engage in different ways in a game, mobilising themselves differently, whether they are challenged on their ability to act rapidly, to find the best strategy, to communicate with different people, etc. To immerse in a game is to get involved in the context, not only physically, but also mentally and emotionally. There have been numerous definitions of immersion in games, based on different aspects of involvement (e.g. tactical, strategy or sensory immersion) (Arsenault & Picard, 2008; Björk & Holopaine, 2004), some of which I introduced in chapter 3. In this chapter, I focus on immersion in a simulation of an authentic situation, and more specifically, a situation that involves many moments of interactions with people. I call "interactional immersion" one that relies mostly on interactions with other players or characters of the game (Ney, Gonçalves, Balacheff, Schwartz, & Bosson, 2011). I use engagement as one of many indicators of perceived authenticity, i.e., whether students play the game or not.

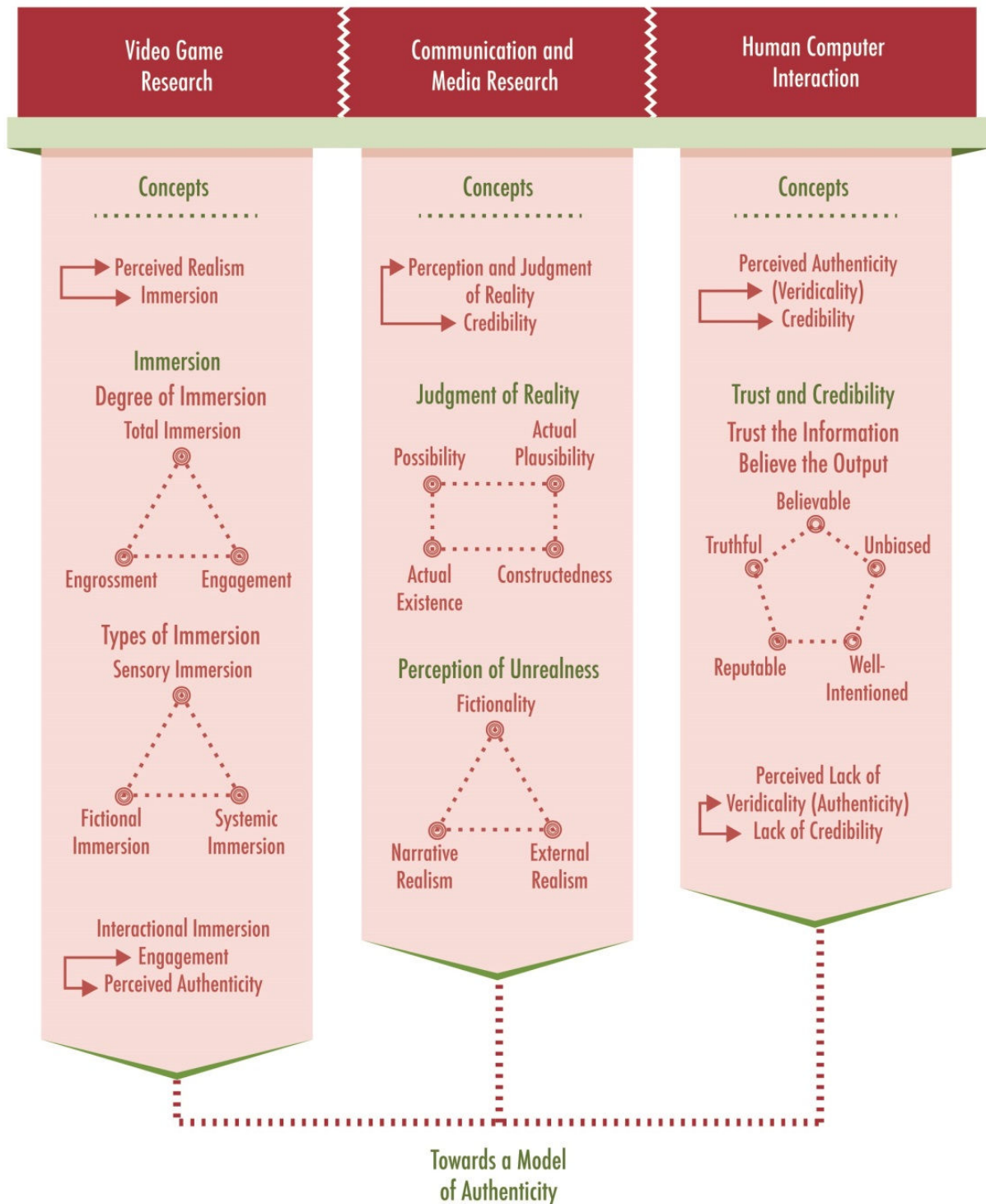


Figure 5.1. Research areas and concepts in the origin of the concept of Authenticity.

Second, authenticity can be linked to the concept of trust, as developed in human-computer interaction studies, the second field of research from which I attempt to define authenticity. The word “trust” refers to credibility, as in “trust the information” or “believe the output”, a meaning that is relevant to authenticity (Francis & Couture, 2003). Tseng and Fogg (1999) suggest various terms to assess trust or credibility in computer environments: believable, truthful, unbiased, reputable and well-intentioned.

According to these authors, there is a direct connection between “perceived lack of veridicality” (which I relate to authenticity) and lack of credibility. In the present chapter, I treat perceived authenticity and credibility similarly. Indeed, users do not always have a personal experience of the simulated reality. The question of authenticity is thus whether they believe it or not. I particularly discuss the credibility of the feedback from the environment to the learners.

Third, in communication and media studies, several researchers have examined the perceived reality, or modality judgements, of television content (Busselle & Greenberg, 2000; Chandler, 1997). These researchers identify various criteria involved in viewer judgements regarding the reality (or the realism) of media content. Chandler (1997) proposes four criteria: possibility (possible to do in reality), plausibility (possible to do, but highly unlikely that one would do it in real life), actual existence (could be done, but nothing like this actually exists in reality), and constructedness (just a virtual situation, not a real one, it is pre-constructed). Interestingly, the judgements are measured on a likelihood scale, which relates to the concept of credibility cited above. Furthermore, Busselle and Bilandzic (2008) offer a theoretical framework to explain the circumstances under which perceptions of “unrealness” affect engagement in narratives and subsequent perceived realism judgements. They discuss three types of unrealness: fictionality, external realism (match with external reality) and narrative realism (coherence within a story). They show evidence that fictionality does not affect narrative processing, unlike the two others.

5.1.3 The Model of Authenticity

I now come to a definition of authenticity that is used both to design game authenticity and to analyse learners’ perceived authenticity. I keep the notions of external and internal authenticity (Busselle & Bilandzic, 2008), and add a new one specific to the present context of a learning game, that is, didactical authenticity (Ney, Gonçalves, Balacheff, Schwartz, & Bosson, 2011). As summarised in Figure 5.2, a learning game may be designed, and later perceived, as authentic from three points of view: it can be more or less realistic (perceived likeness with a real-life reference), coherent (perceived internal coherence of the proposed situations) and relevant (perceived relevance with respect to learning goals).

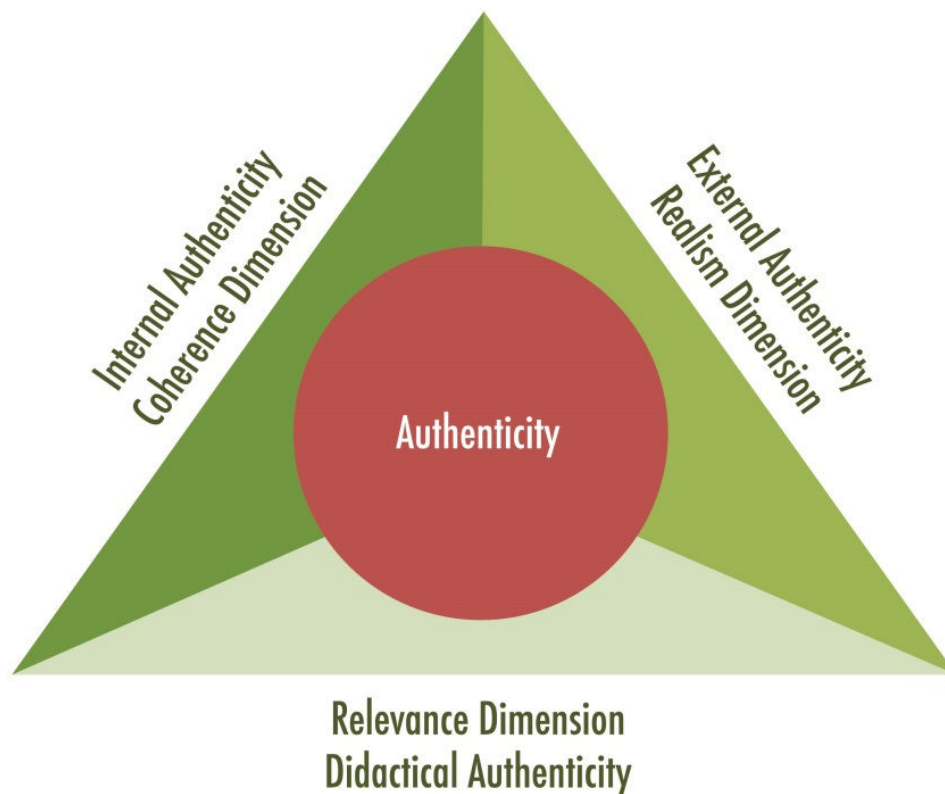


Figure 5.2. Model of authenticity

Why should a learning game be authentic? Some fields are difficult to teach because students do not immediately see the purpose; they are not motivated because they do not relate the learning goals to their personal training project. This is often the case with mathematical teaching contents (e.g., statistics for medical students, as exemplified in the serious game described in the present work, calculus for experimental sciences, etc.). Similar to what other approaches do (e.g., inquiry learning, problem-based learning, discovery-based learning), game-based learning gives an authentic context to the learning at stake. In the present case of learning statistics and epidemiology, students would rather face a public health issue than a statistical issue directly (see Chapter 2). I now justify each of the three dimensions of the model (Figure 5.2).

First, the above-mentioned context should be authentic in the sense of external authenticity, at least for professional training. Otherwise, students would not feel prepared to react adequately in real professional situations.

Second, referring to internal authenticity, the game must remain consistent with a logical sequence of events and feedback. Inconsistencies in the game may cause disengagement. Moreover, communication and media research suggest that one is more susceptible to persuasion or abstract lessons, when engaged in a narrative.

Third, didactical authenticity is related to appropriation, the fact that learners make the proposed problem their own (see Chapter 1, Table 1.2.), looking for their own solutions rather than finding strategies to do only what the teacher expects (Gonçalves, Ney, Balacheff, & Bosson, 2009). This allows learners to appropriate by producing signification and personal sense from the proposed situation, i.e., in terms of what the point is in learning, as I have shown in chapter 4. Otherwise, learners would just focus on a particular solution to a problem, with little ability to transfer to similar problems.

5.2 Research Question

After defining the nature and scope of authenticity, I introduce below the case study on the LOE game, exploring various judgements expressed by learners after the game, as well as their behaviour during the game. The following research questions guided the present investigation:

- (1) Do students perceive the game as authentic? How do students behave in “authentic” moments of interaction with the game’s characters?
- (2) Within the game environment, what cues enable students to make judgements of authenticity? What roles do these cues play in students’ judgements?

5.3 Method

5.3.1 Game Attributes Regarding the Authenticity Model

A list of attributes of authenticity that can be set when designing a simulation game was built on the basis of the bibliographical review of Wilson et al. (2009), a similar work done with a physics simulation (Francis & Couture, 2003) and the LOE design experience (Ney, Gonçalves, Balacheff, Schwartz & Bosson, 2009). Game attributes that could have an impact on learning differ from one author to another. I choose the list of Wilson et al. (2009) because it is comprehensive, exhaustive and based on recent literature review. I focus here on the attributes that are present in the game LOE: evaluation (resulting in feedback and rewards), challenge (defined by the given mission), control (as defined by the degree of freedom given to learners), face to face interactions between players, modes and media of communication between players or characters, interactions at the interface. To indicate more precisely the scope of each

attribute, I group them into four areas: mission, user's freedom, mise en scene and interactions (Figure 5.3).

The figure below lists nine attributes of authenticity. Each attribute is set according to a compromise on the triangle of authenticity, in other words, sometimes didactical authenticity is preferred, sometimes another dimension, sometimes two of them, etc. These attributes are detailed below, with an indication of the compromise that was chosen for LOE, for illustrative purposes. I try to satisfy the three dimensions of authenticity, but sometimes one has to sacrifice one of them in order to solve a contradiction between two dimensions, to make the problems given to students tractable or for practical reasons. In case of conflict, the didactical authenticity is preferred among the three because the main goal is learning.

a. A mission

When starting the game, students are given a mission that gives context to the problems designed for learning. This mission mimics a real situation, with the help of an epidemiologist who conducted this mission in the past. It is presented to students in text and video formats (of a meeting between professionals) on the commission's website. This commission is the institution that gives the mission. I used real data (patients' files, with no identifying personal information to maintain confidentiality and privacy), as stated above. Therefore, external authenticity was the most important viewpoint in designing these attributes related to the mission.

b. User freedom

First, the constraints of the interaction may be considered. For instance, in the interaction with patients, it is important that a patient does not repeat at will his/her answers, which is a constraint that was reproduced in the present system. This particular constraint was designed for didactical authenticity. Indeed, when a patient does not repeat oneself, students learn that they need to prepare their interview and also to look for ways to control their data, two learning goals of the course.

Second, students' level of control on the environment and tasks had to be defined. In LOE, the tutor accompanies the students, who discover by themselves what they have to do and how they can navigate the environment. Students are physicians who can ask for help, but who are relatively free otherwise (external authenticity).

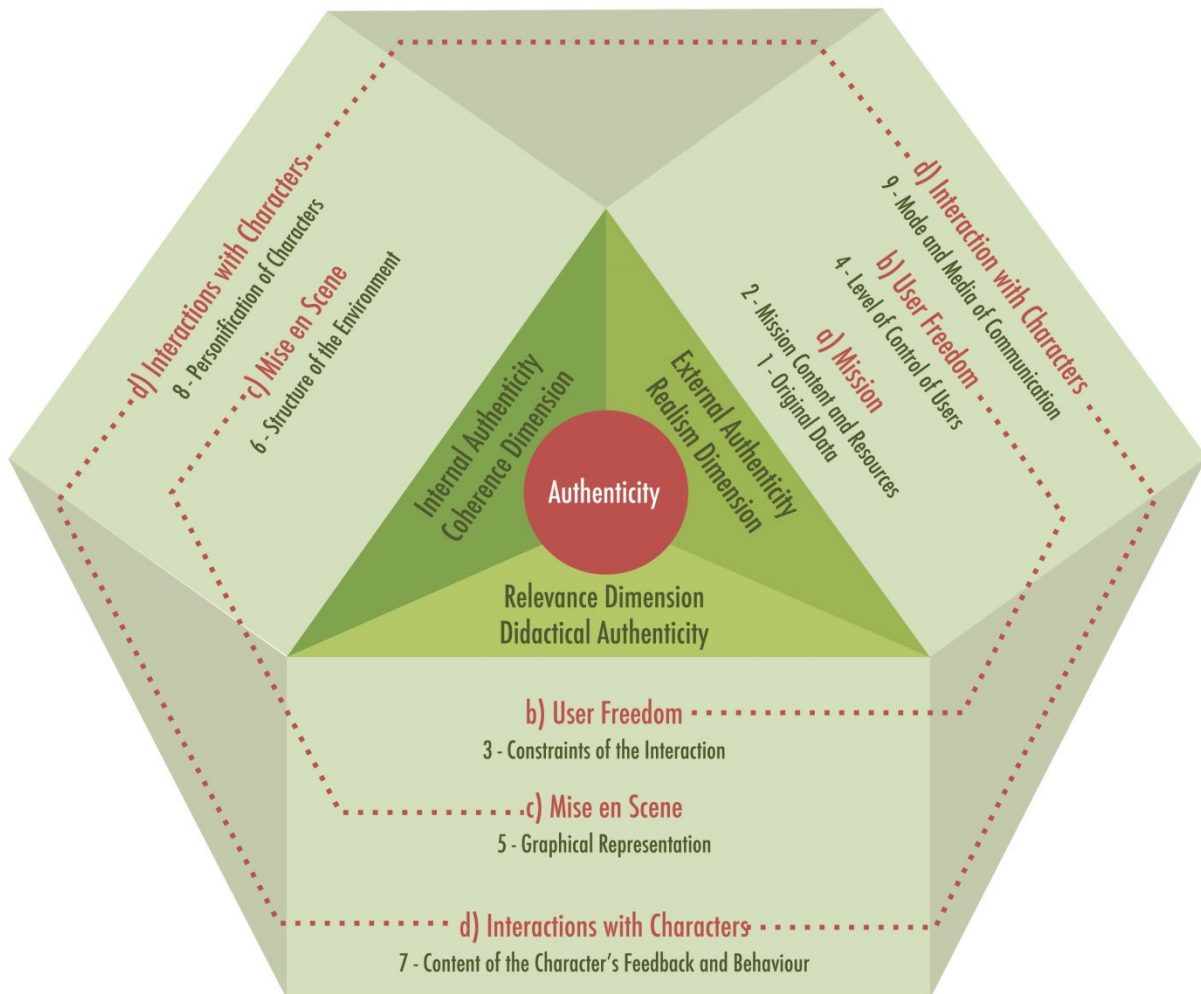


Figure 5.3. Environment attributes of authenticity

c. Mise en scene

The environment that provides the mise en scene is for most part online. Students find the websites of the different organisations with which they have to interact. This was designed to follow mainly the internal coherence principle. Indeed, not all the organisations one could encounter in real life are represented, but the interactions were designed to flow logically within the game.

Furthermore, the graphical representation, especially of the virtual hospitals, follows the didactical authenticity dimension. Instead of an avatar moving within a represented hospital with corridors and wards, I kept only those parts that are relevant for learning, particularly the patients' talks (scripted).

d. Interactions with characters

Considering the authenticity of the present system of interaction, I identified three attributes (see Figure 5.3). The characters with whom students are interacting may be

more or less authentic. This aspect of the game's characters is decomposed into two elements.

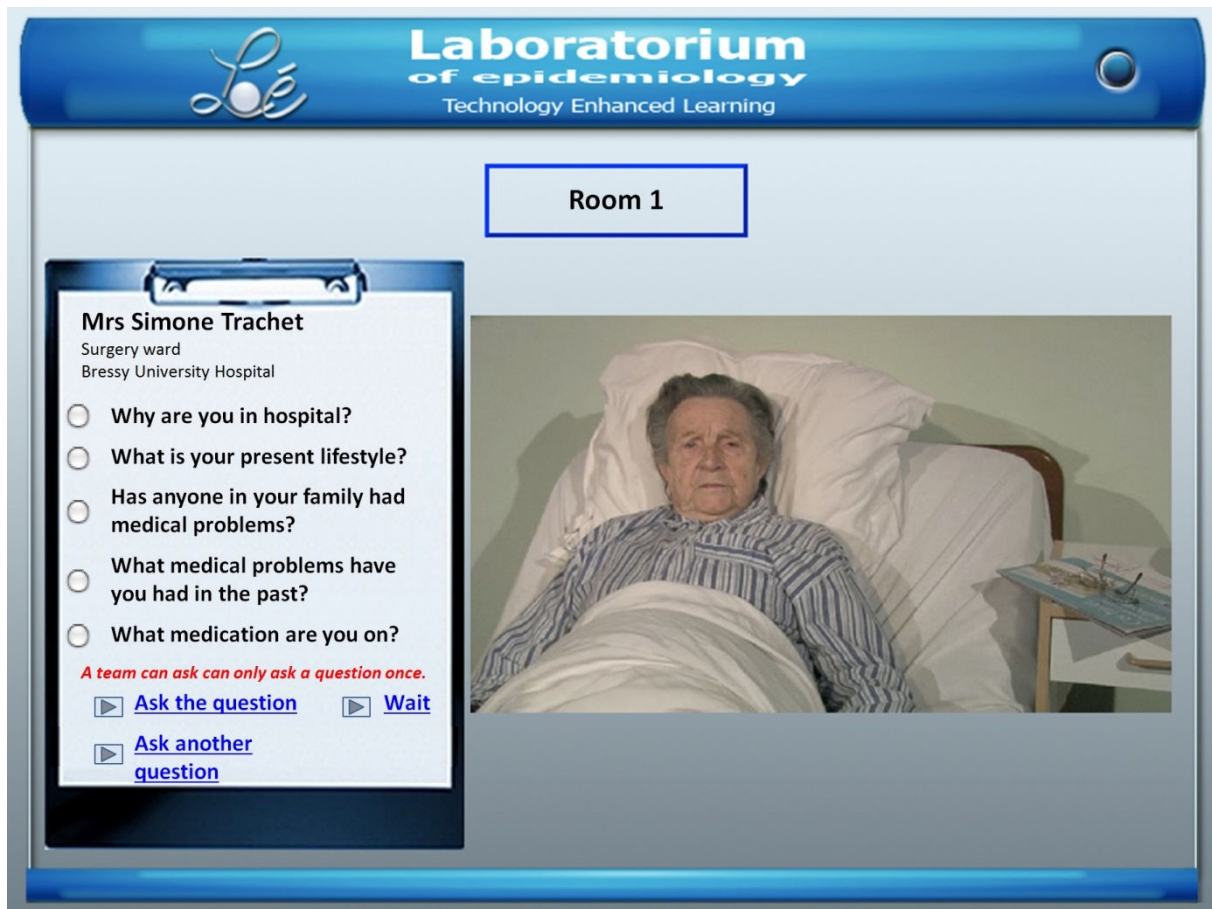


Figure 5.4. Room 1 with patient video and questionnaire.

First, a character's authenticity refers to its personification, what information is available and in what form (text, photos, etc.). This is limited in LOE to satisfy mostly internal authenticity.

Second, the content of a character's feedback to students may be more or less authentic, depending on how adapted this feedback is to students' actions. For didactical authenticity, this feedback is communicated verbally or otherwise (e.g., a patient with heavy breathing can be an important sign) and can be relevant or not (students need to sort the information out) (Figure 5.4).

Finally, the third attribute comprises the communication media (by email, phone, etc.) and mode (textual, verbal, visual, etc.). The latter was designed for external authenticity (Figure 5.4).

Analysis of the serious game LOE illustrates the design and perception of authenticity. Consider an interaction between a learner and a character of the game.

From the perspective of the environment design, it could be designed on the principle of realism (compliance with the character’s occupational status), consistency (integration of this interaction into a series of tasks, such as a validation moment required for the next task) and relevance (the character’s feedback should help students reflect on knowledge).

From the perspective of the student, interaction with a character can be perceived as realistic (similar to a professional reality he/she imagined), consistent (with the rules of the game, particularly the role-playing part) and relevant (the problem to be solved is useful for medical training).

5.3.1.5 Analysis of game activities throughout five sessions

The Table 5.1 below provides an analysis of the game activities on the first five sessions of the Biostatistics practical classes.

In the next sections, I study the perceived authenticity throughout the game. These perceptions are confronted with the game attributes designed to favour authenticity.

Session	Main Tasks	Goals	Computer Gaming Environment	Computer Environment
1	Bibliographical research, choose the main objective and make a plan	To gain knowledge about a specific disease as well as the methodologies used in epidemiological surveys	Public Library, Health Commission, Medical Information Department	LoE websites and videos (Public Health Commission board meeting and Medical Information Department)
2	Design an epidemiological survey and send the protocol for validation	To construct and structure a survey (sample quality, indicator quality, ethical considerations, etc.)	Public Library, Health Commission, Medical Information Department, Ethics Committee	Email application, LoE websites
3	Carry out the survey at one or several hospitals	To implement a survey (translate patient statements into data, control and organise data)	Hospital departments, Head of the hospital departments, patients	LoE virtual hospitals (website), mobile phone and interactive videos (patients)
4 5	Analyse data	To analyse data with statistical tools and thus understand them	Medical Information Department, Public Library	Statistical software, spreadsheet application

Table 5.1. Main tasks and learning goals of the game during five sessions.

5.4 Methodology

5.4.1 Data Collection

The study sample was composed of 170 second-year students of a medical school in Grenoble, France, in a compulsory biostatistics course they took in 2009–2010. They were distributed amongst 45 teams of 3 or 4 students.

Our set comprised transcripts of phone interviews with volunteer students. Between 19 and 23 students from as many teams (one student per team) were interviewed after each session.

5.4.2 Method

This was mostly an exploratory empirical study with the goal to get a large variety of students' feedback.

During the phone interviews I asked three questions during:

- What did you produce today?
- Do you perceive what happened today as strange or intuitively credible, with regard to a professional reference?
- Do you think what you did today is useful for your professional training?

I said very little during the interviews to let students spontaneously put issues on the table. I did not notify participants about the realism of the environment (e.g., that data were real) or about how it would be for a professional. Each phone interview lasted approximately five minutes.

5.5 Data Analysis

5.5.1 Method of Analysis of the Phone Interviews

For this study, we concentrated on the first four sessions (Table 5.1) where the students were the most in interaction with the web site of the game. There were approximately 8 hours of phone interviews, which were transcribed. Each unit of meaning (a topic addressed by a student after a question) was then allocated to one of the nine attributes (Figure 5.2), when one of them was mentioned by the student. The goal of the analysis was to identify cues mentioned by students to explain a perception of authenticity (i.e.,

whether a task seemed credible or not and why). The positions taken by a majority of students, as well as individual variability, could also be identified.

5.6 Results

Analysis of the Phone Interviews

The following presentation and discussion of results are organised under the four groups of attributes shown in Figure 5.3. In keeping with the study's exploratory aim, I believe that the worth of its findings rests on the diversity of issues tackled and on a detailed exposition of differences among individual cases. Therefore, qualitative assessment of the relative importance of various issues for different individuals was a prevalent underlying process in my analysis.

a. Mission - resources and original data

Students made judgements concerning the game's mission mostly during the very first phone interview, at the end of the first session (Table 5.1). Different cues were important to different participants, and assessments of the game's authenticity diverged, depending on what cues were perceived or taken into account by different individuals. On one hand, some students were ready to engage in the mission and to believe in its authenticity. A realism comment from one student was "It looks like it was not made just for us". Some students said that the documents themselves look "serious". Students mentioned two cues most often: the figures in these documents, or the model of protocol, both look real. The video showing a meeting between physicians and introducing the mission's issues was also taken as a cue by several students. One student added that it shows "... the importance of teamwork; it is not just a person who is going to change the world".

On the other hand, some students realised that they were going to conduct their own study but they knew the results in advance (from a literature search in the virtual library). They thought they would "not be able to prove anything new" or that they had to "pretend that the patients are going to be interviewed, but know that data have been collected already". The latter pointed out an internal incoherence perceived by some students: they had to write a protocol as if they were going to collect data, but at the same time they believed (at least for this session) that data would be given to them.

The data sent to students in table format, with patients listed in rows, were real, but students did not know it; most of them thought that the data were not factual but “look very real”. Different cues were used to suggest the data’s authenticity: “the data are variable, with few repetitions”, “there is much information”, “it looks like a physician did the survey because all the different forms of the disease are distinguished”, “there are a lot of details on each patient”, “we did not get exactly what we wanted, it is not ideal, it is annoying”, “the statistical test shows what we expected”, “we got an unexpected result”. The latter shows that whatever the result, students did not question the data’s authenticity. This and the impact of the figures included in the document show the importance of figures as crucial cues for students of their mission’s authenticity. One student even said that if the result was not what was expected from the literature review, they would have to look for an error in their methodology.

b. User freedom – constraints and level of control

One of the study’s findings in this area was that a number of participants mentioned the constraints spontaneously and could even discern the value of the constraints with regard to one of the authenticity dimensions. For one student, two cues for what I called external authenticity were that they did not “have access to patients without asking for an authorisation” and that “the more in advance they ask for data, the larger the number of patient files they get”. In contrast, for those students who got data too quickly, the interaction was not realistic. One important constraint with a didactical authenticity was that students could not listen twice to the same patient’s answer. None of the students understood the value of this constraint (see previous section); several of them even thought that it was not realistic, since in real life it is possible to ask a patient to repeat an answer.

About the level of control, students mentioned that they got more help than in real life (a protocol model to start with, many resources in the virtual library, feedback on many aspects of their protocol by email, etc), which made the experience slightly less realistic. In other words, they recognised the didactical intention behind the feedback they got, even when they came from the game’s characters. However, this was not seen as an internal incoherence or a factor of disengagement. A compromise between realism and relevance worked out in this case.

c. Mise en scene – visual and graphical attributes

No comment was made about the site structure and graphical design. It may be that these aspects were not a source of evidence of authenticity for students. They appreciated the quality of the environment; they characterised the environment as "serious", "well done", "expensive". However, this did not raise any judgement on its authenticity (external, internal or didactical).

d. Interactions with characters – personification and mode and media of communication

I now present how students perceived the various interactions on a scale of personification, starting from the most personified characters, i.e., the patients that appeared to students in the form of actors on videos.

The patients looked real to students, "although we know they are actors" or that "they read a text, for some of them". The cues used by students to talk about the authenticity of the patient interactions were numerous: "patients do not say what we ask them to say", "it is not perfect", "not very clear", patients "use their own words", "there are old people telling their life stories". According to a student, the "different types of patients are represented (cooperative or not, talkative or not, cranky or not...)". Compared to a real patient interview, one said, "It is the same; we have to sort what they say, and to translate it into medical terms".

As for the email interaction with the experts of the Ethical Committee, some students thought, "it looks like we [are] talk[ing] to our teacher" because it asks for modifications like teachers do, "it looks like they say almost the same thing to everybody in part of the message". It is important to note that students tried to compare the interaction with a real-world reference that they did not have. Therefore, realism was judged by what they thought was realistic, not by their prior experience. For this reason, most students reported that they could not judge the situation's credibility. One student believed that "maybe one gets no explanation when the protocol is rejected, in real life". On the other hand, this interaction appeared authentic to most students, for reasons such as "it looks real because the mail looks official", and "the content is serious".

Considering the interaction with the virtual hospitals, I got a different picture. Most students did not find it authentic, neither realistic nor relevant. From their point of view, "it does not look too serious when all of a sudden everybody gets an answer" (by short

message service [SMS]), “it is not credible to talk to an answering machine”, “very bizarre”, and it is the “same number for all hospitals”. However, one student thought that it looked realistic because “it is like that when you want to get an appointment with a physician, you often get to talk to an answering machine”. Several students claimed that it would be easier to know what to say with a real person, although more complicated to answer to his/her questions. It seemed hard for most students to play this interactive game, using an answering machine. On the other hand, only one student directly mentioned that “to get an answer by SMS is not realistic”.

Finally, I examined how the interaction with each hospital’s Department of Information was perceived. Students posted a data request to a virtual hospital and got a short email answer with a data file. Some students found it realistic, one because the email was signed. However, most students did not remember from whom they had requested their data, although they were asked about it only one or two hours after they had done it. Only one student reflected about how the system of interaction worked. For this student, it was magic when “we got data right away, the file, the patients on videos, and just what we wanted”.

5.7 Conclusion

In this chapter, I have presented a model that allows evaluating students’ perceptions of authenticity in a simulation game, and finding parameters that can be manipulated during the design and that favour this perception. This model incorporates three dimensions of authenticity: external (perceived likeness with a real-life reference), internal (perceived consistency of the proposed situations and game rules) and didactical (perceived relevance to learning goals).

The qualitative method used has proven quite successful, as it allowed for the collection and in-depth analysis of a wide variety of judgements concerning these matters. Overall, the results indicate that students’ judgements of authenticity pertaining to the LOE game can be very complex and specific. Particularly, I observed that given cues in the environment could play different, even contradictory, roles in the formation of these judgements. Students could use the same cue to make an opposite judgement. This shows that it would be interesting to look for individual traits that could explain some of the authenticity judgements. I also found that, in some instances, unfavourable

assessments could be promoted by cues that designers had hoped would instead favour authenticity.

I performed a behavioural analysis as follows. External authenticity (realism) was deduced from the fact that students behave in line with what they would do in "real" life. Internal authenticity was analysed in their interviews or in discussions amongst them (chapter 4). Didactical authenticity was finally linked to the recognition of the problem or not (wanted by teachers), and the deployment of a strategy to solve it.

The model (Figure 5.2) can be used to design an authentic game. For this, the proposed approach is to compromise amongst the three dimensions of authenticity for each of the attributes of the environment (Figure 5.3). Along the three years in which I participated on the implementation of LOE, I followed the successful modification on the design of the interactions with hospitals according to the three dimensions of authenticity: minimise the loss of internal consistency, make explicit the problem related to learning, and improve the realism of the mode of communication.

I have illustrated how the model of authenticity (Figure 5.2) can be used to study perceived authenticity. For instance, one may find students who perceive a learning game as externally and internally authentic but not relevant (e.g., students who rely strongly on the teachers and do not see the point of what they do in terms of learning).

Moreover, in a completely different research field, the model could be used when the game's authenticity should be judged by different experts. For example, the game's external authenticity, sometimes called fidelity (Scerbo, 2007), can be assessed by domain experts using recognised criteria. On the other hand, the didactical authenticity of an educational game can be evaluated by teachers. The whole question is then to assess if the gap between conceived and perceived authenticity is tolerable in terms of learning objectives. This discrepancy may result from past experiences of students (giving rise to different perceptions of reality), their understanding of the game's rules and the freedom they take from these rules (internal consistency), or their idea about their training (problems can be more or less prevalent and explicit). In a simulation game, the teacher's role is to support the devolution of a problem (Brousseau, 1997); in other words, to facilitate students' taking over the responsibility of the problem, its resolution and their learning, as well as to provide some methods for its resolution. Didactical authenticity ensures that problems are identified by learners. One must then

make certain that appropriation of problems takes place. In LOE, a lack of feedback from the game or tutors led students to ignore problems that were covered by the learning objectives (e.g., synthetic oral explanation of the purpose of their study, data control during and after their collection).

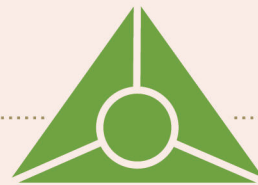
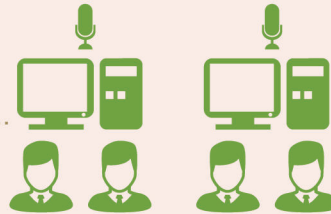
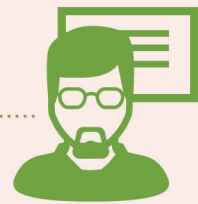
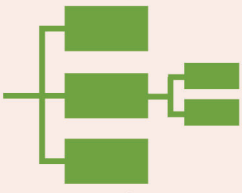
The present chapter's proposal is that designing a simulation game must result from a compromise amongst the three dimensions of authenticity. This authenticity is particularly desirable in courses that do not seem connected to the training's main objectives, such as biostatistics courses for doctors. Indeed, a mismatch between students' perceptions of their future profession and the content of this course (they think that statistics is useless for them) justifies an effort to contextualise the learning, that is, to offer an environment that allows students to go through authentic experiences.

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Part 3



Part 3

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Résumé en Français

RÉALISATIONS

Grille et modèles

Ils comprennent :

Une grille d'appropriation du rôle par l'étudiant (ARE) : pour servir dans un jeu de sérieux, avec jeu de rôles et supports d'analyse *a priori* et *a posteriori*.

Un modèle d'appropriation du problème par l'étudiant (APE) : décomposé en 5 catégories : acceptation, test, choix effectué, anticipation et maîtrise.

Un modèle de conception d'authenticité et de perception d'authenticité (CAPA) : qui génère et analyse d'authentiques expériences d'apprentissage.

Mesures

Mesure de l'appropriation du rôle par l'étudiant : pour y parvenir, j'ai conçu une grille utilisant les relevés d'activités pour formuler des critères et des indicateurs.

Appropriation du problème : lors de l'appropriation d'un problème dans LOE, les étudiants interagissent avec leur environnement, ce qui produit des situations didactiques variées au fur et à mesure que la situation progresse. Parfois, les équipes collaborent et utilisent le processus de grounding. Les étudiants produisent de nouvelles significations à partir de l'objet approprié.

Mesure de la perception d'authenticité des étudiants : j'ai choisi neuf attributs d'authenticité qui se répartissent dans les quatre domaines de conception d'un jeu – mission, liberté de l'utilisateur, mise en scène et interactions avec les personnages. La pertinence, la cohérence et le réalisme définissent l'inclusion de chaque attribut dans le jeu. Lorsque ces dimensions se heurtent, l'authenticité didactique prend toujours le dessus. J'ai créé une grille afin d'analyser l'authenticité souhaitée lors de la conception du jeu, et la perception des étudiants.

Résultats

Grille ARE : détermine le degré d'appropriation du rôle par les étudiants, degré calculé en additionnant les notes des indicateurs.

Modèle APE : confronte les caractéristiques obtenues avec les modèles CPS et SM, facilitant ainsi la compréhension de l'interaction et le processus d'appropriation du problème.

Modèle CAPA : permet d'évaluer la mesure selon laquelle les étudiants trouvent un environnement authentique ou non, et d'ajuster ces éléments lors de la conception de l'environnement afin d'en accroître l'authenticité.

DISCUSSION

Appropriation du rôle et du problème : dans un jeu d'apprentissage, la cohérence, le réalisme et la pertinence d'un problème sont liés. Dans LOE, s'approprier des rôles offre aux étudiants une perspective et un contexte spécifiques à l'intérieur du jeu, apportant une cohérence à leurs actions laquelle permet l'appropriation.

Appropriations individuelle et collective : l'appropriation individuelle d'un problème requiert de la part de l'étudiant qu'il transforme l'objet dans un contexte évolutif. Petit à petit, l'appropriation du problème mêle la création de sens à son application pratique. L'appropriation collective s'opère lorsque les membres d'une équipe coopèrent. Dans LOE, les étudiants articulent une connaissance « individuelle partagée » avec des modèles internes. L'adoption d'un consensus devient cruciale pour le bon déroulement des activités, et le sens est généré par le dialogue. Par l'utilisation d'un discours commun, les étudiants confrontent leurs idées et les négocient, ce qui facilite ensuite l'appropriation collective.

L'appropriation du rôle et de l'authenticité : pour qu'un jeu de rôle fonctionne, l'environnement doit accaparer et immerger le joueur. L'accomplissement de cet objectif dépend en partie de la conception du jeu et de sa cohérence interne. Des éléments constructifs (graphiques, récits) permettent au joueur d'entrer dans le jeu et de s'y concentrer. Le modèle CAPA permet de réunir la cohérence, le réalisme et la pertinence d'un environnement d'apprentissage.

Problème d'appropriation et d'authenticité : la pertinence est fondamentale dans les jeux d'apprentissage. D'autres dimensions (réalisme, cohérence) offrent aussi un contexte et un accès au problème mais elles sont subordonnées à l'apprentissage et, partant, à l'authenticité didactique. Dans un jeu d'apprentissage, les enseignants et les concepteurs du jeu souhaitent que les étudiants résolvent un problème afin d'en retenir une connaissance spécifique. Les étudiants développent une perception de cette pertinence lorsqu'ils s'approprient le problème. Les outils qu'ils développent pour le résoudre sont formés par la connaissance de la cible. Ainsi, les enseignants comme les concepteurs confient aux étudiants la responsabilité de la résolution du problème. Cependant, les étudiants perçoivent également la pertinence du jeu à travers leur propre engagement, et il peut arriver que le problème approprié ne soit pas celui attendu.

Conception et perception de l'authenticité : un écart peut exister entre le degré d'authenticité souhaité et celui perçu par le(s) joueur(s). Les enseignants peuvent le gérer. En concevant des situations didactiques, ils construisent un environnement et y déposent un problème. Cela nécessite une recontextualisation et une repersonnalisation du problème, lequel est ensuite proposé aux étudiants qui interagissent et tissent alors des relations avec le milieu, utilisant leur connaissance pour s'approprier le problème. En agissant ainsi, ils perçoivent l'environnement, re-decontextualisent et re-depersonnalisent le problème.

LIMITES ET SUGGESTIONS DE FUTURES RECHERCHES

L'appropriation : modèle et mesure

Problème n°1 : la grille d'appropriation du rôle ne fut pas validée par les hypothèses imaginées. D'autres analyses parviendraient à renforcer cet instrument.

Problème n°2 : malgré le nombre de données réunies, la taille de l'échantillon reste réduite. D'autres variables devraient être collectées dans de plus grandes quantités.

Problème n°3 : certaines catégories d'appropriation n'ont pas été prises en considération et mériteraient de nouvelles recherches. Notre analyse, qui s'est concentrée sur le cas étudié et environ 1 200 énoncés, pourrait être élargie.

Problème n°4 : le modèle APE souffre de complications dues à son articulation avec deux autres modèles conceptuels – les modèles SM et CPS. Une simplification permettrait d'améliorer sa compréhension.

Problème n°5 : l'acte de tester représente un comportement fondamental lors de l'appropriation individuelle, et la conception didactique doit inclure une durée suffisante. Dans LOE, la durée précisée était « aussi longtemps que nécessaire à l'étudiant ». Certains étudiants ont alors été découragés du temps passé à comprendre l'environnement, livrés à eux-mêmes. Un compromis doit être trouvé entre laisser librement agir les étudiants et leur apporter de l'aide.

L'appropriation : faciliter le processus

Les jeux d'apprentissage proposent des situations dans lesquels les joueurs mènent des enquêtes. Les étudiants mettent à l'épreuve des actions et des significations, ce qui produit peu à peu du sens. Ils appliquent des modèles internes et font des choix qui s'appuient sur leurs découvertes, ils formulent des hypothèses et anticipent leurs résultats. Le rôle du tuteur est principalement d'introduire les étudiants dans le jeu et d'enclencher les situations d'apprentissage et de jeu. Son discours doit donc être adapté. Les intentions du tuteur peuvent influencer les étudiants, ceux-ci peuvent faire des découvertes sans aide extérieure (le risque étant celui d'une appropriation dans la mauvaise direction). Le juste équilibre entre liberté et supervision doit être trouvé.

Authenticité : modèle et mesure

Problème n°1 : le modèle CAPA est trop vaste, ce qui peut le rendre difficile à comprendre et contestable. Je conteste ainsi les écrits qui renvoient systématiquement l'authenticité au « réalisme ».

Problème n°2 : l'authenticité est parfois considérée non pas comme une qualité objective mais comme un jugement subjectif : est ainsi authentique tout jeu perçu comme tel par un étudiant. Je pourrais résoudre ce problème grâce aux spécificités de l'environnement mais, pour le moment, je n'ai pas favorisé une approche fondée sur le profil des étudiants.

Problème n°3 : de nouvelles recherches sont nécessaires pour parvenir à mesurer l'authenticité. La banque de données utilisée pour cette recherche n'a pas servi à produire des résultats quantitatifs ni généralisables.

Le Laboratorium d'épidémiologie (LOE)

Dans le jeu de rôle, la plupart des étudiants ont bien interagi avec les personnages et ont obtenu des scores élevés dans l'appropriation du rôle. Cependant, nous avons noté une préférence pour le rôle de l'étudiant en médecine aux dépens de

celui d'épidémiologiste, vers lequel le jeu tendait pourtant. Plusieurs causes à cela parmi lesquelles :

Les tuteurs : ils n'ont pas toujours pris ou développé un rôle approprié, ce qui a entravé la dévolution et la cohérence.

La conception : l'environnement conçu n'a probablement pas suffisamment gommé le rôle habituel dévolu aux étudiants ni/ou stimulé un besoin pressant de s'approprier un nouveau rôle.

CONCLUSION

L'éducation sous-tendant les sociétés modernes, elle se doit d'évoluer et de s'adapter aux besoins sociaux émergents qui réclament de l'innovation et des défis à relever.

L'application de la théorie des situations didactiques permet d'élucider les processus d'apprentissage *in situ*. La combinaison des nouvelles technologies et des stratégies d'apprentissage produit un cycle d'innovations cherchant à optimiser les situations didactiques.

C'est particulièrement vrai pour l'éducation supérieure, j'entends ici l'éducation médicale. Nombreux sont les étudiants qui investissent du temps et des efforts dans l'acquisition de compétences théoriques (comme la biostatistique) pour lesquelles ils ne trouvent aucune application pratique et qu'ils oublieront par la suite.

Ma thèse s'oriente plus vers une approche psychologique et étudie les processus d'apprentissage lorsque des problèmes pratiques sont contextualisés. Mes recherches n'abordent pas la qualité de l'apprentissage des étudiants.

Lorsque les étudiants apprennent dans un jeu sérieux, les éléments clés comprennent leur appropriation du rôle et du problème. Dans LOE, ils transforment leur rôle supposé pour se l'approprier. Ils s'approprient également un problème et, ainsi, transforment la signification des objets proposés, produisant fréquemment des significations (réelles) qui diffèrent cependant de celles attendues.

Dans cette thèse, je propose des modèles conceptuels qui déterminent les interactions dans un jeu d'apprentissage. L'authenticité joue un rôle de médiation, reliant l'individu à l'environnement. L'authenticité du milieu doit permettre de stimuler des expériences authentiques, par lesquelles l'élève s'approprie un problème et produit de la compréhension (théorie de la signification), agissant dans le sens de la tâche (théorie de l'activité), s'appropriant les éléments graduellement, utilisant et maîtrisant un outil culturel.

Discussion and Conclusion

Based on the embedded phenomena, the Laboratorium of Epidemiology (LOE) project has been developed as a possible answer to some specific needs of the education system by associating new technologies with new learning strategies and frameworks. The present thesis was developed in the context of this need and the emergence of the related innovations, specifically regarding the teaching of epidemiology in medical school. In the following section, I discuss the main contributions of my work.

Having presented three empirical studies in Chapters 3, 4 and 5, this section discusses the contributions of these studies, the results obtained, the relationship between the contributions, the problems I encountered during the execution of the program and the need for further investigation.

6.1 Contributions

In this thesis, I have primarily investigated the student learning experience in particular learning situations (Chapters 3, 4 and 5). I have also presented and analysed the learning object implemented in such situations (Chapter 2), as well as the processes through which the learning took place (Chapter 0 and Chapter 1). In the domain of technology-enhanced learning, I have investigated appropriation phenomena, the perception of authenticity and learning environment authenticity in didactic situations involving role-playing in game-based learning.

6.1.1 Conceptual models

My study contributes to the design of didactic situations and learning information technology (IT) environments through the introduction of a grid and two conceptual models for the analysis and measurement of student role appropriation and student problem appropriation, as well as a model for the design and perception of authenticity.

a. The Student Role Appropriation Grid

The study introduced in Chapter 3 presented a grid for student role appropriation (SRA-Grid) in role-playing interactions with characters of a serious game via email

and voice messages. The SRA-Grid supports the design of *a priori* analyses by representing students' role-playing interactions. It also supports *a posteriori* analyses by offering markers for student role appropriation. One grid covers possible email interactions, while the other grid covers possible phone interactions.

b. The Student Problem Appropriation Model

The student problem appropriation model (SPA-Model) introduced in Chapters 1 and 4 was inspired by Brousseau's (1992; 1997) example of the “**steps** of devolution” of an “adidactic situation”. The SPA-Model provides a frame for modelling five different categories of the process through which students appropriate a problem:

- *To accept* concerns the didactic contract; it is “ground zero” for appropriation and can be seen in the students' intention to invest in problem-solving.
- *To test* concerns the students' actions in the milieu without a clear expectation of what can be obtained by these actions. It is an action motivated by the desire to explore, to discover or to find out what will happen.
- *To make choices* concerns the actions that students perform while they are conscious of other possibilities for performing a given activity but still do not have a clear idea of the results of these actions. When they make a choice, their intention is to spot the result of a specific action among others.
- *To anticipate* concerns the students' action in the milieu as they are conscious of the possibilities of action and the possibilities of results. Students are able to elaborate on the hypothesis and evaluate the impact of their choices.
- *To master* concerns the students' ability to intuitively identify different groups of problems with common characteristics and strategies for problem-solving in different situations.

This model is associated with the Baker's (1995, 2002) Collaborative Problem-Solving Model (CPS-Model) and Brousseau's (1986) and Margolinas' (2004) Model of Structuration of the Milieu (SM-Model). The SPA-Model then supports the design

of didactic situations and learning environments, thereby offering elements for *a priori* analyses of the process students use to appropriate a problem. It also supports *a posteriori* analyses of student problem appropriation, providing elements necessary for assessing students' conceptual constructions as well as elements necessary for assessing the learning environment design and the didactic situation design. A better understanding of the processes that students use to appropriate a problem is likely to contribute to the conception and development of environments that are better adapted to students' learning needs.

c. Model of Authenticity and the Perception of Authenticity

The serious game LOE is designed to contextualise, for instance, the training of students to elaborate and achieve the main objectives of an epidemiological survey and thus provides an authentic learning situation. Serious games are vectors that allow authentic experiences, and these experiences can only be undertaken by the students—the players—who perceive the learning environment as realistic enough to believe, coherent enough to play and relevant enough to learn. The model of authenticity introduces a fundamental compromise amongst realism, coherence, and relevance for learning environment designs, thereby enabling an authentic learning experience.

6.1.2. Measuring tools

The models utilised in this study offer a grid that can be used for measuring role appropriation and analysing problem appropriation, as well as for the conception and perception of authentic designs.

a. Measuring student role appropriation

With the intent of analysing students role-playing during the LOE sessions, I have sought to determine criteria for determining whether a student appropriated a role in the context of the game. In addition, I have sought to determine the indicators of role appropriation that could be collected using an analysis of students' activity tracks. Analyses of role appropriation were conducted using traces of students' interaction with characters in the game through email and voice messages. Using an ethnomethodological approach, I have observed regularities and recurrences in the behaviour from the data analysed in the pilot study, which I

have used to generate a grid that was validated in a large-scale study. The data pool was enriched with a second large-scale study (Chapter 3, Figures 3.6, p. 154, and 3.8, p. 165). The grids for email and voice messages took the following student characteristics into consideration:

- *Elements of Identity*, including the identity assumed by the player during the interaction with the game characters (professional, oneself, student, etc.) and the context in which the players situated themselves during these interactions (naming an employer, working in a team, schoolwork, etc.);
- *Attitude* towards the game character (formal or informal); and
- *The Message*, including the content and structure of the written (heading, text, etc.) or oral messages according to the objectives of the game.

b. Analysing student problem appropriation

In the process of problem appropriation, the students established different interactions with the milieu, producing different didactic situations as they advanced in the structuration of the milieu (Margolinas, 2004). If the students worked in teams, they were also able to undertake collaborative problem-solving and, possibly, grounding processes (Baker, 1995, 2002). Students addressed their intention to appropriate a problem, gradually actively transforming the provided problem and producing new significations and personal senses from the appropriated object in this activity. The processes followed a pattern of behaviours identified in the different categories of the model of appropriation, which were analysed using an interaction analysis protocol (see Chapter 4, Section 4.3.2.2, p. 183).

c. Measuring student perception of authenticity and conceiving authentic environments

To create a measuring instrument, I selected the attributes of authenticity from Wilson et al.'s (2011) propositions of game attributes whenever I could identify such attributes in the LOE. I was able to identify nine attributes of authenticity distributed throughout four different areas of the game design (see Chapter 5, Figure 5.3, p. 224):

- *Mission*: Original data, mission content and resources

- *User Freedom*: Constraints of the interaction and level of control of the users
- *Mise en Scene*: Graphical representation and structure of the environment
- *Interactions with the Characters*: Content of the character's feedback and behaviour, personification of the characters and mode and media of communication

Each attribute was included in the game design following the dimensions of the authenticity model: relevance, coherence and realism (see Chapter 5, Figure 5.2, p. 221). Didactic authenticity (relevance) was dominant whenever a conflict between dimensions was identified. The attributes enabled me to create a grid for analysing the conceived authenticity of the game design as well as students' perception of the authenticity of the game design.

6.1.3. Generalising Results

In the following section, I discuss the results obtained in the analysis of the models and grids proposed in my study.

a. Contributions of the SRA-Grid

The SRA-Grid made it possible to determine whether students appropriated a role, delineating role appropriation in the above-mentioned situations. The sum of the scores attributed to elicit indicators of role appropriation enabled the measurement of role appropriation in the role-playing situation.

b. Contributions of the SPA-Model

Associated with the CPS-Model (Baker, 1995, 2002) and the SM-Model (Brousseau, 1986; Margolinas, 2004), the SPA-Model offers elements for interaction and an in-depth understanding of the process of student problem appropriation. The model was applied in a case study in which the production of meaning and personal sense took place in social interactions within a teamwork setting. Students' utterances during the teamwork process formed a common discourse that became a milieu for knowledge building. This analysis demonstrates the importance of a common discourse during the appropriation process of a problem by illustrating some of the categories from the proposed model.

Appropriation concerns student freedom and responsibility. Freedom of action in a situation gives students a chance to test, to choose, or to anticipate, thereby

enabling the appropriation of a problem. Responsibility for a problem drives students' intent to appropriate a problem and their motivation to act and undertake actions to solve it. Didactic engineering must consider elements of testing and making choices during the structuration of the milieu to facilitate problem appropriation. The learning environment most likely to facilitate problem appropriation is the one that is capable of proposing situations that favour the manifestation of behaviours, such as testing, making choices and anticipating.

Tutors must respect this time of testing and of making mistakes since they are fundamental for the appropriation process. In addition, such a time of testing possibly provides elements for structuring other categories of behaviour, such as making choices and anticipating.

c. Contributions of authenticity

The proposed model for learning games and simulations was the result of a compromise amongst the three dimensions of authenticity: external, internal and didactical.

The model enabled the assessment of the students' perception of authenticity, and the various attributes could be adjusted during the conception stage of the environment to favour a positive perception of authenticity. The behavioural analysis of student-perceived authenticity deduced external authenticity (realism) from the students' underlying assumptions of reality; internal authenticity (coherence) from the students' engagement in the game; and roles and didactic authenticity (relevance) from the students' ability to discern a problem proposed by teachers and to deploy a strategy to solve it. The contextualisation of learning content in a game under the instructions of the model of authenticity offered an environment that was likely to allow students to progress through authentic learning experiences.

6.2 Discussion

Transactions on appropriation and authenticity

For the following topics, I analyse the relationships between the different concepts and variants of the concepts introduced in my thesis.

a. Role appropriation and problem appropriation

A relationship was found between the coherence and the realism of the game and the relevance of the problem appropriated in the game. LOE contextualised the problem in the form of a serious game. In the course of the game, there were moments in which students were required to role-play. This role-playing offered a context in which the students could articulate the problem with a purpose. The identity assumed by the student (whether one of a doctor, a medical student or simply him/herself in the case of LOE) was not actually very important, provided that students took the game character with which they interacted seriously. Role-playing is an activity that produces sense. In order to make a phone call and formulate main objectives or to send an email introducing their protocol in an attached file, students had to appropriate something. The role-playing game as an activity provoked a necessity, for instance, expressing oneself clearly to a character in the game in order to accomplish a task. By trying to express themselves clearly, students ended up formulating implicit models. The thought-activity relationship led to the production of a personal sense in the context of the activity underlying the role appropriation that was not necessarily accessible otherwise. The perspective of the roles that the students appropriated gave them a setting in which the problem had a specific sense in the context in which the role was being played. The goal of the students' actions for addressing a problem in the context of the game (e.g., interacting with a character) in the course of a particular situation brought coherence to the students' actions, which facilitated the appropriation of the problem.

b. Individual appropriation and collective appropriation

Students appropriated a problem individually by transforming the object they intend to appropriate. By doing so, they applied their own available models to build knowledge-objects. Problem appropriation takes place in the situated action and in the transforming development in which contextualised interactions have evolved historically. Problem appropriation gradually combines meaning making and its deployment in activity operations.

Collective appropriation of a problem considers collaborative problem-solving in teamwork. Students produced utterances that articulated knowledge and formulated internal models. They externalised produced meanings and were motivated by their subjective needs. Agreement upon decisions became an important element for the development of the activities. The processes of meaning making were then deployed in the operations of dialogical language activities. Coworkers' common discourse becomes the arena of confrontation of different meanings produced by different individuals. The students negotiated a common semantic basis for the common discourse. Such grounding processes bridge the gap among individuals and contribute to establishing a collective appropriation.

From the individual towards the collective, coworkers share significations and senses developed individually in the form of words and signs. From the collective to the individual, collaborative discourse provides new elements to enrich the knowledge from the individual who actively appropriates it.

c. Role appropriation and authenticity

Role appropriation is closely related to two dimensions of authenticity in a learning environment, namely coherence and realism. Role-playing and game design narratives address students' perception of authenticity. Their purpose is to engross the player, which is an important level of immersion in games (see Chapter 3). Engrossment depends partially on the design of the game, namely, its internal coherence. Various elements, such as graphics, tasks, and the story narrative, are very important here. Engrossed players are emotionally engaged in the game, focusing their attention and their emotions on it. This was the intention of the introduction of role-playing in a serious game. By proposing interactions through phone and email, the game design attempted to gain the players' attention and emotional investment. In my past studies, the model for authenticity has historically come up in the context of a "fail" in role appropriation analysis. Role appropriation is related to immersion and role-playing and cannot develop without these concepts. Role appropriation is also related to the realism of the learning environment. The model of authenticity is an upper layer that connects coherence and realism to the relevance of a learning environment. The relevance dimension, that is, the didactic authenticity, is in turn closely related to the concept

of problem appropriation. Internal coherence is connected to the narrative and thus to role appropriation. The upper layer of the model of authenticity adds external authenticity (realism) and connects both dimensions.

d. Problem appropriation and authenticity

The relevance dimension in learning games (the didactic authenticity of the game) is a major concern. The other dimensions (realism and coherence) are of great importance for contextualising the problem and for providing students with the ability to access the problem in a rich and meaningful context, but these dimensions must be subjected to the main objective here, which is learning, and therefore must also be subjected to didactic authenticity.

Didactic authenticity is closely related to student appropriation of the problem. From the perception of teachers and designers, the relevance of the game is a feature that requires the students to solve a problem that provides an opportunity to learn target knowledge. From the students' perspective, the perception of the relevance of the game arises in the process through which the students appropriate the problem, making it their own and giving it a sense of relevancy to them personally. During this process, students identify and solve the presented problem by the development of a tool, which is the target knowledge that teachers and designers want the learner to assimilate.

The perception of relevance is then partly ensured by teachers' and designers' efforts to transfer the responsibility for problem-solving to the learners. This devolution of the problem takes place through the steps that this problem requires the student to take in the gaming context and that are enabled by the game environment (assignments, information, game rules, game characters, constraints, etc.); therefore, the devolution of the problem is assisted by the other dimensions of authenticity that contextualise the problem. The devolution is also supported by teachers *in situ*, who observe the process that students use to appropriate the problem. On the other hand, the perception of the game's relevance is supported by the students' engagement in the game, addressing their intention to appropriate the problem. In game-based learning, as in every didactic situation, there is always the appropriation of a problem, although not necessarily the problem intended by the teacher. If appropriation of the target problem is not reached, there is a risk that learners will address an unintended problem and adopt a strategy that is not

relevant. The dimensions of authenticity of a learning game (relevance, realism and coherence) therefore mediate the relationship between devolution and appropriation.

e. Authentic game and perception of authenticity

There is always the risk of there being a gap between the designer's intention to produce an authentic learning environment and the user's perception of a learning environment as authentic. Such a gap between perceived and conceived authenticity can be managed by teachers. Teachers must facilitate students taking over the responsibility of the problem, the resolution of the problem, the learning process.

The students' role is to appropriate the problem, and the teachers' role is to ensure the target problem is appropriated. The relationship between design authenticity and the perception of authenticity is similar to the one between the teacher devolution of a problem and the student appropriation of that problem.

Teachers design didactic situations, structuring a milieu in which a problem is hidden. The design of the didactic situation considers a recontextualisation and a repersonalisation of a real problem. The teachers' design should consider the criteria of authentic designs. In a didactic situation, teachers devolve a problem to students in a negotiation that intends to motivate students to take responsibility for the proposed problem. The authentic design of the game supports devolution with the attributes regarding the authenticity model (see Chapter 5, Figure 5.3).

Students interact with this design, establishing relationships with the milieu and mobilising their available knowledge to appropriate the problem. In this process, they perceive the design, they build representations of the design, and they may sense the authenticity that the design affords as they re-decontextualize and re-depersonalise the problem. Difficulties in such a perception should be supported by the teacher *in situ*.

6.3 Limitations and suggestions for future research

In this section, I describe some of the problems and limits of my work and propose solutions for them when possible.

6.3.1 Appropriation: model and measurement

Problem 1:

No hypothesis testing was undertaken for the grid of role appropriation to validate the instrument. Although the grid was designed carefully and with rigour, further analysis of the grid would help to establish a strong instrument for obtaining more solid results.

Problem 2:

Although a large amount of data was collected for role appropriation, the sample size was still small for a heuristic study. In order to be statistically significant, some variables need to be collected in higher quantities.

Problem 3:

Some categories of appropriation could not be considered for issues related to the quality of the material collected and the timing for when the data were collected. The categories “to make choices” and “to master” should be investigated in the future. Another difficulty is the fact that the analysis was based on a case study. Although the illustration helps to clarify the appropriation phenomena, the pool of analysis is composed of about 1,200 utterances; it is therefore necessary to extend the analysis to other classes from the same team as well as other teams to generalise the behaviours of the process of appropriation.

Problem 4:

The SPA-Model is still difficult to manipulate since it functions by articulating two other conceptual models, namely the Structuration of the Milieu (Brousseau-Margolinas) and Collaborative Problem-Solving (Baker). Further simplification of this process is needed for a better understanding of the process.

Problem 5:

A fundamental behaviour supporting individual appropriation is the one of testing. Consequently, time becomes an important element for the didactic engineering design since granting students time to test the IT environment helps them to appropriate a problem. In the case of LOE, the designer and tutors agreed to grant

students as much time as they need to test the environment. The students each appropriated the problem in their own way; however, they were on average paradoxically upset for having spent so much time getting acquainted with the environment without the support of the tutor. Many reports of feeling lost and not knowing what to do were expressed. It is important to find a compromise between giving the students freedom to act and providing support.

6.3.2. Appropriation: facilitating the process

An environment designed to be a serious game is an environment that is intended for training and developing competences. Serious game design that favours problem appropriation is the one proposing situations in which players conduct investigations. In such situations, students gradually become acquainted with the problem by testing actions, meanings and operating actions. Such actions gradually help the students to produce a sense of what is appropriated, which comes from the application of internal models as activities of the game. As tests help to identify options, students gradually become capable of making choices based on the discovered options and by learning the specific results for each option; the students then become capable of formulating hypothesis and anticipating results. A game design that favours appropriation is one that is able to facilitate the above-mentioned process. Game narrative, available information, small missions to enter the game and access the problem are some elements from the environment likely to facilitate appropriation of a problem.

The tutor's discourse is also very important. If in such context, a tutor's purpose is to introduce the students to the serious game, thereby bridging the learning situation and the gaming situation, his or her discourse must be adapted to the one of the game. This requires the tutor to reposition himself in the context because his role in the class becomes different. In this case, a tutor who facilitates the process of appropriation is the one who is capable of devolving the expected problem in the appropriate context.

As Brousseau identified paradoxes of devolution (Brousseau, 1997), there are also paradoxes of appropriation that must be investigated. The intentions of the tutor are likely to influence the intentions of the student. The tutor cannot tell students what they are expected to do; students must find out by themselves or they will

not appropriate their problem, but rather the tutor's problem. Further studies should be dedicated to establishing a difference between the teacher's intentions and the student's intentions, thereby engendering the development of such paradoxes. For instance, there is a paradox of freedom in the appropriation process in a didactic situation—students need freedom to act so they can accept, test, make choices, anticipate, master and consequently appropriate a problem, but too much freedom may provoke behaviours of resistance since they feel lost and do not know what to do. It is important to find a compromise between student's freedom and necessary supervision.

6.3.2. Authenticity: model and measurement

Problem 1:

My version of authenticity is a large concept that includes three dimensions; this may make it difficult to understand this model and may make it contestable. Moreover, I deviate from part of the literature that refers to authenticity as simply realism. Actually, for a long time, the term authenticity has been appropriated by different disciplines and has gained different meanings, becoming rather ambiguous. Further bibliographic study is needed to resolve this problem.

Problem 2:

Petraglia (1998) argues that authenticity is not an intrinsic property possessed by an object, but rather is a judgment or decision made on the part of a learner from the standpoint of his/her past experiences and sociocultural context. An authentic game is a game perceived as authentic by learners. This conception of authenticity sets limits on its development in the sense that authenticity is not something tangible since each individual perceives it differently. To overcome this, I need to develop specificities on the environment, but for now, we have not proposed an approach to favour the perception of authenticity according students' profiles.

Problem 3:

The measurement of authenticity requires further development. What we have produced until now has followed an ethnomethodological approach that has helped us to discover social organisations and create theoretical models. However,

we have not exploited our database to produce quantitative or generalizable results so as to apply the results to other contexts.

6.3.4. The Laboratorium of Epidemiology

When focusing on the serious game rather than my theoretical models, most students did not appropriate the role of an epidemiologist in terms of role-playing, preferring to play the role of a medical student. Despite elements of the IT environment inciting students to play the role of an epidemiologist, students generally preferred play a role with which they were already familiar. However, most of the students obtained relatively high scores in role appropriation. Although they did not play the expected role, most of them interacted with the game character.

Some of the following causes for this mismatch could be investigated:

The tutors

The tutors sometimes did not develop the appropriate role or did not play the appropriate role during the session, thereby handicapping the devolution of aspects of realism and coherence of the game.

The design

The environment may not have had enough elements in its design to create an obstacle to the familiar student role or to stimulate a need for appropriating a new and different role in the context of the game. Designers should introduce techniques to increase the awareness of group dynamics in the didactic situation, converging the learning environment and tutor support to motivate students to work in-role development for role-playing.

It is also important to personalise the characters of the game with information, description, images, and videos in order to render characters more life-like. If characters are sufficiently personified, students will be more likely to engage in a role in order to interact with them.

An element of interaction in the game that becomes too repetitive tends to provoke disengagement, so it is important to render the interactions as natural as possible. In some cases, students had to make more than two phone calls or send more than

two emails to accomplish a game objective. Therefore, Email and phone communication had its instructions adapted along the different experiences in order to avoid too much repetition and thus disengagement. In the case of the phone communications, communication with a real person was even used to help students who were having difficulty formulating their problem.

6.4 Conclusion

Educational systems form the basis of modern societies. Education renovates the structure of societies, preparing individuals to integrate into its institutions. On the other hand, as society evolves, education must also evolve, adapting to society's emergent needs, becoming innovative and facing new challenges. Constructivism and socio-constructivism are paradigms which contributed to a conception of learning from the learner's perspective, which prepared the field for the development of contemporary learning strategies. Problem-based learning, collaborative learning, project learning, game-based learning and discovery learning, for instance, are learning strategies that contributed to innovating education. The theory of didactic situations (TDS) was originally influenced by the constructivism. The TDS offers another focus to allow the understanding of social interactions between learners, teachers and knowledge in a classroom setting, and an understanding of the condition under which learning takes place through ground-breaking concepts such as didactic contract, devolution, institutionalisation, didactic situations and the structuration of the milieu. Its micro-didactic features offer powerful instruments for the design of didactic situations in contexts of problem-based learning strategies.

In parallel, the development of new technologies offered opportunities to innovate education with the integration of technological tools in learning strategies. Scientific communities flourished around the cause of the education and new technologies, such as computer-supported inquiry learning and computer-supported collaborative learning.

The meeting of new technology instruments and learning strategies engendered a cycle of innovations and the emergence of new strategies, concepts and forms of designing or enriching didactic situations. Among these, it is worth mentioning the

embedded phenomena. Applied to the classroom, it proposes simulations reproducing scientific phenomena during regular classes and providing authentic situations of learning. This is an interesting finding for project-based learning, discovery learning, game-based learning and so on. It is a unique manner of introducing simulations and learning games in schools in an ecologic manner. It contextualises learning experiences, finding support in new technologies.

An important field of application for the combination new technologies and learning strategies is training in higher education (e.g., medical education). One of the difficulties in a discipline such as biostatistics in medical school is that students feel that they put forth great effort to acquire competences for which they do not understand the utility. With time, such incomprehension leads students to forget and lose the acquired competences.

This is the context in which my thesis takes place. According to traditional studies in the didactic of disciplines (Jonnaert & Laurin, 2001), the present work is oriented towards psychology, reflecting on the subject as a learner under a special conditions in a learning situation, but it also carries elements orienting towards epistemology, reflecting on learning objects and the learning process.

Considering this context, this thesis investigated the student learning experience when attempting to contextualise practical problems in epidemiology and biostatistics in an innovative learning situation and in a situated and contextualised learning process. The learning experience involves the way students play the game, the way they learn by appropriating a problem and the perceptions they have regarding the authenticity of the situation proposed.

The quality of students' learning itself was not an object of study. The interest here was directed towards the learning process in specific environments. A better understanding of the phenomena underlying the learning process will contribute to future studies on the quality of teaching and the conception of new tools to be introduced in the education system.

This thesis presented theoretical and conceptual propositions in the form of the appropriation phenomena and was interested in investigating the students learning process in the context of a serious game, addressing the very conditions in which such learning happens.

In the learning experience promoted by a serious game, appropriation of a role, appropriation of a problem and perception of authenticity are the elements that compose some of the experiences of individuals when they interact with an object.

The sense of appropriation goes from the individual towards the object in an active process in which the individual appropriates a role while playing a game or appropriates a problem while attempting to solve it. In both concepts, individuals transform in order to appropriate.

Students were expected to play the role of epidemiologist, but mainly played the role of a medical student. They transformed the proposed role in order to appropriate it in the context of the game. Students were expected to appropriate a problem. While appropriating the problem, students transformed the signification of the proposed objects, producing a real signification that was sometimes different, and even opposite, to the expected formal signification.

The sense of the authenticity goes from the object towards the individual. The designer of the game sought to find a compromise between external realism, internal coherence and didactic relevance. The individual actively perceives the coherence, relevance and realism of the game.

Considering the process through which the learning process takes place in an innovative learning situation, I proposed three conceptual models that determine the interaction between individuals and objects in the context of learning games.

Authenticity takes part in some kind of mediation between the individual and the milieu. The authenticity introduced in the milieu intends to provoke an authentic experience. The individual interacting with the milieu seeks to appropriate a problem and produce meaning (theory of signification), acting in the sense of the task (theory of activity) and struggling to appropriate a cultural tool and use it and master it (see Chapter 1, Section 1.2.2.3 a, b and c); this individual perceives, to a certain degree, the authenticity of the milieu. The relationship among external, internal and didactical authenticity is expected to produce an impact on the individual and help him/her in the process of appropriating the problem, providing a context that contains certain realism relative to real world situations and containing an internal coherence in its narrative, which provides credibility and relevance to the target learning. The individual then manifests perceptions of

the authenticity of the design. He/she perceives implicitly the commitment among external, internal and didactical milieu. Therefore, the “authenticity phenomena” (the state and the perception of the authentic state) mediates the student activity of the appropriation of a problem.

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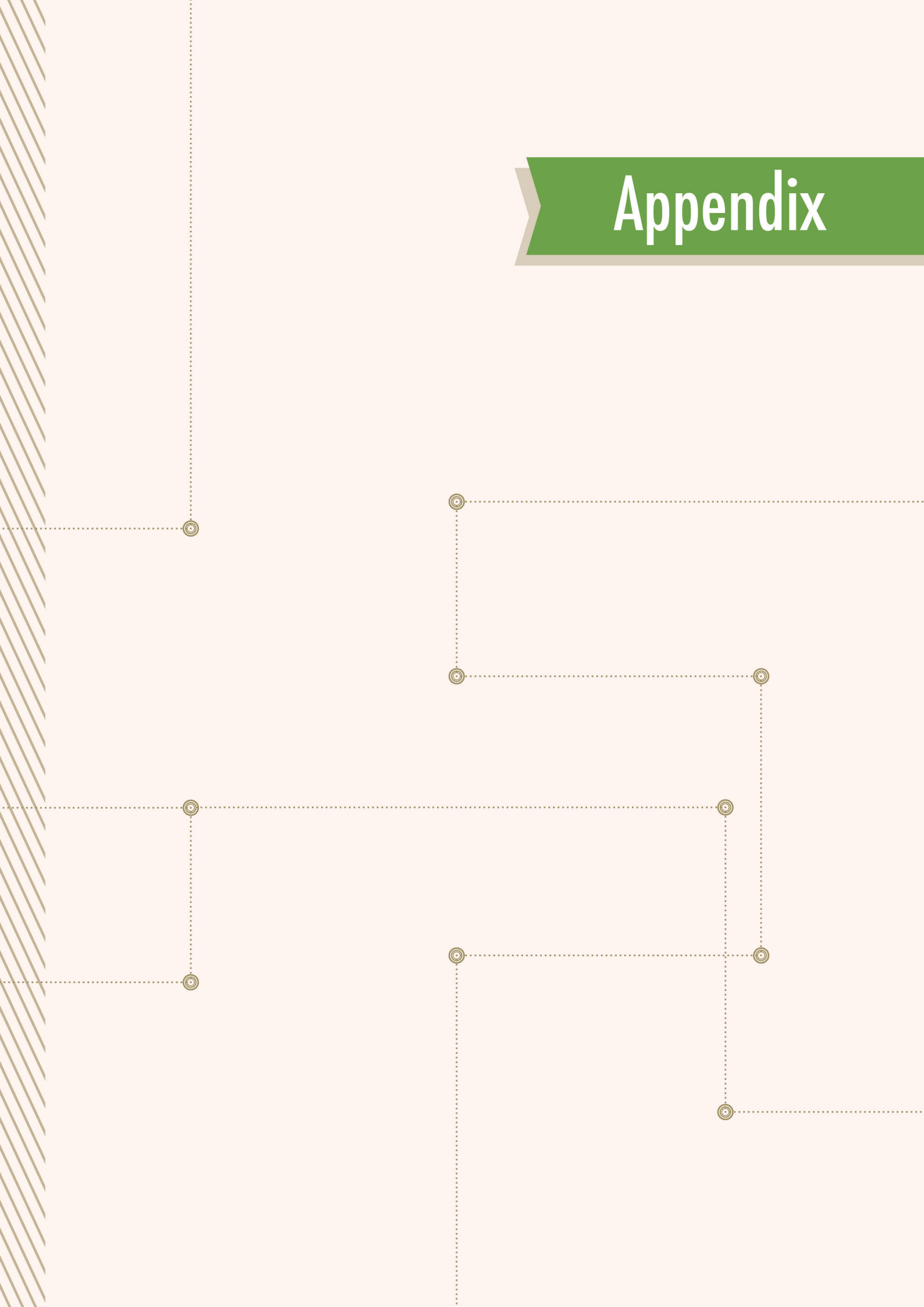
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Appendix



Appendix Summary

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Appendix I

Notes on concepts on epidemiology

The main concepts in epidemiology are: Incidence, Prevalence and Risk.

a. Incidence

The rate of appearance of new cases of a given disease, “frequently applied in Cohort studies” (see Section 1.4.1.5 types of study).

b. Prevalence

The total number of cases of a given disease, “frequently used in Cross-sectional studies” (see Section 1.4.1.5 types of study).

c. Risk

It is the probability of an individual to develop a disease (Bénichou, 2006). Other types of parameters can be distributed in two groups: measures of association and measures of impact.

The measures of association are constituted by: Relative Risk and Odds Ratio. A simple example is the Contingency Table basically composed by a risk factor in two categories (exposed and non-exposed) and an affection reaching or not a population (case and control).

	» Case	» Control	» Total
Exposed	a	b	$e_1 = a + b$
Non-Exposed	c	d	$e_0 = c + d$
Total	$m_1 = a + c$	$m_0 = a + c$	$n = a + b + c + d$

Table AI.1. A model of a general Contingency Table.

In the Table AI, “a”, “b”, “c” and “d” represent the amount of subjects corresponding to a combination of exposition to a given factor (exposed, non-exposed) and health status (case, control). In the last colon on the right, e_1 and e_0 designate respectively the amount of individuals exposed and non-exposed, while “ m_1 ” and “ m_0 ” designate respectively the amount of sicken individuals (cases) and non-sick individuals (control). “n” represents the total of individuals involved in the survey ($a + b + c + d$).

d. Relative Risk

The link between the probability to develop the disease due to a type of exposure and the probability to develop the disease without this type of exposure.

$$\text{Relative Risk} \\ RR = \frac{\text{F case / exposed}}{\text{F case / non-exposed}} = \frac{\left[\frac{a}{a+b} \right]}{\left[\frac{c}{c+d} \right]}$$

Table AI.2. Relative Risk equation.

If the Relative Risk value is greater than 1, there is a relation between exposure and pathological event, if the value equals 1, it means there is no relation, if the value situates between 0 and 1, there is a relation in another sense, it means there is a protection.

e. Odds Ratio

The ratio between the diseases on exposed individuals versus the non-exposed ones.

$$\text{Odds Ratio} \\ OR = \frac{\text{O case / exposed}}{\text{O case / non-exposed}} = \frac{\left[\frac{a}{b} \right]}{\left[\frac{c}{d} \right]}$$

Table AI.3. Odds Ration equation.

The measures of impact are based on Attributable Risk.

f. Attributable risk

The number or proportion of cases of a disease attributed to a given factor of exposure.

$$\text{Attributable Risk} \\ AR = \text{F case}_{\text{exposed}} - \text{F case}_{\text{non-exposed}}$$

Table AI.4. Attributable Risk equation.

2.3.1.4 - Types of Questions (Study Question)

Protocol should start with a clear and precise formulation of the research question. It may be a good practice to write this in the form of a question and not as a statement. While formulating research question, its relevance to public health, feasibility of conducting the study to answer the question and likelihood of implementation of the findings must be kept in mind. The more precise the question, the more likely it is that research will provide new knowledge. Therefore, the question format requires greater precision and lead to a logical approach to the research topic.

2.3.1.5 - Types of Study

The objective of a study in public health is either to investigate (get to know a disease), to intervene (fight against a disease by treatment, prevention or protection against it) or to evaluate (assess the efficiency of the intervention) (Sandra, 2011). Two of these three objectives can lean on three classical methods of study in observational epidemiology: the descriptive studies (to investigate disease occurrence), the analytical studies (to investigate causes of a disease) and evaluative studies (to assess interventions) (Bouyer, 2009; Czernichow et al. 2001).

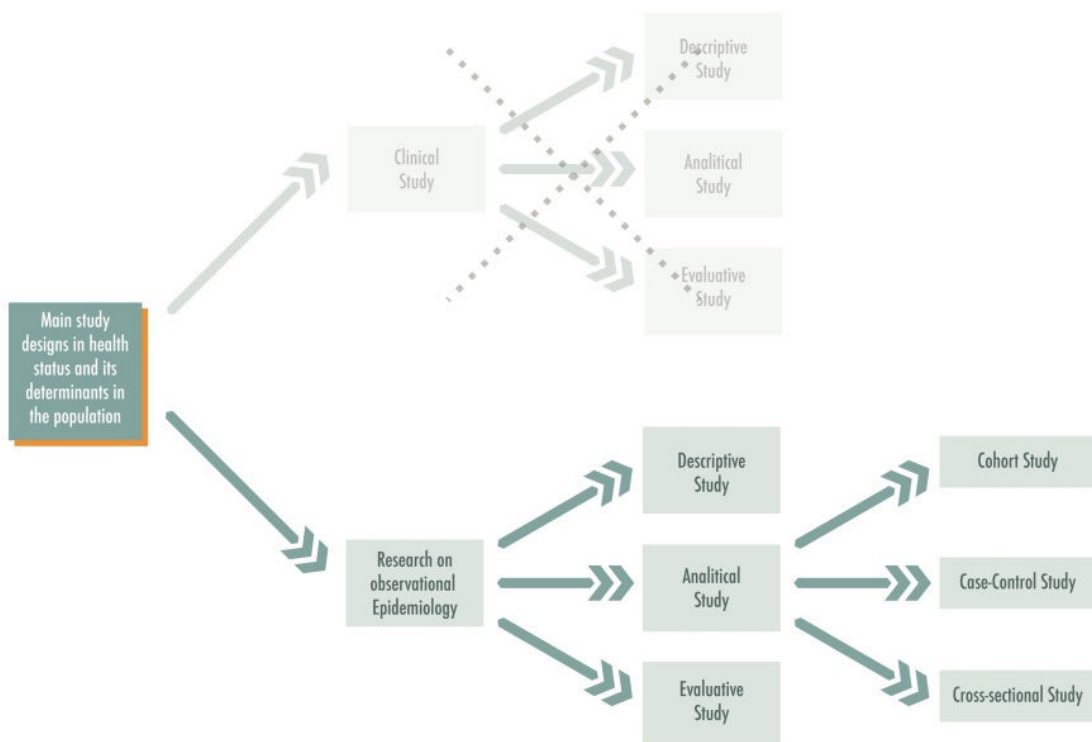


Figure AI. Main study design in Health Status and its determinants in the population

As it will be explained on section 1.4.4 (didactical analysis), the game scenario does not support experimental studies consequently it will not be considered in this analysis. In set of epidemiological studies the evaluative studies are not supported in the gaming scenario neither the cross-sectional studies in the set of Analytical studies (See Figure 2.6). However, these two cases will be briefly defined in order to give a greater picture of the observational epidemiology studies.

a. Descriptive Studies

The descriptive studies describe the arisen of pathological events through space – the incidence rate or mortality of a pathology in the space – and time – the temporal series of the incidence rate or mortality of a disease. In both cases the descriptive studies describe, generate hypotheses, even in some cases validate them partially, but these studies do not allow establishing a proof (Bénichou, 2006). Still, they are a necessary explorative step and usually introduce an Analytical Study.

b. Analytical Studies

The analytical studies enable the establishment or the confirmation of hypotheses concerning the link between exposure factors and pathological events (Bénichou, 2006).

Observational analytical studies are the most frequently performed in Epidemiology and they can be divided traditionally in three types: Prospective Studies, Case-control and Cross-Sectional studies.

b1. Prospective Studies (follow-up study) (LAST, 2004)

Cohort studies follow a prospective model: they follow-up across time subjects whose exposition to one or several factors is known. The occurrence of a pathological phenomenon is then noted. This enables to test one or several hypotheses (specified at the beginning of the study) on existing links between exposure and occurrence of the disease.

Cohort studies allow estimating the incidence rate according to the exposure because the latter is known from the beginning and the subjects are identified at first according to the rate of exposure.

Cohort studies also allows to estimate the association between the exposure and the studied pathological event, and the relative risk – the link set up between the probability to develop the disease after a type of exposure and the probability to develop the disease without being subject to this type of exposure.

This type of study permits to estimate the variation of these rates and relative risks across time.

Cohort studies finally avoid selection bias – since subjects are chosen at first without knowing their later evolution – and recall bias – since the exposure and the pathology occurrence are measured and assessed prospectively by the researcher.

Nevertheless, cohort studies cannot avoid confounding bias completely because the model of this study is not experimental. Thus, the association between the disease and the exposure could be due to a third factor called the confounding factor. Indeed, in this case researchers do not determine the exposure, they only observe if the exposed subjects are going to develop or not the disease compared to the unexposed subjects (Bénichou 2006).

b2. Case-control Studies (or Case referent study) (LAST, 2004)

Cohort studies represent the best in terms of observation and data quality. However, due to its cost, timing, and logistics, they are often replaced by "case-control studies". According to a retrospective model researchers select two groups, one affected by a pathological phenomenon to be studied (the case group) and another non-affected (the control group). They try retrospectively to find a previous exposure and to compare characteristics from the case group to the control group in order to establish associations between exposure and disease. This study allows testing of various hypotheses, but it cannot estimate the global incidence of the disease or its incidence according to a kind of exposure. It is also impossible to estimate directly the relative risk.

Fortunately, case-control studies enable to estimate associations between exposures and pathological events through Odds ratios. This construction may seem artificial, but if there is no association between disease and exposure, the Odds ratio is the product of two terms and equals 1. If there is a relation between

exposure and occurrence of the disease, the Odds ratio value is greater than 1. It behaves as the relative risk. The advantage of Odds ratios is that it permits to estimate the association between the disease and the exposure through the probability of being exposed within sick and non-sick patients.

This is important for case-control studies since there is a sick patient sample and a non-sick patient sample and it is possible to estimate the probability whether they were exposed or not. Obviously, there is a risk of confusion bias, but there is also a risk for recall bias since subjects are asked to remember their own past exposure. Another possible difficulty concerns the selection bias, since the study is carried out in order to compare sick and non-sick groups. However, these studies are much shorter and less expensive than the cohort studies (Bénichou 2006).

b3. Cross-Sectional

Cross-Sectional studies are based on studies over a population at a certain moment, each individual being observed only once. These studies are usually undertaken in a descriptive purpose to estimate the prevalence of a disease (also known as prevalence study), or the number of individuals exposed to risk factors known in a given population. This type of study is the most performed due to its convenience and restricted cost (short duration). (Czernichow et al. 2001).

Cross-Sectional studies are also used in an etiological purpose, the present (or previous) exposure on one hand, and the problem of health on the other hand, being simultaneously measured at each individual. They correspond to three circumstances: First, mostly it is about descriptive inquiries, analytical analysis being only a by-product. The sample is chosen to be a representative subset of the studied population. The distribution of patients exposed (index subjects) and non-exposed (control subjects), or cases (sick subjects) and controls (non-sick subjects) (Meirik 2008) considered is the one existing in the sample at the time of the survey; it cannot be optimized in terms of strength to look for a possible relation between the exposure to the factor and the health problem. Second, sometimes the survey is the initial stage of a cohort study, aiming to identify (and exclude) the prevailing cases affecting the cohort study to be followed. Third and finally, sometimes the survey is really organized in an analytical perspective,

aiming to establish groups strongly contrasted by the exposure of which the causal influence is suspected. (Czernichow et al. 2001).

c. Evaluative Studies

The above-mentioned types of epidemiological studies are concerned especially with the study of the risk factors of the diseases and centred on the description of the diseases frequencies and their causes. They are the first necessary stages before envisaging an intervention to fight against them (treatment, prevention, protection). The following stage to implement a health intervention is to settle objectives and to list the possible means of action and their conditions of implementation; that is what an evaluative study is about.

A correct evaluation is an important stage because the pursuit of the program or its extension depends on it. Furthermore, it is necessary to be convincing about the program success or failure. In the absence of a serious evaluation methodology, it risks to hold only the positive aspects of the results or not realizing they are owed to another factor than the intervention itself.

The purpose of the evaluation is to contribute to a rational decision-making by measuring the effects of a health program with regard to its objectives. Elements necessary for such a decision-making are the distribution of the program, its acceptability by the population, its efficiency, as its economic or sociological consequences. This way, the global evaluation of a health program must be multidisciplinary and associate the researchers and the field actors (Bouyer, 2009).

d. Type of bias

The type of study also determines the type of bias students may encounter in their work, and they should be able to mention the limits of their own study in their protocol. For example, for exposed/non-exposed studies, students may encounter difficulties to sample a population due to selection bias. In this case, patient data can be lost during the survey. Students can also encounter difficulties in obtaining relevant results due to information bias in this kind of study.

»» Type of Study	»» Type of Bias	»» Definition
	Confounding Bias	<p>“Distortion of the estimated effect of an exposure on an outcome, caused by the presence of an extraneous factor associated both with the exposure and the outcome, i.e., confounding caused by a variable that is a risk factor for the outcome among non-exposed persons, and is associated with the exposure of the interest, but is not an intermediate step in the causal pathway between exposure and outcome. Example: In a study of the effect of smoking on the risk of stroke, smokers were being leading to under-estimation unless age is adjusted for in the analysis” (Last, 2001, p. 37).</p>
	Attrition Bias	<p>“A bias associated with the dropping out or the differential exclusion of subjects from a study. Note: If subjects drop out of the study for some reason, their exclusion from the analysis could lead to an overestimate of the effectiveness of the intervention. The differential dropping out of subjects may be due to a selection bias in a comparative experimental study or cohort observation study” (Source: Health Technology Assessment Glossary).</p>
	Performance Bias	<p>“A confusion bias due to systematic differences in care received outside the intervention being evaluated” (Source: Health Technology Assessment Glossary).</p>
Prospective Studies	Information Bias (bias of classification or measurement)	<p>“A flaw in measuring exposure or outcome data that results in a different quality (accuracy) of information between comparison groups” (Last, 2001, p. 95).</p>
Case Control	Information Bias (bias of classification or measurement)	
Prospective Studies	Selection Bias (bias on the representativeness of a population)	<p>“Error due to systematic differences in characteristics between those who take part in a study and those who do not. Examples include subjects in a survey limited to volunteers or persons present in a particular place at a particular time, or hospital cases under the care of a physician, excluding those who die before admission to hospital because the course of their disease is so acute, those not sick enough to require hospital care, or those excluded by cost, distance, or other factors. Selection bias invalidates conclusions and generalisations that might otherwise be drawn from such studies. It is a common and commonly overlooked problem” (Last, 2001, p. 166).</p>
Case Control	Selection Bias (bias on the representativeness of a population)	

Table A1.5. Types of Bias.

Appendix II

Teaching epidemiology worldwide

In France, the medical school of University Joseph Fourier proposes biostatistics lectures and tutorials in the first year, and practical work combining biostatistics and epidemiology in the second year (see Sections 1.4.3.1 and 1.4.3.2). In the United States, the Harvard Medical School proposes lectures on Clinical Epidemiology and Population Health for preclinical first year students in a group of disciplines called fundamentals of medicine:

“Clinical Epidemiology and Population Health (CEPH) combines the teaching of core skills of clinical epidemiology (including biostatistics, study design, and critical reading) as they apply to the care of individuals and populations, with an introduction to key public and population health topics. The overall goal is to allow students to emerge with an appreciation of the problems of individual patients and those of populations as a continuum; and to understand that improving health may involve interventions in populations by physicians, public health authorities, and others responsible for specific populations, as well as medical care for individuals. The course is designed to complement the Ethics, Social Medicine, and Health Policy courses, as well as the basic biomedical sciences and the Patient-Physician sequence. The course is designed and led by the HMS Centre for Population Health Education”.

“Social and population sciences are learned through a sequence of required courses in social and population-based medicine. This sequence, which addresses important issues confronting physicians in the 21st century, includes Introduction to Social Medicine and Global Health, Medical Ethics and Professionalism, Clinical Epidemiology and Population Health, and Introduction to Health Care Policy. These courses present students with an introduction to the social factors that influence health and disease both domestically and globally, the principles of clinical epidemiology and biostatistics required for the evidence-based practice of medicine and the critical appraisal of the medical literature, the ethical dimensions of medical decision-making, and an overview of health care policy issues and options.”

In Brazil, the medical school at the University of São Paulo (USP) proposes the 60-hour discipline “*Quantitative Methods in Medicine*” for second year students in the first term. The program proposes 14 sessions with the following program:

“Main quantitative methodological concepts, probability, statistical distributions, inferences and medical reasoning, Z test, T test, variance analysis, non-parametric statistics, correlation and regression, Chi-squared, Bayes theorem for Medicine (definition and applications), mathematics for populations, Inheritance: Introduction to quantitative genetics, and Darwinian evolutionary medicine”.

In the second term the school proposes the 75-hours discipline “*Epidemiology I: Population Health Diagnosis*”.

“Epidemiology, an essential discipline for Public Health and Preventive Medicine, studies the occurrence and the distribution of worsening health in human populations. This discipline presents the main indicators used as instruments to understand the profile of epidemics in a population, a competence that all physicians, regardless of specialty, need to possess nowadays for a better professional performance in the communities they act. The interpretation of these indicators helps to build a health diagnosis of the population under analysis, identifying the most important problems, helping to define their needs and the priorities of medical physicians in the health system. Health diagnostics contribute to the indication of priorities for epidemic researches and more generally in the field of medicine. Epidemic indicators analysed are traditionally more applied in the field of Medicine and Public Health: the mortality and morbidity indicators based on diagnoses performed by physicians on their patients. There are also underlying indicators which aim to measure general conditions of life and health, among which, indicators relating to the quality of life predominate. This discipline constitutes the first part of the epidemiology studies for medical students and it follows and complements the next discipline – Epidemiology II: Epidemic studies”.

Appendix III

An example of an Expected Protocol

Titre : “ Dormir fait-il mourir ? ” *Etude de l'effet de l'alitement complet sur le risque de survenue de MTE*

1. OBJECTIFS :

Objectifs Principal :

Déterminer le risque de survenue de MTE qu'induit la durée d'alitement complet chez des patients hospitalisés.

Dans l'objectif d'éliminer le facteur âge nous avons choisi de n'étudier que des patients de plus de 50 ans qui ont donc tous un risque de MTE augmenté.

Cette étude ne s'intéresse donc qu'à une population à risque de MTE.

Pour mener à bien cette étude nous allons distinguer 2 populations :

- une hospitalisée et alitée (la définition exacte de l'alitement sera donnée plus loin dans la description de cette étude).
- l'autre hospitalisée mais non complètement alitée.

Nous effectuerons ensuite une comparaison du nombre d'apparition de MTE entre ces 2 populations.

Objectif Secondaire :

L'objectif secondaire est ensuite d'évaluer l'impact du temps d'alitement sur le risque de MTE.

- Nous voudrions tout déterminer une durée d'alitement au bout de laquelle le risque de survenue d'une MTE augmente significativement par rapport au groupe non alité.

- puis déterminer une limite de temps au bout de laquelle le risque d'apparition de MTE devient suffisamment pour être pris en considération par l'équipe soignante.

En première intention, nous avons choisi de fixer le seuil de risque à Un patient sur cinquante patient alité qui présente une MTE.

Dépassé ce nombre nous considérerons que le risque sera devenu suffisamment important pour que l'équipe soignante prenne des mesure préventives à l'égard du malade.

2. POPULATION :

L'étude est menée sur 750 à 800 patients en service de médecine et de chirurgie sur plusieurs centres.

En effet nous effectuons une étude cas/témoins évaluant la survenue de MTE, ce test est non paramétrique. Nous avons choisi un ODDs ratio minimum détectable de 1,25 avec une proportion attendue de témoin exposé de 30%, un risque alpha de 5% et une puissance de 80% enfin nous avons choisi de prendre 4 témoins par cas.

Le groupe cas est constitué d'une population de patients hospitalisés complètement alités, qui ne marchent pas plus de 3 x 20mn par jour, ce seuil est une recommandation issue d'un consensus multidisciplinaire de médecins et de kinésithérapeutes.

Le groupe témoin est donc lui composé de patients hospitalisés mais non complètement alités, c'est-à-dire marchant plus de 3 x 20mn par jour.

Critère d'inclusion :

- Plus de 50 ans
- Hommes et femmes (50/50 autant que possible)
- Hospitalisé(e)s en service de médecine et de chirurgie

3. METHODOLOGIE ET METHODE D'ANALYSE

Etude rétrospective cas/témoins auprès de patients hospitalisés et complètement alités qui répondent aux critères d'inclusion.

La récolte des données se fera directement auprès des services, après interrogatoire.

on retiendra la MTE en cas de survenue :

- d'Embolie **Pulmonaire** (Diagnostic par radiographie thoracique et dosage des D-Dimères)
- et/ou de **Thrombose Veineuse Profonde** (Diagnostic par un Echo-Doppler des membres inférieurs).

L'analyse statistique se fera par un **test de Chi²**.

4. LIMITE DE L'ETUDE

Biais de sélection: L'échantillon n'est pas représentatif de la population générale.

Biais de confusion : Interactions avec d'autres FDR non exclus de l'étude, on peut citer par exemple les antécédents de MTE, chirurgicaux, les pathologies de l'hémostase, le sexe...

Le biais de confusion sera le plus important de l'étude en effet pour augmenter la puissance de l'étude nous avons choisi d'effectuer l'étude sur une population de patients en chirurgie et en en service de médecine (sachant que les patients en chirurgie auront un risque augmenté par rapport à la norme), l'inclusion en plus dans l'étude de certains patients présentant des trouble de l'hémostase pourrait encore aggraver le biais.

5. ÉTIQUE ET REGLEMENTATION

Validation du protocole par le Comité de Protection des Personnes.

Une lettre d'information au patient sera aussi dispensée, expliquant les buts de l'étude et donnant les droits et modalités d'accès aux données informatisées le concernant.

Le recueil du consentement libre et éclairé des patients sera effectué.

Appendix IV

The information letter

LETTRE D'INFORMATION AUX ETUDIANTS

Vous êtes étudiant en P2 à l'Université Joseph Fourier et suivez huit Travaux Pratiques de Biostatistique basés sur le jeu Loé (Laboratorium of Epidemiology). Ce jeu a été conçu conjointement par des enseignants et des chercheurs.

Pour évaluer l'impact de ce jeu, nous avons réalisé en 2010 une étude en didactique, avec l'accord de l'équipe enseignante. Il s'agit d'une évaluation des apprentissages en statistiques et en épidémiologie et des comportements lors de l'utilisation du jeu. **Cette année**, nous allons uniquement recueillir les traces informatiques de vos activités. Pour ceux d'entre vous qui se porteront volontaires, nous allons vous contacter, **une seule fois**, par téléphone pour un bref entretien sur vos vécus dans les séances précédentes. L'appel ne durera que quelques minutes. Nous vous demandons simplement aux volontaires de nous donner prénom, nom et numéro de téléphone.

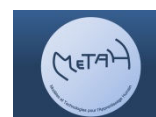
Les données vous concernant seront centralisées dans un fichier informatique à des fins de traitement statistique par les chercheurs. Ces données resteront strictement confidentielles et ne seront pas communiquées à vos enseignants. Les résultats de ces recherches en didactiques seront communiqués sans faire mention d'aucun de vos noms (données anonymisées). Cependant, vous pouvez refuser cet enregistrement informatique simplement en le signalant à votre enseignant. Dans ce cas, vos données seront effacées de la base.

Le fichier du recueil des données a fait l'objet d'une déclaration à la CNIL. Conformément aux dispositions de la loi du 6 janvier 1978, relative à l'informatique aux fichiers et aux libertés, vous disposez d'un droit d'accès et de rectification.

En coopérant à cette étude, vous participerez à la recherche en didactique, c'est-à-dire la compréhension des meilleurs moyens d'apprendre et d'enseigner un contenu particulier, à l'amélioration de la formation qui vous est apportée et finalement à l'amélioration du jeu Loé pour les promotions futures.



Muriel Ney, Nicolas Balacheff, Celso Gonçalves et Marie-Caroline Croset
Equipe MeTAH – Modèles et Technologies pour l'Apprentissage Humain
LIG – Laboratoire Informatique de Grenoble



Appendix V

Corpus of Students' Interactions

- 1 Arnaud alors, c'est bon, on téléphone [proposition] einh [demande soutien]
- 2 Gaspard Tiens ! du coup t'as le téléphone appels d'aide (rire)
- 3 Arnaud donc ... on va appeler après, alors
- 4 Bruno sur la standardiste
- 5 Gaspard si tu veux la prévalence moi je l'ai moi
- 6 Arnaud donc Un la prévalence, Deux trouver trouver des signes spécifiques et sensible, d'accord ?
je dis ça, ça c'est un peu l'obj ..., ça c'est un truc pour tout [explique le but de faire un brouillon] ... 'fin ça c'est un truc de l'objectif principale quoi ... trouver des (?) spécifique et sensible d'accord ?
- 7 Arnaud
- 8 Yves ok
- 9 Arnaud avec une bonne définition des symptômes
- 10 Yves [marmonnement d'une lecture]
- 11 Arnaud d'accord ?
- 12 Yves pas de problème [se montre d'accord] ... attends moi j ... [travail tout seul dans son coin]
- 13 Arnaud et classer les patients ... selon les symptômes ...
- 14 Arnaud troisièmement il y a un truc ... avec le contexte et le facteur de risque ... 'faut qu'on fasse ... 'faut qu'on compare ... soit le critère, donc la Chir.' ... soit facteur de risque ... bon bah la Chir.' avec ... les vieux ...
et quoi d'autre ... les vieux [écrit sur le papier] et il y a tromboprophylaxie aussi ... ok ? thrombo - pro - fi - laxie [écrit sur le papier] ... ok ?
- 15 Arnaud
- 16 Bruno il y a les cancers, leucémie, syndrome myéloprolifératif (?) boulimie, on a un paquet einh
- 17 Arnaud les cancers [écrit sur le papier]

- 18 Bruno maladie inflammatoire, les médicaments, maladie cardiovasculaires, insuffisance veineuse, obésité, le stress
- 19 Arnaud l'item Quatre on va mettre aussi:: cadre diagnostique différentiel
- 20 Yves alors déjà c'est quoi un diagnostic différentiel moi je je
- 21 Arnaud bah par exemple, pour douleur thoracique, ça peut être un infarctus et ça peut aussi sous embolie pulmonaire
- 22 Yves ah ! c'est donc, c'est un symptôme ...
- 23 Arnaud c'est un symptôme et ...
- 24 Yves et du coup ça peut être ...
- 25 Arnaud voilà ...
- 26 Yves ok:: ... [confirme] alors ... bon alors Trois ou Quatre [se dit à soit même en reprenant ses notes]
- 27 Arnaud alors, après il y a la prof qui nous dit l'objectif ... c'est de disposer d'un bon avec quelques ... questions clés pour hiérarchiser ... d'accord ? ou alors un score avec les cumules des valeurs ... des facteurs de risque, d'accord ? c'est-à-dire qu'on prendrait euh ... tu vois différentes ... différents scores pour un facteur de risque en additionnel les fact' les:: par exemple genre pour là ... genre par exemple en dessous de Cinquante ans tu as, on va dire, c'est ... t'as Zéro points, en dessus des Cinquante ans t'a un point tu vois
- 28 Yves ouais ouais ouais d'accord
- 29 Arnaud ... 'fin je dis une ***** [terme vulgaire pour dire stupidité] tu vois ... t'a préparé genre si tu as fait de la Chir.' avant t'a Cinq points si tu n'a pas fait t'a Zéro points tu vois ... plus ton score est élevé, bah plus tu as des risques
- 30 Bruno oui mais en fait ça dépend du facteur de risque (inaudible)
- 31 Arnaud oui bien sûr, bien sûr, bien sûr
- 32 Arnaud pour le diagnostic différentiel ... "faut chercher avec la prévalence des meilleurs semios', facteurs de risque, population général, cancer, Chirurgie, etc.", "combien des patients", [lecture de ses notes] un certain nombre de patients, "méthodo, ... beaucoup de demande à habituel" [marmonnement d'une lecture] ... "étude de cas-témoins" ... "cohorte prospective avec des patients à l'arrivée" [lecture de ses notes] donc ... ce qu'on va faire nous ... (1,5s) donc on va faire ...(1s) une étude ... (2s) cas-témoins, ... d'accord?

- 33 Yves Ok
- 34 Arnaud cas-témoins [écrit] ... une étude cas-témoins [écrit] ... donc ça va ...
là il faut qu'on trouve ce qui va être les cas et ce qui va être témoins
- 35 Bruno m ?
- 36 Arnaud il faut qu'on trouve ... bah ... sur dix cas-témoins, ce qui est les cas et
ce qui est les témoins
- 37 Bruno bah les cas c'est: T: ... (1s) des:: TPE mais ... 'fin les Thrombose ...
Veineuses
- 38 Arnaud ouais mais, ouais mais je veux dire ... on les prend où ? ... 'fin euh::
- 39 Gaspard justement tu vas avoir dans les services
- 40 Bruno ouais, mais c'est prospectif
- 41 Arnaud c'est prospectif
- 42 Yves mais déjà on prend quoi comme service parce qu'il y a Chirurgie,
cancérologie ... il disait [Arnaud] ... sujet âgé ?
- 43 Gaspard hum ? de quoi ?
- 44 Yves donc c'est ces trois-là qu'il fallait qu'il disait [Les services de
l'hôpital]
- 45 Arnaud ouais, je dis on peut très bien compter euh Urgence ... (2S) Chir.' ...
(1s) et Méd.
- 46 Gaspard ouais, c'est ça ... autant déjà faire, regarder déjà dans les Urgences
- 47 Bruno et dans les prospectifs c'est euh: tu définis les catégories en fonction
du facteur de risque non ?
- 48 Gaspard non, mais ce qui serait déjà pas mal, c'est de regarder entre les
différents centres [hospitalier] s'il y a des différences ou pas [dans le
nombre d'individus] ... ou voir au moins les différents services [unité
fonctionnelles]
- 49 Arnaud ouais, oui mais d'abord, oui mais d'abord justement il faut qu'on met
au point la méthodologie pour savoir ce qu'on va faire
- 50 Gaspard oui justement faire une étude multicentrique pour voir ...
- 51 Bruno mais on a les données euh numériques là ?
- 52 Gaspard (1s) bah je pense qu'il faut (inaudible)...

53 Yves attendez !! attendez !! c'est quoi prophylaxie

54 Arnaud prophylaxie c'est un traitement préventif

55 Arnaud Non, mais il faut les appeler

56 Gaspard Bruno ! (en s'adressant à Bruno)

57 Bruno mais sérieux elle est ... on va tomber sur une infirmière, qu'est-ce qu'elle va me dire ? euh: "Alors excusez-moi, je voudrais vous:: demander la prévalence dans votre centre de ... " [en balbutiant une voix]

58 Gaspard non !

59 Bruno elle ne va pas me répondre, elle ne va pas me répondre la meuf

60 Gaspard ils vont t'ouvrir le truc tu vas rentrer, tu va avoir le nombre de patients euh:

61 Arnaud euh oui oui

62 Bruno elle va faire "petit ***** [injure exprimant "individus sans intelligence "] là!" je crois ... "va ***** [expression péjorative exprimant "va importuner"] quelqu'un d'autre!"

63 Yves tu es sûr qu'on peut ... [probablement à propos des appels téléphoniques] tout à l'heure, tu disais que tu l'avais la prévalence là [Yves reprend une suggestion de Gaspard au début de l'enregistrement]

64 Gaspard euh: c'est Cinquante à Cent mil cas responsable

65 Yves ah! mais sur Wikipédia là!

66 Arnaud étude cas-témoins [écriture ou lecture, dit à soit même]

67 Arnaud bon moi je dis on va prendre [la valeur de la prévalence] et puis ...

68 Gaspard de Cinq à Dix mil décès

69 Yves ah ! oui ! responsable de Cinq à Dix mil décès ouais

70 Gaspard ouais

71 Arnaud Comment?

72 Gaspard mais l'incidence annuelle c'est de Cinquante à Cent mil ... là j'ai l'incidence

- 73 Bruno non mais ce qu'on voulait c'est dans le centre:
- 74 Bruno il y en a pas tous un téléphone en plus sur la table ... hum! ... A mon avis on ne téléphone pas maintenant hein
- 75 Gaspard si ! si !
- 76 Bruno euh::: il y a que nous qui va téléphoner
- 77 Gaspard euh justement profites-en !
- 78 Arnaud sinon on peut faire on peut faire ... on peut faire ... parce que là on a trois truc, on a la Méd.', la Chi' et les Urgences ... donc on peut très bien prendre les patients à l'arrivée soit ... attends, parce que ... parce qu'en fait le truc c'est que tu sais il te dis pas [patients] ... 'fin ... genre ... Yves, Gaspard, à partir des Urgences on prend tous les ... on distingue les personnes qui vont au Méd.' et les personnes qui vont au Chir.' ... et on regarde ce qui leurs arrivent
- 79 Yves ouais
- 80 Arnaud fin: là ça nous fait un cas-témoins tu vois, Méd.', témoins, Chir.', cas ... (1s) d'accord ou pas ?
- 81 Gaspard non mais cas-témoins c'est les patients, c'est pas les::
- 82 Arnaud oui, c'est les patients
- 83 Yves ouais c'est vrai, mais ... ouais ... 'fin, après il disait justement que l'âge et tout ça interférais dessus, alors que ça se trouve que les mecs ils vont en Méd.' et puis ils sont vieux
- 84 Arnaud oui mais ça, ça peut être un critère principale ... et après un critère secondaire ... et bah on peut mettre l'âge, le cancer ... (1s) la thrombo prophylaxie ... (1s) en fait il faut qu'on leur donne tout ce bordel quoi
- 85 Bruno c'est claire que là il faut leur donner ça einh
- 86 Arnaud il faut donner tout ça einh ... bon est-ce que maintenant tu appelles ?
- 87 Yves non mais !
- 88 Bruno on appel rien de tout, je s'rien raconter moi à cette meuf ... rien je rien à lui dire
- 89 Arnaud Bruno, si, t'appelles, hé ! hé ! bouge pas !
- 90 Yves attendez ! attendez ! étude multicentrique ... (dis à soit même)

- 91 Gaspard mais ah ... Bruno ... Bruno je te fais remarquer que c'est la même meuf pour les trois hôpitaux einh ! du coup ... c' c' hé:: c'est le même numéro pour les trois hôpitaux
- 92 Yves non mais mon pote ... attends ... on ne va quand même pas appeler un numéro qu'on connaît rien de tout (inaudible) truc
- 93 Gaspard pourquoi ? ... c'est le même numéro pour les trois unités des trois hôpitaux différents, bah justement ... t'appelles ça débloque
- 94 Yves oui, bah c'est super ! ok !
- 95 Arnaud attends, attends, on clique sur Urgence c'est le numéro Isabelle White ... bon, appelle
- 96 Bruno et qu'est-ce que je lui dis ?
- 97 Arnaud tu dis "bonjour, je m'appelle Bruno Legrand ..."
- 98 Bruno ok je m'en fous ... je suis un étudiant en deuxième année de médecine, d'accord oui
- 99 Gaspard je suis en TP de Biostatistique
- 100 Arnaud je suis, voilà, j'aimerais accéder à ... à votre unité fonction'
- 101 Gaspard l'unité fonctionnelle des Urgences
- 102 Arnaud voilà
- 103 Bruno à votre unité fonctionnelle
- 104 Yves non, non, non, on ne va ...
- 105 Arnaud mais si ***** [injure] ! allez ! appelle ! allez ! appelle ! ***** [injure]:: !
- 106 Yves non non mais attendez les mecs ! ... attendez ! réfléchissez bien ! ... il y a pas besoin
- 107 Gaspard allez ! il y a des numéros ... ça se trouve on gagne quelque chose
- 108 Yves les gens sont en train d'appeler t'sais euh
- 109 Gaspard ça se trouve on gagne quelque chose einh
- 110 Arnaud bah oui bah ***** [injure] ! ... C'est occupé ***** [injure exprimant déception] ! allez encore on va essayer
- 111 Gaspard ah euh ... on est en train d'essayer de chercher des réponses quoi ...

- mais on appelle les hôpitaux pour avoir accès aux unités fonctionnelles (rires) ... (Repère verbal à l'extérieur du groupe ou communication intergroupe "pour avoir un mandat ?") ouais
- 112 Yves ils vont peut-être trop vite on a rien de tout euh, ils appellent déjà les mecs::
- 113 Yves "allô ! oui (rires) c'est juste pour vous dire qu'on voulait téléphoner, mais on ne sait pas pourquoi"
- 114 Yves non mais les mecs attendez, mais franchement ... bon, oh les mecs ... non mais attendez ! on ne va pas euh ... pourquoi on ne ... non mais ... même si c'est un faux numéro ... ok ? mais ça sert à quoi d'appeler directement là ?
- 115 Arnaud mais pour avoir les données ***** [injure envers Yves] ! mais c'est parce que c'est là qu'on va récupérer les chiffres ... (1s) pour les patients
- 116 Gaspard ouais
- 117 Yves pour les patients ? ... tu crois qu'on les a où ?
- 118 Arnaud tu crois qu'on les a où ?
- 119 Yves c'est pas marqué sur le site ? je sais pas euh ... bon déjà t'a (inaudible)...
- 120 Gaspard hé ! hé ! mais ... (1s) hé un peu de jugeote ! un peu de jugeote ! t'a des CHU qui sont disponibles ... c'est pas pour : faire joli
- 121 Yves bon d'accord ok, ok, alors maintenant juste donne-moi le numéro du truc que t'a sur Wikipédia, au cas où
- 122 Gaspard de quoi ? les cinquante mil: à cent mil cas ?
- 123 Yves ouais ... ouais attends ouais
- 124 Gaspard mais ça c'est l'incidence
- 125 Yves c'est quoi la différence
- 126 Bruno (inaudible) (en train de lire un texte)
- 127 Gaspard c'est pareil
- 128 Yves c'est pour les maladies génétiques qu'on différencie ces machins là
- 129 Arnaud ah mais tu vois déjà il faut qu'on valide un protocole

- 130 Bruno (inaudible) ... données, commission du médicament ...
- 131 Arnaud hé ! les gars ! les gars ! hé ! hé !
- 132 Gaspard oui
- 133 Arnaud les gars, il y a un truc, c'est que il faut d' ... aujourd'hui il faudrait qu'on fixe notre protocole parce que après il faut qu'on l'envoie et il faut qu'il soit validé
- 134 Yves ouais
- 135 Arnaud parce que si ... tu vois ... en fait ... regardes ... en fait on a tout ça à faire nous [sur l'écran le texte de la mission ouvert sur le site de la commission du médicament] ... on doit valider notre protocole d'abord en suite en doit autoriser ... 'fin ... après on appelle les gars au truc pour qu'il autorise à interroger leur malades ... et leur bande de donnée ... en suite eux ... (inaudible) [lecture probablement du site de la commission du médicament] ... après eux ... traite des données ... eux on leur soumet notre ... ce qu'on a trouvé finalement
- 136 Yves ouais
- 137 Arnaud ... notre bon de demande d'examen et tout ça ... et après eux [congrès médical] ... et bah on leur soumet notre article avec ... avec ce qu'on a trouvé ... et voilà ... (inaudible) en fait [frappe sur l'écran avec un stylo] ... tu vois là 'faut d'ab ... là il faut qu'on [frappe sur l'écran] ...
- 138 Gaspard mais ... ils sont où les experts ?
- 139 Arnaud 'faut qu'on fasse le protocole
- 140 Gaspard Arnaud!
- 141 Arnaud Comment?
- 142 Gaspard "Pour construire le protocole vous obtiendrez de l'aide auprès du CHU où vous comptez enquêter" [lecture de la rubrique "protocole" dans le site du CPP] ... du coup il faut reprendre le CHU euh ...
- 143 Bruno "du DIM", c'est quoi DIM? [Lecture de la même page, mais en faisant référence à un mot occulté par GASPARD = BRUNO]]
- 144 Arnaud Directeur euh:..... en Médic ... je sais pas ...
- 145 Bruno (inaudible) [continue la lecture]
- 146 Arnaud bah alors on rappelle?

147 Bruno est-ce que c'est pas ça le DIM ce que tu appelles le numéro?

148 Bruno [lecture du site] responsable d'unité ... DIM

149 Arnaud attends ... tu peux me rappeler le numéro BRUNO, excuse-moi ...

150 Bruno (inaudible)

151 Bruno faudra taper à chaque fois hein

152 Bruno ça se trouve ils sont à la salle d'à côté ils sont au téléphone avec une hein

153 Yves bon allez laisse-moi un peu regarder

154 Arnaud bon alors ...

155 Yves bon bah c'est un peu du jeu quand même hein, on peut aller sur chacun des trucs hein

156 Gaspard il y a rien dedans

157 Yves c'est vrai?

158 Gaspard ouais

159 Arnaud quoi ?

160 Yves CHU de Gremont

161 Gaspard Arnaud !

162 Gaspard les précédentes pour les appels

163 Arnaud non mais non ! pour la vidéo !

164 Arnaud bon, les gars, alors ...

165 Gaspard bah, en fait, on est bloqué parce qu'on attends ce numéro-là .. 09

166 Arnaud bon, on est bloqué donc autant définir l'étude

167 Bruno ouais c'est peut-être plus logique (inaudible)

168 Gaspard (inaudible)

169 Yves oui mais le truc c'est que elle, elle nous aidera sûrement elle ... parce là

- 170 Arnaud qui ça ?
- 171 Gaspard demandez à elle pour le numéro ...
- 172 Yves de la Dame
- 173 Arnaud la Dame elle ne peut pas vous aider einh ! La Dame, elle veut juste faire accéder à ses données et c'est tout
- 174 Gaspard bah si
- 175 Gaspard non mais ...
- 176 Arnaud elle s'en branle complètement
- 177 Gaspard demande-lui pour le numéro
- 178 Yves mais tu sais que pour pouvoir trouver des fact., 'fin des critères etc., 'faut déjà connaître les critères
- 179 Arnaud nous on les a déjà là les critères ...
- 180 Yves euh des petits critères ouais, on a je sais pas l'histoire de ... de la baisse de ... de je sais pas quoi attends, j'avais marqué là ... hyperventilation ... sinon par exemple ... (inaudible)
- 181 Bruno ouais, c'est **** [terme vulgaire voulant dire « gênant »]
- 182 Arnaud bon ...
- 183 Yves Dyspnée, j'ai eu la dyspnée ... c'est valable que si on est sûr qu'il n'y a pas de maladie cardiaque
- 184 Arnaud oui, mais justement ça c'est pas ... (3s) oui, mais ça c'est pour l'embolie pulmonaire ça
- 185 Yves ah oui ? pour l'embolie pulmonaire ça ?
- 186 Bruno il y a ça dans les hôpitaux on n'a même pas ... on n'a même pas essayé quoi !
- 187 Yves ouais, c'est vrai que c'est un peu de l'embolie pulmonaire ...
- 188 Bruno voilà, on n'avance pas des masses einh ! ... information médicale ...
- 189 Gaspard faut ... il faudrait leurs demander pour le numéro ...
- 190 Arnaud Chir., Méd ...

191 Bruno Attends mec !

192 Bruno base de données, demande de données, 'fin voilà , tu vois en peut ...
(1s) c'est ça le DIM

193 Arnaud modèle de protocole !

194 Arnaud ah ouais ! Vas-y ouais !

195 Bruno ... (inaudible) si vous souhaitez (inaudible) suivant vos ...

196 Gaspard ça se trouve le téléphone là, il n'est pas ...

197 Bruno mais il y a pas besoin de téléphone einh, c'est ça, il faut que tu cliques
sur euh ... (1s) tu sais quand t'as des hôpitaux, t'as Urgences,
Chirurgie, médecine et t'as le dernier encart là , il faut que tu cliques
dessus que tu ailles sur ça

198 Arnaud (inaudible)

199 Arnaud vas-y descends

200 Arnaud ah ! ah ! ah ! Attends !

201 Arnaud ah mais non .. ça ... ça ... non, mais non ...

202 Bruno mais, t'as plusieurs truques ...

203 Arnaud mais regardes !

204 Arnaud là selon le nombre des patients qu'on met, on mais tout ça

205 Arnaud là il faut qu'on leur soumet eux nos chiffres

206 Arnaud il se trouve que nous on a aucun chiffre

207 Yves aide là ! aide ... oh ! pu ... mais t'a trouvé un truc là ! ah ! c'est **** ça !
[expression vulgaire exprimant "ce qui révèle un manque
d'intelligence"]

208 Bruno non mais regardes ... parce que les données elles sont avant

209 Bruno ça c'était pour soumettre la (inaudible) et la base de donnée est là

210 Gaspard (inaudible)

211 Yves ... nous on a un truc d'aide à la formation d'un protocole là !

212 Yves Ho !

213 Yves on a trouvé un truc sur l'aide à la formation d'un protocole

214 Arnaud ah ! c'est bien ça !

215 Yves Ils ont rien jà foutre

216 Arnaud ouais, mais tu vois il y a ...

217 Bruno attends, est-ce qu'il dit pas faut aller (inaudible) ...

218 Gaspard bon, on a trouvé un machin qui nous aide à faire le protocole

219 Arnaud non il ne dit pas

220 Arnaud comment ?

221 Gaspard on a trouvé un truc là

222 Arnaud ouais, vas-y, vas sur le (inaudible) protocole

223 Yves ... (inaudible) protocole

224 Bruno ... (inaudible) conception d'un protocole ...

225 Arnaud bon les gars, on va faire le protocole maintenant après (inaudible) on y va ?

226 Yves donc objectif, population

227 Arnaud modèle de protocole

228 Yves déjà la population, la population visé c'est ... des personnes chez qui on suspecte une MTE

229 Arnaud voilà

230 Bruno sérieusement là ?

231 Bruno ... qu'est-ce qu'il me fait ce ... ce ***** [injure exprimant "individu dénué d'intelligence" en s'adressant à l'ordinateur] là ...

232 Arnaud ouais, bah nous on n'arrive pas à ouvrir

233 Bruno ouais, il n'est même pas installé

234 Arnaud donc, tu peux faire ton modèle de protocole avec BRUNO ?

235 Gaspard ... (inaudible) non, mais laisse le temps que ça charge

236 Arnaud c'est le temps que ça ... ah d'ac... c'est ok

237 Arnaud (inaudible)

238 Yves Attends, moi je suis en train de regarder

239 Arnaud ouais on va prendre le modèle qu'ils ont là

240 Arnaud objectif

241 Yves donc, objectif on a déjà dit. objectif principal, objectif secondaire, machin etc. ok

242 Arnaud ok, la population

243 Yves pourquoi tu as changé (inaudible) ?

244 Yves Alors, en suite c'est la population. Donc la population c'est chez les patients ... chez qui on suspecte ... avec suspicion ... de MTE

245 Bruno qu'est-ce qu'il fait ?

246 Bruno (inaudible)

247 Arnaud ouais

248 Yves ... avec suspicion de ...

249 Arnaud MTE

250 Yves ... de MTE

251 Arnaud à l'arrivé aux Urgences

252 Yves à l'arrivée aux Urgences ? t'es sûr ? c'est ça ?

253 Arnaud ouais

254 Yves parce que apparemment en Chir. etc. ... c'est peut-être en plusieurs services einh. Pas obligatoirement en Chir. ... pas obligatoirement aux Urgences

255 Arnaud oui c'est vrai

256 Arnaud voilà, ok ça marche

257 Yves moi je pense que ... (inaudible) MTE

258 Yves voilà, ensuite

- 259 Arnaud MTE
- 260 Gaspard le deuxième c'est quoi ?
- 261 Arnaud ... (inaudible) mets dans le service de ch ... de Méd
- 262 Arnaud tout ça c'est pas possible, comparer les services de Méd, Chir. ... et PU
- 263 Yves c'est quoi PU ? ça tu sais pas (inaudible)
- 264 Arnaud Urgences
- 265 Arnaud tu peux monter un petit peu GASPARD ?
- 266 Bruno ouais, voilà c'est le plan ... et puis il faut mettre ça (inaudible)
- 267 Arnaud méthodologie de recueil
- 268 Bruno il faut essayer d'en mettre un maximum
- 269 Yves méthodologie de PU, bon voilà, là justement c'est le truc qui devient un peu plus compliqué
- 270 Arnaud méthodologie
- 271 Arnaud là ça devient compliqué alors, on va faire quoi les mecs ? étude de cas-témoins ...
- 272 Yves attends mais là il faut réfléchir. einh, ça c'est pas ...
- 273 Arnaud étude cas-témoins, en fait, non non, étude de cas-témoins ... on va prendre les patients
- 274 Bruno mais est-ce que ça c'était pas un conseil ? Parce que, sinon tout le monde va faire la même chose, mais là c'était juste un conseil
- 275 Arnaud ouais, mais il avait bien dit ...
- 276 Arnaud Attends, (inaudible) il a dit noir sur blanc quoi
- 277 Bruno après j'ai bien envie de suivre son conseil (inaudible)
- 278 Arnaud il a dit plutôt étude de cas-témoins, parce que là on peut très bien faire une étude de cas-témoins, c'est à dire qu'on va prendre ... (1,5s) des patients qui non rien ... (1s) et on va prendre des patients qui ont effectivement une MTE
- 279 Bruno parce que en fait, cas-témoins c'est parce que on n'a pas bien individualisé le facteur de risque, on pourrait faire exposé non-

- exposé parce que on ne connaît pas vraiment le facteur de risque principal quoi
- 280 Arnaud voilà
- 281 Bruno donc, cas-témoins c'est la plus logique
- 282 Arnaud donc ce qu'on peut faire c'est que ... les cas va prendre des gens qui ont eu des MTEs de tout truc confondu ... d'accord ... on prend un patient ...
- 283 Bruno mais non, si c'est prospectif, on étudie les facteurs de risque et on regarde l'apparition de MTE justement... (3s) c'est pas l'inverse, c'est pas rétrospectif
- 284 Yves mais nous ce qu'on fait... Le cas-témoins, c'est toujours rétrospectif
- 285 Bruno c'est pas l'inverse, c'est pas rétrospectif
- 286 Bruno Alors pourquoi il parle de cas-témoins et de prospectif?
- 287 Arnaud je sais pas
- 288 Yves oui, mais après le mec il a dit non, mais justement parce que le problème c'est qu'on aura évidemment beaucoup moins de cas que de témoins
- 289 Arnaud ouais
- 290 Yves je veux dire, tu vas pas non plus trouver... Y a pas euh... je sais pas y a peut-être 1000... je sais pas combien y a de patients dans l'hôpital... peut-être 1000 ou 2000 mais je veux dire tu auras pas 1000 patients qui ont eu des MTE là ... t'en aura au CHU ... tu en auras 200 peut-être
- 291 Arnaud ouais, mais regarde, moi, fin... Je vous montre mon truc... Regarde... Vous pouvez prendre par exemple 1000 patients qui ont eu la MTE, d'accord?, on n'sait pas ce qui leur est arrivé, ils ont juste eu une vraie MTE qui a été confirmée, tout ça etc. Ils sont morts, tout ça...
- 292 Yves ils sont morts?
- 293 Arnaud Bah on sait pas... enfin... Est-ce qu'ils ont eu une MTE? Fin... Tant que tu as pas des signes, ils ont eu une MTE
- 294 Yves ouais ouais d'accord... ils l'ont eu
- 295 Bruno (inaudible) rétrospectif (inaudible)
- 296 Arnaud ouais ça c'est rétrospectif, rétrospectif... A partir de ça, eh bah on

remonte, on va casser l'équation en fonction de où ils viennent, par exemple, est-ce qu'ils viennent des Urgences, de la Chir., de la Méd.?... Fin faut voir qu'en Chir., y a 95% de (inaudible) qui ont des MTE alors qu'en fait y en a beaucoup moins... On va voir là -dedans est-ce qu'y en avaient beaucoup qui avaient des cancers, s'ils étaient plus âgés, s'ils avaient eu une thromboprophylaxie par rapport aux cas, tu vois, il n'avait pas de MTE

- 297 Gaspard une étude transversale?
- 298 Arnaud troisième service
- 299 Arnaud non, j'ai pas besoin de ça, c'est quoi?
- 300 Arnaud Gaby, je te refais mon truc?
- 301 Arnaud on fait une petite quête ou non, d'accord?
- 302 Arnaud les cas, on va prendre une cohorte de patients qui ont eu une MTE, d'accord? Et on va les analyser en fait, leur dossier, pour voir s'ils étaient vieux, s'ils avaient des cancers, le service d'où ils venaient, s'ils avaient reçu une thromboprophylaxie, et ça, ça permet de remonter en fait aux facteurs de risque
- 303 Gaspard hum hum
- 304 Bruno (rires)
- 305 Gaspard c'est ça ?
- 306 Gaspard du coup on coche tout ?
- 307 Arnaud non mais ça c'est un truc ça, après on doit soumettre nos données mais là, on n'a pas de données
- 308 Gaspard non, mais c'est eux qui se remplissent les derniers, non?
- 309 Arnaud ah bon?
- 310 Gaspard euh soumettez votre demande et le machin complètera votre base de données
- 311 Arnaud qui doit contenir les données d'au moins 15 patients
- 312 Gaspard ouais mais on les a comment?
- 313 Arnaud bah oui c'est justement
- 314 Gaspard regarde, c'est écrit là

- 315 Arnaud mais attends, on revient sur le truc témoins, et comme ça on pourra remonter les facteurs de risque
- 316 Yves voilà, on peut proposer ça mais après le mec, c'est que justement dans l'exposé de la petite vidéo là, il disait que ici, après il faudrait faire un truc donc euh...
- 317 Bruno l'objectif principal t'as écrit quoi?
- 318 Arnaud distinguer les malades à haut risque de thrombose veineuse ... non je sais pas ... Je sais même plus
- 319 Yves après il a dit qu'il fallait faire une étude prospective... Donc moi je vais re-regarder le truc...
- 320 Bruno (inaudible) l'objectif principal?
- 321 Arnaud donc moi c'était ça puis Yves aussi quoi
- 322 Yves de quoi?
- 323 Arnaud tu veux regarder par la vidéo?
- 324 Yves Moi, je vais le re-regarder
- 325 Bruno l'objectif principal c'était quoi ?
- 326 Yves l'objectif principal c'est de distinguer les malades à haut risque de ceux qui ... bas risque de MTE qui peuvent l'atteindre dans moins de 24 heures quoi
- 327 Arnaud distinguer les malades
- 328 Gaspard où c'est que je peux mettre?
- 329 Yves ouais, qui peuvent attendre 24h quoi...
- 330 Arnaud bah risque de MTE
- 331 Arnaud eh bah voilà, bah regarde, c'est exactement ça, attends, regarde... Imagine le cas-témoins, on fait comme on a dit, on va par exemple avoir que, par exemple les patients qui ont un cancer, bah ils ont tant de fois plus de chance d'avoir ça, les patients qui sont âgés, à partir d'un certain âge, ils ont tant de chance de plus d'avoir ça, donc après c'est une file aux réponses au truc... S'ils sont âgés, est-ce qu'ils ont un cancer?
- 332 Yves mais c'est quoi la (inaudible)?

- 333 Yves d'abord tu fais une étude de... cas-témoins qui te permet d'avoir certains facteurs et après tu fais un truc en...
- 334 Arnaud voilà
- 335 Arnaud voilà
- 336 Bruno ce qu'il faudrait c'est justement déterminer le score à partir du moment où ça devient urgent de traiter donc c'est-à-dire que on garde ceux qui ont été exposés au facteur de risque et ceux qui ont eu justement à la MTE et ceux qui ont eu les facteurs de risque mais pas la MTE c'est ceux qui ont eu un score insuffisant pour s'en préoccuper euh ... suffisamment
- 337 Arnaud et tu sors les facteurs
- 338 Arnaud ouais, ouais ouais
- 339 Gaspard il faudrait mieux pas étudier ça dans les Urgences?... Prendre les patients qui arrivent dans les Urgences et...
- 340 Bruno on peut pas étudier tout dans un service... c'est multi centrique et multi services
- 341 Arnaud on va regarder si...
- 342 Gaspard quoi ?
- 343 Arnaud on va faire tous les services
- 344 Gaspard (inaudible)
- 345 Arnaud parce qu'il a dit... non il a dit qu'il fallait comparer les services parce que le Chir. il a beaucoup de problèmes
- 346 Gaspard l'adresse d'Urgence pour les patients qui arrivent, on regarde s'ils ont déjà eu de la Chirurgie, ceux qui ont déjà été opéré
- 347 Arnaud ouais, mais ça n'a rien avoir si le mec il a été opéré il y a 20 ans... Là il disait bien que c'était les personnes qui sont en Chirurgie
- 348 Gaspard on est pas sûr qu'ils ont eu de la Chirurgie
- 349 Arnaud non... (3 s) je suis pas d'accord
- 350 Arnaud bon on verra...
- 351 Arnaud après genre... après tu vois... on pourrait dire par exemple euh... si on fait un score, avec tous les trucs qu'on a eu, bah le Chir. de 0 à un tel...fin tu vois, comme un score quoi

352 Gaspard ouais tu...

353 Bruno alors, quel type d'étude permettrait de déterminer un score

354 Gaspard Arnaud ... après tu vas donner des points différents pour ceux qui seront du pied, de la main

355 Arnaud mais non pas du tout

356 Gaspard ah bah si

357 Arnaud bah non

358 Gaspard bah si puisqu'il a bien dit que c'est pas la même chose si tu te fais opérer, euh, au niveau pulmonaire ou au niveau du pied

359 Bruno bah justement! C'est pour ça que t'établis un score!

360 Gaspard bah voilà

361 Arnaud bah oui, on va faire des scores différents

362 Arnaud de 0 à 5 par exemple, on va casser les Chirurgies qui sont les plus propices à la TVP... fin la MTE quoi...

363 Bruno c'est ça le score ou la valeur... la valeur... la valeur du score?

364 Arnaud c'est ça le score ouais... par exemple si...

365 Bruno justement pour distinguer le fait que si tu te fais opérer quelque part, les jambes par exemple, la Chirurgie euh... la Chirurgie euh... comment ça s'appelle?

366 Gaspard thoracique

367 Bruno non, pas thoracique... des jambes quoi... c'est une prise à risque... Chirurgie des mains quoi, ça c'est sûr...

368 Arnaud des pieds...

369 Arnaud non, l'ortho c'est plus à risques que la Chirurgie des mains, par exemple des gars qui se font opérer par exemple de la Chirurgie, qui se font Chir. de la main...

370 Gaspard on peut pas avancer les réunions? ça... (inaudible)

371 Arnaud par exemple les gars qui se font Chir. de la main, on leur mettra 0 et les gars qui se font Chir., dans Chir. à risques, on leur mettra 5

372 Bruno bah ouais

373 Arnaud voilà

374 Arnaud méthodologie... donc on va donc... étude cas-témoins... (4s)... donc en fait on...

375 Arnaud Yves, t'écoutes ou pas?

376 Yves ouais, vas-y

377 Arnaud donc on va prendre... x patients avec TVE... avec euh MTE... avec MTE

378 Gaspard hum, hum...

379 Gaspard et... ah Adrienne, tu peux pas (inaudible) la Chirurgie

380 Arnaud oui, non mais je sais, non mais c'est un exemple

381 Yves non mais tu fais quoi? tu fais euh... donc déjà il faut lire type étude... étude euh...

382 Arnaud cas-témoins

383 Yves étude::: cas-témoins

384 Gaspard ce qui serait bien c'est déjà de voir la prévalence

385 Arnaud rétrospective

386 Bruno oui, vous appelez étude épidémiologique... faut pas un paquet de personnes?

387 Arnaud si... oui mais là on s'en fout, parce que faut qu'on mette au point notre protocole

388 Gaspard mais si, la prévalence dans des différents centres pour voir s'il y a

389 Arnaud oui, oui pour comparer les centres

390 Gaspard oui

391 Arnaud mais là, si aujourd'hui on fait cette histoire de protocole, franchement on a fait un bon bout quoi

392 Bruno non...mais vas-y c'est ça ce qu'on va faire hein

393 Arnaud donc, on va prendre x patients avec MTE... avérée

- 394 Bruno à la limite, je vais commencer à noter l'objectif principal
- 395 Bruno on suite (inaudible)
- 396 Arnaud on va prendre... on va prendre x patients avec MTE... puis on va regarder dans leur dossier... bah les facteurs de risque
- 397 Bruno ... alors l'objectif principal c'était de déterminer...
- 398 Arnaud en fait, on peut vous soumettre le protocole qu'on veut faire ... ?
- 399 Yves non mais ... déjà j'ai une première question à vous poser ... c'est la ... la chose qu'on veut faire maintenant ... c'est que là justement il disait "spécifique" pour pas que ce soit donc c'est par exemple, on va centrer dans un service ou alors une étude sur quoi ?
- 400 Patricia-tuteur 1 ça c'est à vous de choisir
- 401 Yves c'est à nous de choisir aussi quoi ... d'accord
- 402 Arnaud en fait::
- 403 Bruno on aura plus qu'une valeur c'est le multicentrique ou multicentrique ou multiservice tout ça mais on ne pourra jamais euh:: englober euh:: tous les centres toutes les spécialités et tout ça ... on peut le faire ça ? ... ça serait généraliste à ce point-là ? ça n'aura aucune valeur
- 404 Yves alors les mecs il faut qu'on choisisse déjà ça hein
- 405 Patricia-tuteur 1 il ne faut pas être trop généraliste non plus hein
- 406 Bruno voilà ouais
- 407 Arnaud en fait, nous on était parti en se disant ... genre un truc cas-témoins voilà ... genre on va prendre tous les patients dans plusieurs services dans plusieurs centres qui ont eu enfin un MTE ... 'fin ... une vrai quoi ... diagnostiqué ... voilà ... et on va faire un truc prospectif et on va remonter en fait à leurs dossiers.
- 408 Bruno rétrospectif !
- 409 Arnaud ... rétrospectif ... à leurs dossiers ... voir leurs antécédents ... pour voir quel sont les facteurs de risque qui sont associés ... à partir des facteurs de risque on pourra associer des scores::
- 410 Bruno ceux qui ont plus de valeurs
- 411 Arnaud par exemple, si ils ont eu une Chir.' à risque ... on leurs mettra 5 une

- autre 0 etc. et puis on prend les ... 'fin les principaux facteurs de risque et puis on met un score à chacun pour avoir au final un ... un score::
- 412 Patricia-tuteur 1 oui mais il y a beaucoup de ... 'fin, vous allez avoir beaucoup des facteurs de risque hein
- 413 Arnaud non, on ne prend que les principaux quoi ... 'fin
- 414 Patricia-tuteur 1 voilà, à mon avis il faut que vous fassiez quand même des ... il faut cible::
- 415 Arnaud à c'est à dire qu'on cherche vraiment euh ...
- 416 Gaspard en Chirurgie par exemple
- 417 Arnaud on cherche que les gros trucs quoi ... d'accord
- 418 Patricia-tuteur 1 voilà il faut vous orienter sur un (inaudible)
- 419 Bruno et dans une première partie on va se focaliser sur un facteur de risque qui euh qui (inaudible) la MTE et puis dans une deuxième partie justement on va cibler les principaux et justement euh: pourvoir faire peut-être ... on peut faire deux études ? une étude rétrospective pour cibler les facteurs et en suite prospective en étudiant justement (inaudible) par rapport à un service ?
- 420 Patricia-tuteur 1 alors attendez ... vous voulez faire deux étude pour cibler les facteurs
- 421 Bruno une rétrospective pour cibler les facteurs qui ont plus de rôle dans l'apparition de la MTE
- 422 Patricia-tuteur 1 là ... vous n'avez pas eu dans le cours déjà ... vous n'avez pas quelque chose qui permette de répondre à ça ?
- 423 Bruno je sais pas ... bah voilà ... alors ... étudier une rétrospective et on suite une prospective par rapport aux plus important ... si
- 424 Arnaud ouais
- 425 Bruno et du coup euh:: et du coup ça nous permettrait d'établir ... bah donc le score on l'établit si on a déjà les facteurs de risque les plus important ...
- 426 Patricia-tuteur 1 non, mais vous avez une ... une idée ... voilà
- 427 Bruno une idée quoi d'une part

- 428 Patricia-tuteur 1 avoir une idée et après ... vous êtes quand même obligé de faire des choix puisque vous n'allez pas vous voir ...
- 429 Arnaud tout étudier ouais
- 430 Patricia-tuteur 1 là c'est quelque chose qui est très général volontairement ... vous avez besoin justement de recentrer et de réfléchir.
- 431 Patricia-tuteur 1 à mon avis il faut demander quand même à l'expert [Laurent-tuteur 2] donc on va voir s'il va dire la même chose que moi
- 432 Arnaud ok ... d'accord ... écoutez les gars [à Yves et Arnaud]
- 433 Patricia-tuteur 1 [Patricia-tuteur 1 s'adresse à Laurent-tuteur 2] : ils disent qu'ils veulent faire une étude, avant, rétrospective pour cibler les facteurs de risque et après faire une étude prospective sur les facteurs de risque ... mais est-ce qu'il y a pas déjà des études qui ciblent les facteurs de risque
- 434 Laurent-tuteur 2 [Laurent-tuteur 2 répond] : ouais la partie rétrospective ... allez la chercher dans la documentation ... il y a plein de choses connus sur la maladie ... la question de cours vous apprend plein de choses ... le but c'est de partie d'emblée vers un protocole définitif, donc un seul protocole
- 435 Yves ok
- 436 Arnaud prospectif
- 437 Laurent-tuteur 2 [Laurent-tuteur 2 continue suite à Arnaud] : prospectif ... cas-témoins ...
- 438 Yves mais là ... mais ... je veux dire ... les informations les ... par exemple, les informations sur les études on les obtient comment?
- 439 Laurent-tuteur 2 [Laurent-tuteur 2 répond à Yves] : sur les autres études ?
- 440 Yves en téléphonant par exemple ?
- 441 Laurent-tuteur 2 [Laurent-tuteur 2]: bah ... non ... mais dans la bibliothèque il y a déjà pas mal des choses
- 442 Yves ... dans la bibliothèque, ok
- 443 Laurent-tuteur 2 [Laurent-tuteur 2]: et volontairement parce que on est gentil avec vous, on vous a quand même sélectionné des trucs pour pas que vous dispersez quoi ... le but c'est pas que vous soyez des spécialistes de la MTE tout de suite

- 444 Yves ouais
- 445 Arnaud moi il y a un truc qui je ne comprends pas, c'est que ... si on fait une étude cas-témoins
- 446 Laurent-tuteur 2 [Laurent- tuteur 2]: ouais
- 447 Arnaud par exemple ... 'fin ... on était parti là-dessus ... genre on va prendre 1000 patients qui ont eu euh:: MTE ... et on va remonter ... 'fin on va regarder ... il va dire:: bah ... sur les 1000 il y en avait euh:: 900 qui avait ça euh: 10 qui avait ça et comme ça on hiérarchise les facteurs de risque ... mais ça c'est euh
- 448 Laurent-tuteur 2 hum
- 449 Laurent-tuteur 2 ça c'est des cas ... il faut des témoins
- 450 Arnaud mais les témoins c'est la population générale
- 451 Laurent-tuteur 2 fin les autres malades
- 452 Arnaud fin les autres malades à l'hôpital quoi
- 453 Laurent-tuteur 2 un des grands défauts des études cas-témoins c'est que si tu prends des malades, très malades qui on plein de cancers et mâchant et des petits jeunes qui attendent le tram c'est différent [rire]
- 454 Arnaud oui, bien sûr ouais
- 455 Laurent-tuteur 2 prends n'importe quel paramètre et tu vas trouver des différences, donc il faut trouver des témoins ...
- 456 Arnaud mais ça, ça marche ça ? ... 'fin
- 457 Laurent-tuteur 2 oui bien sûr
- 458 Arnaud mais là, je veux dire on fait que remonter un facteur de risque qu'on connaît déjà un petit peu quoi
- 459 Arnaud oui mais, après pour hiérarchiser il faut mettre un score à chaque truc
- 460 Laurent-tuteur 2 la ... oui ... la problématique de la commission c'est une problématique ... parfaitement de terrain ... c'est à dire, on sait des choses sur la maladie bidule ... dans notre hôpital c'est le bordel, il y a beaucoup trop de demande, donc pour une autre population, d'un

- autre hôpital en France ... comment il faut s'organiser ... parce que les études elles sont internationales, tu as des américains, des australiens ... les américains ils disent "l'obésité est un facteur de risque majeur, c'est un problème chez nous" ... c'est pas sûr, par rapport à leur problème à eux:: donc il y a forcément besoin de se réapproprié la connaissance et de la tester sur le terrain
- 461 Arnaud d'accord
- 462 Laurent-tuteur 2 et après on ne demande pas de faire un prix noble et un (inaudible)
- 463 Laurent-tuteur 2 après c'est à vous de réfléchir. à quels sont les bonnes conditions de ...
- 464 Bruno après ce qu'on veut c'est trouver l'examen ... donc pas l'examen clinique parfait, mais l'examen qui va nous permettre ...
- 465 Laurent-tuteur 2 voilà, les éléments clé, priorisez-les
- 466 Bruno voilà pour éviter donc de mener un patient à lui faire faire un tas d'examen
- 467 Laurent-tuteur 2 le but du jeu c'est d'éviter d'humilier le future externe de garde de l'hôpital, parce que si on donne à chaque externe de garde la liste de 50 facteurs de risque de MTE qu'ils doivent connaître par cœur avant de cocher à chaque fois qu'il fait une demande d'écho doppler ... ils vont se flinguer ... donc il faudrait leur demander actuellement le bon ... on vous a donné hein il est quelque part dans la commission hein, le bon actuel, c'est une page blanche, dites-moi alors quels sont les facteurs de risque et quel sont les signes cliniques ... ce qu'on vous demande c'est remplissez la page blanche avec des trucs qui vont aider vos futures collègues
- 468 Arnaud donc genre à la fin en fait, on sort un petit truc avec quatre questions cliniques genre ... est-ce que le patient, il a ça et ça ... et puis on peut coter par exemple le facteur de risque ... et voilà
- 469 Laurent-tuteur 2 voilà, ça s'appelle un score et ça permet d'hierarchiser, c'est exactement ce qu'on vous demande
- 470 Laurent-tuteur 2 après ça peut se décliner par thématique, les vieux, les jeunes, les femmes, les hommes, les malades de Chirurgie, cancers, mâchant
- 471 Laurent-tuteur 2 ça c'est à vous de développer un projet cohérent dans un champ donné quoi
- 472 Arnaud Donc les gars, c'est bon, on est bon, donc on va... On résume tout... On va faire une étude cas-témoins sur "X" patients avec MTE avérée, on va regarder rétrospectivement

- 473 Arnaud les principaux facteurs de risque
- 474 Yves il disait pas justement que maintenant y avait une bibliothèque où on pouvait avoir des informations...etc.?
- 475 Arnaud si mais justement parce qu'il faut... il faut qu'on... en fait, il faut pas qu'on dise euh ouais on va regarder tous les facteurs de risques qu'ils avaient. Non, on va en choisir 3 ou 4
- 476 Arnaud 3 ou 4 principaux... Les plus importants, d'accord? Que nous on pensait que les plus importants donc on va vérifier si c'est les plus importants, et à partir de ces 3, 4 facteurs de risque, on va mettre au point un score, d'accord?
- 477 Yves ouais qu'on va tester ensuite par une étude prospective
- 478 Yves non parce qu'en fait là , ça fait, ça fait déjà une étude
- 479 Arnaud oui
- 480 Arnaud Mais après je veux dire... là y a même pas besoin de faire un truc prospectif, fin...si ça marche dans un sens, ça marche dans l'autre
- 481 Arnaud on prend un score qui permet bah à l'arrivée du patient, eh bah dévaluer rapidement les principaux facteurs de risque pour voir effectivement s'il faut le prendre en charge rapidement parce qu'il a une forte suspicion de la MTE ou si non, ou si c'est pas la peine
- 482 Arnaud GASPARD, tu euh... tu euh... tu absous?
- 483 Bruno ouais, carrément
- 484 Arnaud toi, ça te va?
- 485 Bruno ouais
- 486 Arnaud bon bah voilà
- 487 Arnaud c'est bon Gaby, t'es ok sur le truc?... Gaby?
- 488 Arnaud c'est bon, t'es ok sur le truc? sur le protocole?
- 489 Gaspard bah en gros, sélectionner les facteurs de risque et puis euh...
- 490 Arnaud ouais
- 491 Arnaud bah moi je vous propose qu'on cherche un peu les principaux facteurs de risque... non? GASPARD?

492 Bruno ouais

493 Arnaud chercher un peu les principaux facteurs de risque, il faut qu'on en prenne 3 ou 4

494 Arnaud je sais pas où c'est... t'as vu tout à l'heure le cours là ?

495 Bruno de quoi?

496 Arnaud le cours sur les facteurs de risque, tout ça là ...

497 Bruno là en fait c'est... C'est dans... C'est stat, ressources... euh...

498 Bruno euh... compte-rendu rapide... euh... les actualités...

499 Arnaud diaporamas, non?

500 Bruno bah c'est ce qu'on avait, ouais... Alors, ouais c'était dans diapo

501 Arnaud c'est à la fin là

502 Bruno attends mais je crois qui c'était

503 Yves [Yves cherche des informations sur MTE et dit "maladie plurifactoriel". Lecture d'écran.]

504 Bruno Age... Finalement c'est le plus important quoi

505 Arnaud ok, donc alors, il faut des... L'âge, c'est le plus important, il faut essayer de définir un seuil, non?

506 Arnaud un seuil euh... par exemple, t'as un jeune qui arrive : à 20 ans, il a pt-être pas de...

507 Bruno ouais mais ouais mais euh...

508 Arnaud comparé à un vieux de 90 ans tu vois...

509 Arnaud risque de (inaudible) croissant

510 Bruno on n'aura pas un âge rupture à 55 ans pile poil

511 Arnaud pt-être un intervalle quoi...

512 Bruno on va dire que passer 70 ans ou 60 ans.pt-être..

513 Arnaud peut-être... Un seuil

514 Arnaud euh...

- 515 Arnaud attends, tu peux revenir juste un coup sur la (inaudible) d'avant
- 516 Yves Socialisation entre Yves & GASPARD
- 517 Bruno au final, est-ce que c'est pas maladie cardio-vasculaire, médicament, maladie inflammatoire qu'il faut mettre quoi?
- 518 Arnaud ouais (inaudible)
- 519 Bruno et après tu vois, t'as les ++ dans le cancer, t'as les ++ dans l'âge...
- 520 Arnaud là de toute façon... Là je veux dire, on peut tout mettre quoi... fin...
- 521 Bruno on va parler d'obésité aussi
- 522 Arnaud ouais mais l'obésité... fin... C'est pas le truc principal
- 523 Bruno mais est-ce que... l'objectif principal à mon avis, on n'est pas obligés de garder celui-là tu sais, comme ils disaient... est-ce que...
- 524 Yves maladie plurifactoriel ... plurifactoriel c'est ça, qu'est-ce que ça veut dire maladie plurifactoriel, ça veut dire qu'il y a plusieurs facteurs qui peuvent induire [la maladie], par exemple, la thrombophilie, stase veineuse, tu vois là déjà on a les premier trucs, il y a alitement ... déjà, alitement par exemple, ... [lecture de l'écran]
- 525 Arnaud ouais, on peut mettre ... ouais
- 526 Bruno est-ce que on peut pas faire une étude comparative Amérique-France pour savoir si l'obésité est un facteur de risque de la MTE? Un truc comme ça...
- 527 Arnaud ouais...
- 528 Bruno pour déterminer si l'obésité justement est un facteur de risque important à prendre en compte ou pas quoi
- 529 Arnaud GASPARD tu veux dire en plus?
- 530 Bruno non, notre étude serait une étude comparative des Etats-Unis et de la France par rapport à l'IMC mondial... L'IMC national qui est bien plus élevé aux Etats-Unis
- 531 Yves oui mais là je pense que c'est en France quand même
- 532 Arnaud ouais mais là on se perd un peu quand même, non?
- 533 Yves c'est multicentrique et tout si tu veux faire un truc comparé

- 534 Bruno mais pourquoi il nous a parlé des obèses aux Etats-Unis?
- 535 Arnaud Non, mais non justement il nous a dit
- 536 Gaspard mais justement c'est pour te centrer
- 537 Arnaud il nous a dit que si on (inaudible), parce qu'il n'y a pas d'obèses ici
- 538 Gaspard les obèses c'est pas forcément un facteur de risque
- 539 Gaspard les obèses, ça peut être un facteur de risque hein GASPARD, mais en France, étant donné le nombre d'obèses comparé aux Etats-Unis, c'est pas très représentatif quoi
- 540 Arnaud ici, ça marche pas trop ouais
- 541 Yves justement tu vois, on peut pas prendre des études des Etats-Unis et les reporter en Europe directement comme ça
- 542 Bruno donc l'obésité on le prend pas en compte en facteur de risque?
- 543 Arnaud non ouais
- 544 Arnaud moi avec Gaspard, on a trouvé 3 trucs dans ses cours
- 545 Yves moi j'ai trouvé alitement... Alitement apparemment ça fait une stase veineuse, machin...
- 546 Gaspard ouais mais le problème de l'alitement c'est qu'ils te les mettent en alitement parce qu'ils savent
- 547 Bruno puis même si tu fais cas-témoins dans un hôpital, tout le monde est alité
- 548 Arnaud ouais (inaudible)
- 549 Yves non non mais pas toujours si ça te fait une étude aux Urgences ou quoi
- 550 Arnaud bah tu vois là, regarde, facteur de de risque de la maladie thromboembolique veineuse, facteur du patient, âge +++, cancer +++, insuffisance cardiaque +++...etc. [en frappant sur l'écran], antécédent personnel de la MTE et antécédent familial +++)
- 551 Yves non mais moi je pense que l'âge c'est justement pt-être parce qu'ils sont plus alités
- 552 Bruno (rires) mais non, tu peux pas être plus alité quoi (rires)
- 553 Arnaud bah si puisqu'il a la tête en bas (rires)

- 554 Gaspard les personnes âgées, elles dorment plus
- 555 Yves mais regarde c'est marqué là : la stase veineuse est un alitement
- 556 Arnaud non mais ça d'accord mais ça c'est un truc euh...
- 557 Yves c'est bon, en même temps le mec tu vas lui poser : vous avez un cancer, quelque fois il le sait pas hein
- 558 Arnaud non mais ça on s'en fout, c'est...
- 559 Bruno le décubitus chronique n'est pas un facteur de risque et par contre la position assise oui
- 560 Arnaud aah...
- 561 Yves c'est quoi ça?
- 562 Yves le décubitus chronique, mais qu'est-ce que c'est que ce truc?
- 563 Bruno c'est être allongé
- 564 Arnaud c'est être allongé
- 565 Gaspard y a dyspnée et douleur thoracique aussi
- 566 Yves bah est-ce que vous vous asseyez souvent...(rires)
- 567 Arnaud bah là t'es pas assis là ?
- 568 Bruno non mais par contre, tu vois les vieux, ils vont rester assis longtemps sans se lever parce que ça les fatigue et ils resteront assis derrière leur fenêtre à regarder les petits oiseaux tu vois...
- 569 Yves non mais eh...
- 570 Bruno alors que le jeune il va au moins vouloir se lever pour aller faire un petit peu de marche quoi
- 571 Gaspard c'est clair ouais
- 572 Bruno donc c'est... tu vois c'est rééducation (inaudible)... les vieux à mon avis
- 573 Arnaud bon les gars, il faut qu'on se trouve quelques...
- 574 Yves bon bah mets est-ce qu'ils sont souvent assis
- 575 Arnaud ouais mais tu peux pas mettre souvent... fin je sais pas...

576 Gaspard et y a les D-dimères hein

577 Arnaud non mais ça c'est pour euh... ça c'est un examen ça

578 Gaspard mais s'ils sont négatifs, on fait éliminer la MTE

579 Arnaud oui, mais là on cherche des facteurs de risque... Et D-dimères c'est pas des facteurs de risque

580 Yves qui sait qui dit mères là ?

581 Gaspard non mais ça servirait à changer les... à faire les témoins et les cas ... ceux qui ont les D-dimères positifs et ceux qui les ont pas

582 Arnaud les examens

583 Arnaud non là on a un truc, normalement c'est sur l'âge : y a 2 seuils où l'âge c'est 40... et 75 ans

584 Gaspard euh ça servirait à sélectionner les cas et les témoins

585 Arnaud oui mais les D-dimères c'est pour l'embolie, non?

586 Gaspard non, les D-dimères permettent d'éliminer le diagnostic de la MTE lorsqu'ils sont négatifs

587 Arnaud d'accord, donc en fait là, y a 2 trucs principaux : c'est les D-dimères et les échos doppler

588 Gaspard euh non, les échos doppler c'est pour la thrombose veineuse profonde

589 Arnaud ok donc les D-dimères

590 Gaspard et après l'écho doppler ça permet de faire une...

591 Arnaud ouais mais ça c'est pas un facteur de risque

592 Gaspard parce que la MTE ça... apparemment ça regroupe une thrombose veineuse profonde et une embolie pulmonaire

593 Arnaud ouais, ouais, ouais...

594 Gaspard du coup ça peut confirmer qu'il a une thrombose veineuse

595 Arnaud ouais

596 Yves ouais c'est ça

597 Bruno bon tu mets Chir. des membres inférieurs hein

598 Arnaud bah Chir. des membres inférieurs

599 Yves l'intégrale de cosinus carré c'est...

600 Arnaud bon les gars, pour nous avec GASPARD, on a trouvé 4 trucs principaux : c'est l'âge avec 2 seuils qui sont décrits de 40 à 75 ans, les antécédents (si ta mère ou ton père, ou si toi t'as déjà eu une MTE, t'as beaucoup beaucoup de risques d'en refaire une), l'insuffisance cardiaque et enfin la Chirurgie des membres inférieurs

601 Arnaud pour nous, ça c'est les 4 risques, ça c'est les 4 facteurs de risque principaux

602 Bruno c'est pas mal ça déjà ... on va commencer par ça...

603 Arnaud pour nous, les 4 facteurs de risque principaux c'est ça

604 Bruno bah en fait, est-ce que sur Wikipédia, on n'a pas un petit truc genre vite fait?

605 Arnaud Comment?

606 Arnaud tu veux qu'on

607 Yves bah ils disent qu'il faut poser 4 questions mais tu vois, on en prend 6 et puis on prendra les 4 meilleurs tu vois

608 Arnaud ok, ouais on prendra les 4 meilleurs, ouais

609 Arnaud on va en proposer d'autres et on prendra les 4 meilleurs

610 Arnaud après par exemple, tu vois, l'âge... par exemple là ... fin tu vois... fin score ou l'âge... par exemple ou 1 côté sur 4 par exemple... fin non pardon, l'âge si, c'est très important on va coter sur 10 par exemple

611 Arnaud moins de 40 ans, zéro

612 Gaspard et euh...y a des maladies post-thrombotiques hein... des maladies post-thrombotiques au niveau des jambes

613 Arnaud eh Gaspard?

614 Gaspard eh bah c'est un gros facteur de risque apparemment

615 Arnaud c'est marqué où?

616 Gaspard ça présente un risque immédiat, potentiellement vital à la::

- 617 Arnaud oui, mais ça c'est un risque d'EP ça
- 618 Arnaud varices... ah oui...
- 619 Gaspard tu vois, à distance de l'épisode aigu, le risque est lié au développement d'une maladie post-thrombotique
- 620 Yves mais tu sais ce que c'est qu'une maladie post-thrombotique toi?
- 621 Arnaud c'est des varices sur les jambes
- 622 Yves maladie post-thrombotique ...
- 623 Arnaud 30% des...
- 624 Yves mais là c'est 600 000, tout à l'heure c'était un truc du genre 100 000...
- 625 Gaspard ouais mais ça c'est aux Etats-Unis hein... Lis un peu!!
- 626 Arnaud ouais y a beaucoup de Chirurgie du bassin hein ... Chirurgie des membres inférieurs et du bassin
- 627 Arnaud après, faudrait qu'on cote ça en fait
- 628 Arnaud avec la Chir.
- 629 Bruno (inaudible) ah bah voilà, bah t'as... ah c'est pour ça qu'ils ont des bandelettes de condensations
- 630 Gaspard euh... Hypercoagulabilité ... C'est un gros facteur de risque
- 631 Yves non mais attend mon pote, est-ce que vous ...
- 632 Arnaud mais c'est pas possible...
- 633 Gaspard la paroi vasculaire abimée par la Chirurgie orthopédique (inaudible) traumatisme ... tu as l'hypercoagulabilité et tu as la stase veineuse ... circulation trop lente du sang dans les veines, lié à l'alitement ou au voyage en avion
- 634 Yves alitement, c'est la triade de Virchow
- 635 Gaspard bah on les a tous là ... l'alitement ça en est un je suis désolé hein
- 636 Yves ouais ouais la stase veineuse ouais ... bon après il y a différence selon la maladie
- 637 Yves FDR majeur donc antécédent personnel de MTE, donc ça on prend,

Chirurgie récente, moins de 45 (inaudible)

- 638 Gaspard tu vois, traitement anticoagulant
- 639 Yves en absence de traitement anti coagulant
- 640 Gaspard mais oui
- 641 Gaspard bah ... justement
- 642 Yves bon mais c'est vrai qu'une Chirurgie récente ça entraine une hypercoagulabilité hein
- 643 Gaspard ouais mais justement le mec si tu lui demande (inaudible) ou pas
- 644 Yves le cancer, l'insuffisance cardiaque ou respiratoire et l'alitement ... bon on a qu'à reprendre les quatre là et on va garder ...
- 645 Gaspard j'ai bien envie de t'applaudir hein, parce que j'ai raison finalement
- 646 Arnaud quoi, pour quoi ...
- 647 Gaspard [lecture d'un texte] ... chez les sujets jeunes l'investigation étiologique étant noté par la présence de signes cliniques ou par l'interrogatoire dans la recherche d'anomalie d'homostase
- 648 Arnaud ouais ... mais bah oui mais ...
- 649 Gaspard "Oh! ***** [injure] je l'ai eu" [voix de moqueur]
- 650 Gaspard Je t'ai eu
- 651 Arnaud mais non!
- 652 Gaspard mais si!
- 653 Arnaud eh bah ...
- 654 Gaspard le sujet jeune il n'aura pas de cancer il aura ... qu'est-ce que tu veux en trouver de MTE chez les sujets jeunes? il faut bien qu'il ait une ***** [terme vulgaire pour dire indisposition]
- 655 Arnaud de quoi?
- 656 Gaspard problème d'homostase
- 657 Arnaud eh bah! on va rajouter ça, voilà !
- 658 Gaspard eh bah voilà

659 Arnaud t'es content?

660 Gaspard bah grave!

661 Gaspard oh du coup t'es de la ***** [injure] !

662 Arnaud hémostase ... [en écrivant]

663 Arnaud et cancer ... allez

664 Gaspard parce que si tu prends que ces facteurs là il y a les trois quart chez les jeunes ... cancer vite faits ... après la Chirurgie euh ... c'est tout hein

665 Arnaud non il y a les antécédents aussi

666 Arnaud familiaux

667 Gaspard non

668 Gaspard antécédent quoi

669 Arnaud familiaux

670 Gaspard bah justement c'est ça

671 Gaspard antécédents familiaux c'est le problème homostase

672 Arnaud mais non! antécédents familiaux de MTE

673 Gaspard oui ... familiaux d'homostase

674 Arnaud oui! si tu veux ...

675 Gaspard le problème ...

676 Gaspard d'antécédents familiaux

677 Arnaud et toi, tu as dit ... examen complémentaire systématique limité au patient avec MTE et expliquer ... donc tes D-dimères là je te ***** [expression vulgaire exprimant "rejeter comme sans valeur"]

678 Gaspard ah non! examens complémentaires

679 Arnaud bah oui c'est systématique

680 Gaspard [inaudible] ... D-dimère

- 681 Arnaud mais c'est quoi les D-dimères, c'est des examens complémentaires
- 682 Gaspard complémentaire ça donne une valeur précise (?)
- 683 Arnaud [essoufflement de fatigue]
- 684 Arnaud non ... allez viens ...
- 685 Arnaud (inaudible)
- 686 Gaspard [rires]
- 687 Arnaud Bon les gars ...
- 688 Gaspard du coup, pendant cet interlude, j'ai réussi à mettre en avant mon point de vue que la recherche par interrogatoire, de l'anomalie de l'homostase est important
- 689 Yves attend, mais tu l'as vu où ?
- 690 Arnaud bon, c'est vrai que ... voilà
- 691 Gaspard ici
- 692 Gaspard du coup j'avais raison avec mon (inaudible)
- 693 Bruno Alors, on a un protocole qui commence à se mettre en place ou quoi?
- 694 Arnaud ouais, donc les gars ! on va récupérer les facteurs de risque d'accord?... l'âge ... on sait déjà qu'il y a un seul de 40 à 75 ans et il faut les vérifier ... et après on pourrait les compter, d'accord?
- 695 Yves ok
- 696 Arnaud les antécédents personnels ou familiaux de MTE ... si tu as déjà fait une MTE ... tu vas en faire une dans ta vie. Si ton père en a eu une, tu as une grande chance d'en avoir une. Incidence cardiaque, d'accord? Donc ainsi on peut mettre un score tu vois? C'est le plus ou moins grave etc. La Chir.' des membres inférieurs et du bassin, ça c'est fatal quoi ... les maladies d'homostase ... et cancer on a oublié les cancers.
- 697 Bruno bon les mecs, définir une population à risques
- 698 Gaspard par contre euh... la Chirurgie... Arnaud
- 699 Yves la population ... ah oui!
- 700 Gaspard la Chirurgie il disait bien que c'était inférieur à 45 jours

701 Bruno alors... définir les populations de l'étude

702 Yves attendez!

703 Arnaud ouais

704 Bruno est-ce qu'on prend un service en particulier ou pas?

705 Arnaud et euh:: ... avec ou sans prise de anticoagulant

706 Yves justement

707 Yves attendez les mecs, est-ce qu'on prend un service en particulier?

708 Bruno est-ce que tu peux diviser tes facteurs de risque comme Chirurgie, médecine, Urgence?

709 Arnaud bah faut qu'on les...il faut qu'on les foute quelque part

710 Yves est-ce qu'on s'intéresse par exemple qu'à la Chirurgie ou alors vraiment on fait comme si on était dans les services d'Urgence alors?...

711 Gaspard bah l'âge ... c'est euh ... pour tout le monde ... c'est pas un service particulier ... euh: pareil pour l'homostase ...

712 Arnaud ouais

713 Arnaud bah le but du jeu c'est quand même ça, c'est les patients qui arrivent...

714 Bruno trouble de l'homostase c'est médecine! C'est pas de la Chirurgie!

715 Bruno trouble de l'homostase c'est euh ... pathologie (inaudible)

716 Arnaud tu veux pas qu'on demande à la prof comment caser la Chir., la Méd. et les Urgences?

717 Bruno non parce que... est-ce qu'on pourrait pas prendre un service en particulier et prendre les facteurs de risque spécifiques à certains services?...

718 Yves ouais parce que dans ce cas-là, il faudrait prendre un truc spécifique au service ou alors on fait un truc général... Si c'est aux Urgences, on peut demander tout quoi...

719 Gaspard ce qui serait bien c'est ... moi je pense ouais

720 Bruno parce que tu vois en Chirurgie, les mecs ils sont alités et ils sont obligatoirement alités... ça par contre, ils ont pas le droit de se

- balader tu vois... s'ils sont en Chirurgie vasculaire, ils sont alités
- 721 Gaspard moi, je pense que ce qui serait bien c'est faire déjà ...
- 722 Arnaud bah ça justement, ça pourra confirmer... on fait ça... On prend tous les patients et on ...
- 723 Gaspard non, mais ce qui serait bien, c'est de prendre déjà les Urgences ... parce que les Urgences, tu auras plein de facteurs de ris ... 'fin, plein de patients qui auront plein euh ... il y en a qui ont eu de la Chirurgie, il y en a qui ont eu de la médecine et du coup ça fait un pas un peu plus vite dans tous les services
- 724 Arnaud parce que sinon, on peut très bien prendre tous les patients et en suite on les ... 'fin je veux dire, on peut tous les prendre et regarder d'où ils viennent quoi et on ... enfin, comment dire ...
- 725 Gaspard justement, c'est pour ça qu'il vaudrait mieux prendre les Urgences
- 726 Arnaud non mais si on les prend tous, on peut mettre en évidence la différence entre la Chir., la Méd. et les Urgences et ça, je veux dire, c'est un truc différent. D'un côté, on les considère tous ensemble, peu importe du service d'où ils viennent, et on regarde les facteurs de risque, et je veux dire, dans le même temps, on peut très bien les prendre séparément et vérifier, bah la différence entre les services
- 727 Bruno voilà
- 728 Arnaud tu vois ce que je veux dire ou pas, GASPARD?
- 729 Bruno hum hum...
- 730 Arnaud je veux dire, tu peux très bien... je veux dire, eux ils ont tous les mêmes facteurs de risque
- 731 Yves ouais, non mais non, c'est pas tout à fait la même chose parce que là tu vois, un mec qui a une question en Chirurgie, je te dis, il a été alité pendant obligatoirement pendant un bout de temps
- 732 Arnaud oui, oui
- 733 Arnaud mais voilà
- 734 Yves le mec qui viendra aux Urgences, il aura jamais eu ça de sa vie
- 735 Arnaud non mais d'accord
- 736 Gaspard tu peux pas comparer des Urgences avec de la Chirurgie hein

737 Bruno ouais, moi je pense qu'il faudrait prendre un service en particulier ...

738 Gaspard ouais, mais bien sûr ...

739 Yves Il faut qu'on arrive à cibler ... moi, je pense que l'important c'est

740 Gaspard moi, je prendrais les Urgences hein

741 Yves il faut qu'on prenne les Urgences ou la Chir. ...

742 Gaspard ou alors prendre les services et les regarder entre les différents hôpitaux mais tu peux pas comparer la Chir. et les Urgences

743 Yves moi je pense qu'on peut... on prend un service

744 Arnaud il faut...pff

745 Yves qu'est-ce que vous voulez prendre comme service? ... (inaudible), la Chir.?

746 Gaspard les Urgences

747 Arnaud mais c'est réducteur quand même

748 Gaspard le but ce serait quand même de désengorger les Urgences

749 Bruno et est-ce qu'il y a pas un service où on a plus de cas de MTE justement?

750 Arnaud bah en Chir., bah en Chir., ça c'est en Chir.

751 Bruno donc ça doit être ça le plus intéressant quand même

752 Gaspard non mais, la Chir.' ...

753 Arnaud ouais mais attends, ouais mais ton étude, elle est biaisée dès le départ hein

754 Arnaud si tu pars directement sur un service où tu sais qu'il y en a plein, ton truc il va être biaisé quoi

755 Gaspard GASPARD! [BRUNO]

756 Bruno bah oui, mais on va forcément avoir un biais hein

757 Arnaud et tandis que si tu prends tous les.. oui mais si tu prends tout le monde, t'as pas un biais de sélection.

758 Yves mais ça, il faudrait pt-être qu'on demande au mec...

- 759 Bruno oui mais c'est un peu compliqué... fin je veux dire...
- 760 Yves faut qu'on demande
- 761 Arnaud moi je lui demande...
- 762 Arnaud on lui demande, non?
- 763 Bruno bah ouais tant qu'à faire...
- 764 Gaspard moi je trouve qui va être compliqué ... ou alors comparer entre ...
- 765 Arnaud [en s'adressant à Patricia- tuteur 1] en fait, on est confronté à un petit problème parce que on se demande ... en fait, les facteurs de risque tout ça en fait, on se demande comment inclure les trois pôles - Méd, Chir.', Urgence - dans l'étude ... c'est à dire, est-ce qu'il faut qu'on n'en prennent qu'un et à ce moment-là on s'exposé à un biais de sélection par exemple avec la Chir.' où il y a beaucoup plus de MTE que ailleurs, donc voilà , il y a un biais de sélection ... euh est-ce qu'on prend la Méd où il y a peut-être moins ou les Urgences ou pas enfin on ne sait pas trop quoi ?
- 766 Bruno Est-ce qu'il serait trop compliqué de faire un étude sur les trois services ...
- 767 Arnaud sur les trois
- 768 Bruno ... et en suite de faire un comparatif entre les services à la fin de l'étude, quoi ?
- 769 Yves ouais parce que
- 770 Bruno il faut d'abord une étude généraliste et ensuite ... sur euh ... concernant les trois services et ensuite on essaye de recentrer:: sur chacun des services et faire une moyenne
- 771 Yves c'est clair qu'on va avoir un extrême(?)
- 772 Yves mais le truc c'est que la population est tellement ... n'est pas assez ciblé si on prend tout les services, que finalement la population qu'on a elle ne représente rien quoi ... elle ne représente ni quelque chose qui est ... même une population qui vient aux Urgences::, elle ne soit pas bien représenter parce que ... par exemple toute la population de Chirurgie ... euh ... ils sont alité etc. et ça c'est pas quelque chose ... donc c'est sur qu'on peut pas prendre tous les services quoi, ... maintenant moi je pense que possible
- 773 Gaspard je pense qu'il faut faire une étude multicentrique sur un service

- 774 Patricia-tuteur 1 après voilà plus vous allez prendre des données::: ... forcément c'est pas ... après vous allez avoir de biais aussi ...
- 775 Arnaud plus on va (inaudible) quoi, ouais
- 776 Bruno il y aura forcément euh:
- 777 Bruno il y aura forcément des biais dans nos critères de sélection quoi ... je veux dire, on ne peut pas faire une étude sur toute les populations du monde sur tous les services
- 778 Patricia-tuteur 1 non mais, on ne vous demande pas ça hein
- 779 Bruno ouais
- 780 Arnaud ouais
- 781 Patricia-tuteur 1 on ne vous demande pas de faire une étude sur ... enfin ... après c'est à vous de faire des choix qui vous pensez ... judicieux, voilà.
- 782 Arnaud judicieux
- 783 Bruno mais est-ce que le fait que la Chirurgie soit plus exposée à ses menaces de pathologies
- 784 Yves non, ça je pense que ça fait pas un biais parce que ce sera dans une population de fin... la population c'est en Chirurgie donc il y a pas de biais directement
- 785 Bruno non mais, ce que je étais en train de dire c'est que vue (inaudible) traiter ...
- 786 Arnaud ouais mais le truc c'est que
- 787 Gaspard le problème c'est que après tu ne peux pas la comparer la Chirurgie aux Urgences
- 788 Arnaud parce que nous après ... ouais ... après nous on veut ... parce que on est bien d'accord que le but du jeu ... en fait ce qu'il y a c'est aux Urgences, quand les gars ils arrivent ... bah hup! quatre questions ça va, si vraiment il faut se dépêcher ou si on laisse traîner ... je veux dire si on prend les gars en Chir.' ou le risque ... 'fin, en Chir.' c'est pas représentatif ... 'fin, c'est pas ... on ne peut pas extrapoler vraiment ... 'fin ... tu vois ce que je veux dire
- 789 Patricia-tuteur 1 euh: il y a déjà des ... oui ... il y a déjà des oui ... c'est possible
- 790 Yves ouais, moi j'ai pas de ... j'avais pas compris ... parce que moi j'avais

- compris que l'objectif justement ce n'étais pas obligatoirement euh: aux Urgences, mais c'était si on suspecte un patient d'avoir
- 791 Patricia-tuteur 1 oui, c'est pas qu'aux Urgences
- 792 Arnaud d'accord
- 793 Patricia-tuteur 1 c'est ... oui oui ... c'est sur l'interrogatoire que fait le médecin quand il pose des questions au patient sur quelque chose, est-ce que lui il juge urgent ou pas de faire des analyses parce que il y a un risque qu'il ait cette maladie ... mais c'est euh il n'arrive pas [le patient] dans le service des Urgences quoi
- 794 Yves ???
- 795 Arnaud d'accord ok
- 796 Yves ah ouais
- 797 Bruno hum, donc ce qu'on disait de traiter un service en particulier, ça peut être un moyen de disperser (inaudible) une bonne idée [rires]
- 798 Yves donc là dans ce cas-là ... par contre dans ce cas-là ... dans un
- 799 Yves mais si on vise un patient ... mais par exemple si on dit qui c'est un patient qui est à l'hôpital, en retire juste le service des Urgences
- 800 Patricia-tuteur 1 non mais, ça c'est au moment de ... 'fin moi j'ai peur de ... je pense que c'est à vous d'essayer de voir ce qui est le plus ... ce qui vous trouver le plus pertinent
- 801 Yves les Urgences (inaudible) ... attendez, moi je propose un autre truc, imaginons juste pour des gens qui seraient à l'hôpital, donc pas justement aux Urgences, qui sont hospitalisés et donc on veut ... on suspecte une MTE et donc on essaye de regarder et par exemple là dans ce cas-là on peut mettre s'il est on Chir.' on lui mettait des points en plus
- 802 Arnaud bon allez on se barre [rire]
- 803 Gaspard ouais, c'est ça
- 804 Arnaud oui, on a mis ça, on a mis la Chir.' dans les facteurs de risque ... on a dit qu'on mettrait un score
- 805 Yves ouais, justement donc ça peut ... ça peut rentrer dedans ... si tu prends les gens aux Urgences, c'est clair que le mec s'il est ... enfin je veux dire ... il sortira pas de Chir.' quoi ... 'fin.

- 806 Bruno ça se peut hein
- 807 Yves ça se peut ouais ... ça se peut ouais ...
- 808 Patricia-tuteur 1 fin, ça se peut ... il y est pas encore [rire] il va peut-être y aller [rire]
- 809 Arnaud bon, bah déjà on vire les Urgences ... on vire les Urgences
- 810 Yves [rire]
- 811 Gaspard [rire]
- 812 Yves dans ce cas-là tu t'intéresses juste au patient de l'hôpital hospitalisé ... au patients à l'hôpital ... les patients hospitalisés ou alors les patients qui viennent à l'hôpital, c'est un des deux
- 813 Gaspard moi j'aurais pris les Urgences
- 814 Patricia-tuteur 1 de toute façon, vous avez ... je pense dans la manière dont est fait ... vous êtes obligé de prévenir les services, parce que si vous voulez aller interroger les gens dans un services, vous devez avoir l'autorisation etc. mais après dans le ... 'fin, je ne sais pas si on vous a expliqué, vous allez pouvoir accéder à des services ... vous allez demander l'autorisation du chef de service pour pouvoir y aller ... par contre après vous allez ... pour avoir ... quand vous aurez déterminé le nombre des patients, cela il faudrait faire avant vous en avez besoin pour votre étude, vous allez faire une demande au DIM, vous allez accéder en fait à une vrai base de données de patients qui est répertorié là -bas et puis vous allez avoir des critères, vous avez accès à la fiche là si vous voulez avoir une idée. Vous allez avoir des critères et c'est là où il faudra choisir les patients ...
- 815 Gaspard moi j'aurais pris les Urgences hein
- 816 Yves pourquoi les Urgences ? les Urgences là ?
- 817 Gaspard ici tu as un peu de tout aux Urgences
- 818 Yves mais est-ce que tu croix que ça existe un mec qui vient avec une thrombose aux Urgences?
- 819 Gaspard le mec il a mal
- 820 Gaspard parce que eux le but c'était de désengorger les Urgences hein
- 821 Arnaud ouais, c'est ça
- 822 Bruno il faut pas faire un (inaudible) demander à un service

- 823 Yves et juste par contre
- 824 Patricia-tuteur 1 par contre ... ah non, vous ne faites qu'une demande sur la fiche mais euh: après je ne sais pas si vous pouvez ... vous pouvez pouvoir cocher plusieurs ... c'est la même chose hein
- 825 Bruno (inaudible)
- 826 Arnaud ouais ouais
- 827 Yves excusez-moi, par contre, juste une chose, est-ce que vous savez si c'est possible ... 'fin une MTE, imaginons que j'en ai une là, est-ce que j'ai la possibilité moi d'aller aux Urgences ou alors je suis directement là ... 'fin, c'est directement les:: ... est-ce que c'est quelque chose de violent une maladie ... une thrombose comme ça::
- 828 Patricia-tuteur 1
- 829 Patricia-tuteur 1 ah bah ça dépend du stade que vous avez, alors moi je ne suis pas:: bien qualifier pour vous donner des précisions ou de point de vue sur la maladie
- 830 Arnaud c'est demande de données je crois [Bruno]
- 831 Bruno ça? [Arnaud]
- 832 Yves parce que ... je ne suis pas sûr qu'aux Urgences on dépiste beaucoup de MTE quoi ... ça m'étonnerais quoi
- 833 Patricia-tuteur 1 non mais, ... c'est vous qui avez dit qui c'étais pas le but
- 834 Yves bah justement ouais, et c'est parce que justement je me pose un peu la question: ... aux Urgences ça me paraît bizarre quoi
- 835 Patricia-tuteur 1 voilà
- 836 Patricia-tuteur 1 bah si si ... si un nombre ... si
- 837 Patricia-tuteur 1 voilà ... c'est ce que j'allais dire ... une embolie c'est là [après intervention d'un étudiant d'un groupe derrière]
- 838 Yves ouais, tu le remarques lorsque tu vas aux Urgences, tu le remarque, tu tombes dans les pommes, tu fais quelque chose quoi ... c'est une ambulance qui vient le prendre elle va directement:: euh
- 839 Yves l'objectif principal: discerner les malades à haut risque des malades à bas risque de MTE [dicte à Bruno qui tape sur le clavier]

- 840 Arnaud à fin de:: à fin de:: ...
- 841 Bruno non "à fin" on fait ça euh::: ... allez objectif secondaire, on a un objectif secondaire
- 842 Yves attends après il faut dire "chez les patients" ...
- 843 Arnaud non non non, attends, attends, mais il faut dire, mais, pourquoi on fait ça ... 'fin ... non! il faut dire pourquoi on fait ça ... tu dis pour une prise en charge précoce
- 844 Bruno quoi!?
- 845 Arnaud parce que le but c'est que ... attends, mais le but c'est que les patients ils crèvent il y a 30% de mort!
- 846 Yves non mais attends mon pote il faut être claire!
- 847 Arnaud non mais d'accord il faut être claire
- 849 Yves déjà si tu mets pour une prise en charge précoce
- 848 Bruno ça c'est l'objectif quoi ... oui ... voilà [dit à Yves] ... et en suite dans l'objectif secondaire si tu veux, c'était pour déterminer une prise en charge la mieux possible
- 850 Arnaud ah d'accord, ok
- 851 Bruno voilà, déterminer la prise en charge la plus::: euh ...
- 852 Yves non non mais c'est l'objectif c'est de ... il faut dire que ça ...
- 853 Bruno déterminer la prise en charge la plus approprié
- 854 Arnaud non ... tu mets carrément euh: à partir des facteurs de risque établir un score
- 855 Yves ah non! ça n'est pas un objectif secondaire, ça c'est un objectif principal
- 856 Arnaud eh bah oui! et pourquoi on n'est pas là alors!
- 857 Yves eh bah alors, tu peux mettre discerner les malades par la mise en place d'un score
- 858 Bruno oui voilà, ça, ça sera dans la méthodologie et le recueil ... le score ...
- 859 Arnaud non mais, ça c'est le but de l'étude hein ...

- 860 Bruno non, mais c'est général, il faut y aller en mot tu vois, tu ne vas pas commencer à parler de score ou un truc comme ça quoi
- 861 Yves ah bah, rajoute juste "par la mise en place d'un score" quoi ...
- 862 Bruno si vous voulez je peux le mettre en parenthèse quoi mais:: ... ça ne me semble pas très utile à dire ... et là on peut mettre euh: le but est de: ... 'fin, de l'objectif secondaire, déterminer une prise en charge ...
- 863 Arnaud ouais mais...
- 864 Gaspard on n'a pas d'objectif secondaire
- 865 Arnaud bah en fait euh, il n'y a pas en fait, parce que le score on le met là ...
- 866 Yves non mais, déterminer une prise en charge ce sera seulement le score
- 867 Gaspard non l'objectif secondaire c'est en différents facteurs, suivant l'âge, suivant le ...
- 868 Yves ouais, peut-être ouais ...
- 869 Arnaud ouais, objectif secondaire tu mets étude des facteurs de risque
- 870 Gaspard c'est l'âge, c'est la chirurgie, c'est ...
- 871 Arnaud non mais du coup c'est aussi un peu aussi le facteur princip ...
- 872 Yves ouais, c'est ça ouais, c'est l'étude de facteurs de risque, tu as raison
- 873 Gaspard c'est ça? c'est ce qu'ils faisaient pour: tu sais, les trucs pour cardiaque là, (inaudible) après suivant quoi ...
- 874 Arnaud ouais
- 875 Yves voilà, donc la population c'est donc patients hospitalisés ... 'fin si on fait ... c'est pas sûr ... moi j'ai mis [dans ces notes personnelles] patients hospitalisés chez lesquels on suspecte une MTE
- 876 Arnaud non non, pas chez qui on suspecte ! ... qui "ont" [une MTE] !
- 878 Yves non non non, chez lesquels on suspecte une MTE
- 879 Bruno mais non, mais non, mais non, tu dis la même chose que Gaspard tout à l'heure ouais
- 880 Arnaud non!!!
- 881 Gaspard si si si si

- 882 Yves non mais attends! là ce qu'on veut voir c'est s'ils sont à haut risque ou pas de MTE, donc ils l'ont pas encore, s'ils l'ont
- 883 Bruno je suis d'accord avec toi Yves
- 884 Yves donc c'est « chez lesquelles on suspecte une MTE » [dicte à Ben qui tape sur le clavier]
- 885 Bruno [tape sur le clavier]
- 886 Arnaud non mais attends attends attends!!! deux secondes, à ce moment-là il y a plus d'étude de cas-témoins
- 887 Yves non non non, mais si!
- 888 Gaspard la population c'est les Urgences
- 889 Bruno ça c'est ce qu'on lui a posé la question tout à l'heure [tuteur], il a dit "non, ça vous allez chercher dans les données et vous, vous faites une étude prospective, on ne fait pas une étude rétrospective
- 890 Yves attends mon pote! parce que là depuis le début là, tout ce qu'on a monté c'était une étude cas-témoins quoi
- 891 Bruno non, mais on lui a posé la question tout à l'heure, il a dit non, vous faites pas ça ... il a dit "vous faites une étude prospective ... euh en en étudiant par rapport au facteur de risque et la probabilité de l'apparition d'une MTE", c'est ce qu'il a dit tout à l'heure quand on lui a posé la question
- 892 Yves en tout cas tu fais une étude ... une étude ... comme elle s'appelle encore:: ...
- 893 Arnaud bah et pourtant
- 894 Gaspard bah tiens la population c'est la population qui ont déjà des::... des MTE avec facteurs de risque
- 895 Arnaud mais je veux dire, ... regardes ... la population des patients chez qui on suspecte la MTE et les mecs on n'est même pas sûr qu'ils ont une MTE et on va étudier un facteur de risque alors qu'on n'est même pas sûr qu'ils en ont une?
- 896 Yves Oui, justement, comment on est même pas sûr qu'ils en ont une ?
- 897 Gaspard non ! ... c'est la population ... la population ... non! la population c'est les gens qui ont la MTE
- 898 Bruno mais, comme c'est prospectif on va avoir l'apparition de MTE

- 899 Gaspard non mais justement ... non la population c'est des gens qui ont des MTE
- 900 Yves mais non !!!
- 901 Bruno moi je suis d'accord avec Yves
- 902 Gaspard mais si! non parce que ... regardes ... regardes ... si tu mets des patients qui non pas de MTE et des gens qui on suspecte d'avoir de MTE, si tu cherches (inaudible) nous on a déjà les facteurs de risque
- 903 Arnaud voilà, là tu vas tout ruiner quoi
- 904 Yves attendez les mecs! si c'est une étude prospective tu peux pas avoir de patients qui ont déjà un MTE
- 905 Bruno justement oui mecs! on cherche les facteurs de risque les plus significatif
- 906 Gaspard justement, tu les trouves chez les gens
- 907 Bruno et on connaît les facteurs de risque, on en prend trois et on détermine ceux qui sont les plus significatif et dont ...
- 908 Gaspard oui! chez les gens qui ont une MTE
- 909 Yves mais non! dans ce cas-là c'est une rétrospective, c'est une étude rétrospective, tu vas demander est-ce que vous avez eu ça, ça, ça et mâchant, alors que justement il a dit qu'il fallait pas faire ça [tuteur]
- 910 Arnaud eh bah on fait comment pour déterminer les ...
- 911 Bruno bah on retenant la particularité par rapport au factor de risque. On choisit une cohorte de patients avec les facteurs de risque qu'on a déterminé et on regarde l'apparition et la probabilité qui est qu'il appelle ... tu comprends là ?
- 912 Arnaud d'accord, ok. ouais, ouais
- 913 Yves voilà, dans ce cas-là on fait une étude prospective ... attendez je vais chercher le mot dans mon truc::
- 914 Bruno (inaudible) on étudie une cohorte de patients avec les facteurs de risque qu'on a déterminé et on étudie le facteur de risque qui sera le plus susceptible de donner un MTE et donc les euh: examens complémentaire qu'on pourrait faire par rapport à ce facteur de risque pour déterminer la probabilité d'apparition
- 915 Yves attendez les gars cet étude elle a un nom. ***** [injure] ! [Yves cherche dans ses affaires et n'arrive pas à trouver le mot dans ses

- notes].
- 916 Gaspard C'est pas [ceci ne serait pas] ce que tu fais normalement pour voir un facteur de risque ? pour identifier un facteur de risque ?
- 917 Bruno ah bah non ! si tu fais une prospective tu connais les facteurs de risque et tu étudies leur influence sur l'apparition de la maladie ... et par contre si tu fais une rétrospective tu étudies la maladie et la proba ... et euh: ... et les facteurs de risque qui correspondent, mais nous on connaît les facteurs de risque, donc on fait du prospectif ... on choisit la cohorte avec les facteurs de risque (inaudible) [en utilisant de la gestuelle pour expliquer les différences entre les types d'étude]
- 918 Gaspard tu m'as convaincu avec tes petits mouvements là [rires] hum...
- 919 Bruno alors, ... là je ne vous sens pas trop chaud ... pas très ... alors allez-y dites-moi tout ce que::: ... tout ce dont vous êtes (inaudible) et on va essayer de se mettre d'accord parce que ça sert à rien
- 920 Yves attends attends attends mon pote, d'abord attends, je regarde mon cours là
- 921 Arnaud ouais ouais ouais t'a raison
- 922 Gaspard bah c'est une étude ... c'est une étude dans les Urgences
- 923 Arnaud attends parce que
- 924 Yves bon attends mon pote je cherche
- 925 Arnaud non non mais attends attends ... parce que là ... là ouais
- 926 Bruno non non mais là on essaye de tous se mettre d'accord, si tu veux dans la même longueur d'onde
- 927 Gaspard mais justement, on prendrait les Urgences
- 928 Arnaud parce que là on s'en fout
- 929 Bruno non mais là on ne cherche pas la méthodologie pour l'instant
- 930 Gaspard non mais c'est pas méthodologie on essaye de::
- 931 Bruno non parce que là ... vous, vous étiez pas d'accord, vous voudriez plutôt une étude rétrospective, étude des gens qui ont déjà une MTE et je veux comprendre pourquoi vous voudriez ça et essayer qu'on tombe d'accord tu vois

- 932 Arnaud ouais ouais en fait ... en fait ... il y a un truc qui n'est pas claire, c'est que ouais ouais bah ... merci Bruno. en fait ... 'fin ... je vais la reprendre.
- 933 Bruno vas-y
- 934 Arnaud en fait, nous on a les facteurs de risque
- 935 Bruno ouais
- 936 Arnaud on les connaît
- 937 Bruno ouais
- 938 Arnaud ce qu'on veut c'est ... non parce là, après, si on fait comme tu dis [frappe stylo sur l'écran]
- 939 Bruno hum
- 940 Arnaud on pourra pas les coter les facteurs de risque, on pourra pas établir un score, on pourra pas les hiérarchiser
- 941 Gaspard non mais en fait si si si ... si si regardes
- 942 Yves les mecs ... si ! ce qu'il faut qu'on fasse c'est une étude exposé non-exposé, il faut qu'on fasse une étude exposé non-exposé
- 943 Arnaud ah mais c'est d'accord, ok, ok [dans son raisonnement, ne fait pas encore attention à ce que dit Yves]
- 944 Gaspard regardes, je te montre ... tant de patients ... comptez l'âge ... il y en a tant qui ont la maladie ... du coup tu peux voir là ... les facteurs de risque combien ...
- 945 Bruno oui les cohortes ... combien ont les facteurs de risque et voilà
- 946 Arnaud genre tes patients, ils arrivent et ils sont là [dessine sur le papier] suspicion de MTE, tu regardes leurs âges, leurs truc, leurs trucs et est-ce qu'ils en ont une ou pas
- 947 Yves voilà ... et ça, ça s'appelle une étude exposé non-exposé
- 948 Arnaud mais non ! ça s'appelle pas un exposé non-exposé ça !
- 949 Yves si !
- 950 Bruno ah si ! une cohorte exposée à un facteur de risque et une cohorte non-exposée
- 951 Yves Une cohorte avec ceux qui sont exposé à un facteur de risque chacun

- et après euh:: [simultanément avec Bruno]
- 952 Arnaud ah ouais ouais
- 953 Gaspard après ça fait beaucoup de facteur de risque pour une étude
- 954 Bruno bah elle a dit [en faisant référence à Patricia- tuteur 1]
- 955 Patricia-
tuteur 1 pour vous ... pour votre question sur les [étude] multicentrique ... vos histoire de "est-ce que certain" ... alors il y a deux éléments de réponse, c'est que plus vous allez avoir de centre mieux c'est, parce que vous allez avoir, puisque vous allez avoir ... et par contre il y a des biais ou des confusion qui vont être lever qui vont être lever, par exemple l'alitement et la Chirurgie entre autre vous pourrez faire des tests pour voir si ça a une influence ou pas ... ça c'est des choses que vous pouvez après(?) (inaudible) comment vous allez amener les idée(?) les lever quoi ou les mettre en exergue quoi
- 956 Bruno hum hum, tout au long(?) de l'étude essayer de minimiser
- 957 Patricia-
tuteur 1 voilà
- 958 Yves juste, c'est donc là nous on est ... maintenant on est parti sur une étude
- 959 Patricia-
tuteur 1 ça y est vous êtes partie ... bon c'est bon [rires]
- 960 Yves non non ... on est parti sur une étude prospective ... voilà, donc on part ... on réduit ... on prend en différent groupes donc qui ont chacun un facteur de risque, par exemple ... euh
- 961 Arnaud l'âge
- 962 Yves je sais pas moi ... l'âge etc. et on va regarder euh ... donc dans l'hôpital ... donc on a centré sur des patients hospitalisé etc. et donc on voudrait regarder ... mais vu que ça s'appelle ... ça c'est une étude exposé non-exposé ... même si il y a plusieurs facteurs de risque ou alors c'est une étude de cohorte ?
- 963 Patricia-
tuteur 1 [rire]
- 964 Arnaud [rire] mais tu étudies une cohorte tout le temps Yves
- 965 Yves non non ça peut être ou cohorte ou exposé non-exposé
- 966 Arnaud non!

- 967 Bruno non ça peut être une étude de cohorte exposé et::: ...
- 968 Arnaud mais une cohorte c'est un groupe de personnes
- 969 Yves non une étude de cohorte ... une étude de cohorte c'est un ensemble global ... 'fin je veux dire ... qui ont tous le même truc
- 970 Arnaud une cohorte c'est ... Non mais une cohorte
- 971 Bruno qui ont tous le même facteur de risque ... bah oui, une cohorte c'est des gens qui ont tous le même facteur de risque, c'est ça une cohorte
- 972 Yves non! non non ... c'est une espèce de truc qui mesure une population, oui c'est toute une ligne
- 973 Arnaud mais une cohorte c'est les deux, ça peut être n'importe quoi
- 974 Patricia-tuteur 1 ça peut être
- 975 Arnaud là je veux dire [on pointant la salle derrière lui] tu as une cohorte de P2 quoi
- 976 Bruno et le facteur de risque serait d'être des P2
- 978 Arnaud bah voilà
- 977 Yves bah voilà mais attend et il y a des P2 qui fume et des P2 qui fume pas
- 979 Arnaud eh bah oui ! tu as une cohorte de P2 qui fume et une cohorte de P2 qui fume pas
- 980 Etudiante d'autre groupe [une étudiante dans un groupe derrière dit: "mais ça, ça serait une étude exposé non-exposé"]
- 981 Yves non !
- 982 Arnaud et tu as une grosse cohorte de ... et tu as grosse ...
- 983 Yves non tu as un sous-groupe dans la cohorte
- 984 Arnaud mais non la cohorte c'est ... c'est ... n'importe ... tu dis ... on ... mais c'est ... mais ça veux ... c'est pas précis comme terme "cohorte"
- 985 Yves moi je pense pas hein
- 986 Arnaud non mais [se tourne vers le groupe d'étudiant derrière] aidez-nous ! Qui est-ce qui a raison ?

- 987 Etudiants et tuteur [rire du tuteur et d'autres étudiants]
- 988 Bruno ouais, il fallait pas prendre partie
- 989 Etudiante d'autre groupe moi je pense que c'est vous que [point un des étudiant]
- 990 Yves c'est exposé non-exposé ou cohorte ?
- 991 Etudiante d'autre groupe [l'étudiante du groupe derrière reprend] quand il prend des P2 fumeur ou non-fumeur c'est exposé non-exposé ... avec les exposé c'est les fumeurs et les non-exposé c'est les non-fumeurs [une autre étudiante rajoute "c'est le facteur de risque"]
- 992 Yves c'est ce que je disais
- 993 Etudiante d'autre groupe [elle reprend] et la cohorte tous les P2 qui auront
- 994 Yves bah voilà, c'est ce que j'ai dis
- 995 Etudiante d'autre groupe bah, c'est ce qu'il a dit aussi hein
- Patricia-tuteur 1 Uh!
- Yves non mais!
- Arnaud mais c'est ce que je viens de dire putain !
- 996 Arnaud au final ça peut tous être une cohorte une cohorte c'est un gros groupe de personnes tu veux aller sur Wikipédia !
- Yves une cohorte c'est (inaudible) une cohorte c'est un gros groupe de personnes !
- Arnaud bah c'est un gros groupe de personnes
- Yves genre là il y a peut-être 50 P2 qui fument bon c'est pas beaucoup

- 1010 Arnaud Eh bah ! Cohorte c'est pas pareil qu'exposé non-exposé !!!
- 1011 Yves Bah oui !!! et c'est exactement ce que j'ai dit. Donc c'est ou cohorte ou cas-témoins.
- 1012 Gaspard [rires]
- 1013 Bruno [rires]
- 1014 Arnaud ouais, c'est pas pareil quoi... (rires)
- 1015 Bruno [rires]
- 1016 Yves Mais c'est pas pareil... Donc, il faut qu'on choisisse laquelle des deux on fait, et justement j'essaie de voir si cas-témoins ... (inaudible)
- 1017 Gaspard [rires]
- 1018 Bruno alors essaie de me définir ce que c'est une enquête de cohorte par rapport à une exposé non-exposé. Je voudrais comprendre...
- 1019 Yves une exposé c'est rétrospectif déjà c'est pas (inaudible), une exposé-non-exposé c'est rétrospectif. Alors, (inaudible)...
- 1020 Arnaud ouais
- 1021 Bruno non
- 1022 Gaspard non non mais
- 1023 Arnaud eh non non parce que dans le cours de cohorte tu parles aussi de... par exemple, la cohorte des gens exposé à Hiroshima, tout ça. Non, moi je suis sûr que
- 1024 Yves Une cohorte ?
- 1025 Bruno Découvrez-le, personne n'a su ...
- 1026 Yves Ouais il faudrait qu'on (inaudible). Attends! Je vais chercher le mec [probablement Laurent- tuteur 2]
- 1027 Arnaud Bon, c'est quoi ce qu'on fait en attendant?
- 1028 Bruno (inaudible) ... (inaudible)
- 1029 Arnaud Les mecs ! On commence à faire notre planning.
- 1030 Bruno Et qu'est-ce que tu vas mettre ? Tu as une idée de ce qu'on va faire la semaine prochaine ?

- 1031 Arnaud Ouais, la semaine prochaine ouais, on va finir [il tape sur le clavier] ... finir le protocole [il tape sur le clavier] ... et le soumettre
- 1032 Gaspard (inaudible) ... qui est en voie de:: rétablissement (rire) ... déjà il était partie tu vois c'est ... (rire)
- 1033 Arnaud ... autorisations et ... [tape sur le clavier, probablement l'item du planning correspondant à TP 3, ce que veut dire qu'entretemps, Arnaud à remplis les cases TP1, TP2, Entre 2 et 3 et maintenant TP3]
- 1034 Gaspard Le truc c'est qu'on va prendre des populations qui ont la maladie et autres qui ne l'ont pas
- 1035 Arnaud [tape sur le clavier]
- 1036 Bruno Non, on va prendre les populations qui font les facteurs de risque et l'autre qui l'ont pas. ... Parce que là tu reviens sur ce que tu disais tout à l'heure
- 1037 Gaspard Il y a forcément des gens qui vont l'avoir la maladie
- 1038 Bruno Qui vont l'avoir ! Mais on ne va pas prendre la population en fonction du fait qu'ils l'ont pas
- 1039 Gaspard Mais, ah::, mais dans ce cas-là on ne peut pas savoir, étant donné que les personnes que les personnes n'ont pas eu, du coup tu ne peux pas savoir
- 1040 Bruno Mais c'est prospectif! On attend l'apparition et on regarde si un certain facteur de risque
- 1041 Gaspard Mais, on n'aura jamais des résultats
- 1042 Bruno Dans vos cohortes ça peut prendre des années, mais (inaudible) ...
- 1043 Gaspard Mais je ... ouais, mais juste ... Non! Parce que les patients, on pourrait dire mais "bah, lui, il y a possibilité qu'il en ait une, mais tu auras jamais les résultats en sachant s'il a eu ou pas
- 1044 Arnaud A ce moment-là, ça pourrait être une étude ...
- 1045 Yves [Yves qui était parti voir Laurent- tuteur 2, revient et interrompe la conversation] Vous aviez raison, en fait c'est une étude de cohorte, et dans l'étude de cohorte, on fait une étude exposé-non-exposé
- 1046 Arnaud [émet des sons représentant des coups d'épée ou des claques pour commémorer le fait qu'il avait raison]
- 1047 Yves [rires]

- 1048 Gaspard [rires]
- 1049 Bruno [rires]
- 1050 Arnaud et à ce moment-là on peut aussi faire une étude épidémiologique prospective
- 1051 Bruno Non, Gaspard n'est pas d'accord avec nous.
- 1052 Yves (inaudible)
- 1053 Bruno euh: sur le fait que rétrospectif/prospectif prend des gens malades au départ de l'étude
- 1054 Yves tu veux qu'on te balance par la fenêtre ? [rire] tu cherches la ***** [injure exprimant "tu cherches des problèmes"] là !
- 1055 Arnaud [rire]
- 1056 Bruno [rire]
- 1057 Gaspard Non, non, mais non, parce que ... parce que le problème c'est que tu veux dire "bah, lui il a les facteurs de risque ... c'est bien
- 1058 Yves bah! et comment ...
- 1059 Gaspard et tu c'est pas s'il aura la maladie ou pas.
- 1060 Yves eh bah! tu sais pas! Justement, et tu regardes combien il y en a qui vont l'avoir
- 1061 Gaspard Justement, comment tu vas avoir les résultats ! ? Si les gens tu ne peux pas savoir s'ils vont l'avoir ou pas
- 1062 Yves [rires] ***** [injure]! Mais c'est une étude à long terme, une étude épidémiologique
- 1063 Gaspard Mais ... et l'étude à long terme sur 4 mois ! ?
- 1064 Bruno Mais non! Pas sur 4 mois, tu peux la faire sur 25 ans si tu veux.
- 1065 Yves Non, non, non, mais ...
- 1066 Gaspard Nous, on ne va pas la faire pendant 25 ans surement.
- 1067 Bruno Et on ne va pas la faire de tout !
- 1068 Arnaud Bah, pourquoi pas: ?

- 1069 Gaspard Mais si!
- 1070 Yves C'est une fausse étude !
- 1071 Bruno Mais oui, on va la présenter et on va la proposer, mais c'est pas une vrai étude [rire] dans 25 ans on ne sera pas toujours dessus einh!
- 1072 Gaspard ça sert à rien
- 1073 Yves on va prendre les résultats
- 1074 Gaspard ça sert à rien
- 1075 Yves on va prendre les résultats, ou alors ... non mais, ce qu'on fait en vrai là, en vrai ...
- 1076 Bruno En tout cas à mon avis, ce qu'on fait ça a déjà été fait.
- 1077 Yves C'est une étude ...
- 1078 Gaspard C'est un truc de frustré
- 1079 Yves [rire]
- 1080 Gaspard [rire]
- 1081 Arnaud Bah, c'est vrai que là ::
- 1082 Bruno Oui! Le but c'est la recherche, c'est pas la réalité, c'est ça qu'il a dit [Laurent- tuteur 2] ! Tu ne seras pas noté par rapport à la réalité, il n'y aura pas.
- 1083 Arnaud Là ça peut, là c'est frustré, c'est que là là :
- 1084 Gaspard on va être frustré!
- 1085 Arnaud C'est vrai que là , ça peut être désagréable parce qu'on attend que le truc... mais ... arrive ... mais euh ... c'est **** [expression vulgaire exprimant "ce qui révèle un manque d'intelligence"] !
- 1086 Gaspard Le truc c'est qu'on aura jamais la réponse
- 1087 Yves Donc voilà, donc on gros ...
- 1088 Bruno On propose le protocole, le but c'est de proposer un protocole là ! [frappe le stylo sur l'écran] ... c'est pas d'avoir des résultats et une conclusion et d'écrire un article einh! On ne va pas être publié mecs einh!

- 1089 Yves ça c'est dommage que (inaudible)
- 1090 Gaspard mais ... dans c...
- 1091 Yves Bon, allez, vas-y, méthodologie du truc là, mais ... étude de cohorte, exposé non-exposé, mâchant ...
- 1092 Gaspard ça sert à rien
- 1093 Arnaud [tape sur l'ordinateur, probablement sur la première version du protocole]
- 1094 Bruno c'est un cours de biostat !
- 1095 Bruno c'est ... si, ça sert:: regardes, c'est sympa là ! on réfléchit, on utilise(?)
- 1096 Yves et tu dis, là tu dis les différents facteurs qu'on prend en compte einh!
... Avec prise en compte, avec prise en compte de
- 1097 Gaspard Ah non, mais c'est là qu'il fallait les mettre les facteurs de risque einh! [probablement pointant sur l'écran] ... c'est comme un objectif secondaire
- 1098 Yves Ah non, non! Moi je pense pas, "avec prise en compte des différents facteurs
- 1099 Gaspard non, non ... ouais, mais les facteurs de risque tu les mets en objectif secondaire
- 1100 Yves avec les différents ... oui, mais on n'est pas ... non, mais ce qu'on veut savoir, c'est les plus important
- 1101 Gaspard (inaudible)
- 1102 Arnaud Chut! Attend! ... Attends! Chut!
- 1103 Arnaud étude de cohorte, exposé non-exposé avec des différents facteurs de risque ... Il faut, là on peut être (inaudible) pour dire qu'on va ... voir chez qui préférentiellement ... quel facteurs de risque ... quand ça va pas (inaudible) 'fin, tu vois ce que je veux dire.
- 1104 Gaspard C'est facteurs de risque, les facteurs de risque, il faut mettre ça einh!
Ceux qu'on a choisi [montre probablement une liste faite depuis le début de la séance] ... dans l'objectif secondaire
- 1105 Arnaud Ouais, là c'est un brouillons attend ... on fait un brouillon quoi!
- 1106 Gaspard Ouais mais:::
- 1107 Bruno Là mais:, on fait pas sérieusement, on essaye juste de se donner

- (inaudible)
- 1108 Gaspard ça se met ici einh! les objectifs, 'fin les facteurs de risque qu'on a choisi
- 1109 Arnaud Il est partie le mec einh [référence à Laurent- tuteur 2] ... facteurs de risque [tape sur le clavier, probablement en remplissant un brouillon de protocole]
- 1110 Arnaud ça va si on dit ... "on regarde ..." attends!
- 1111 Arnaud (inaudible)
- 1112 Arnaud qu'on ... que dans les différents groupes de facteurs de risque ... 'fin ... exposé à différents groupes de facteurs de risque, on va regarder l'appa ... 'fin ... l'apparition de la maladie ... 'fin ...
- 1113 Yves c'est ça qu'on fait
- 1114 Gaspard hum hum [manifeste qui est d'accord]
- 1115 Bruno Oui, mais ça c'est ...
- 1116 Bruno euh:: étude de cohorte exposé non-exposé c'est inclut dans ça einh!
- 1117 Bruno c'est à dire, par rapport à les facteurs de risque, en regarde l'apparition de la maladie
- 1118 Arnaud Et pourtant, exposé non-exposé c'est rétrospectif
- 1119 Yves Non, mais là ... par contre le pense que ... par contre ce que je te dis c'est que ...
- 1120 Arnaud Attends! Attends! Un truc exposé non-exposé c'est rétrospectif
- 1121 Yves Ah oui! (inaudible) exposé non-exposé c'est euh::
- 1122 Bruno de cohorte
- 1123 Yves c'est euh::
- 1124 Yves Ah si !! Non! Non, non! je me suis rappelé, exposé non-exposé c'est euh:: prospectif
- 1125 Yves C'est cas-témoins qui ...
- 1126 Arnaud MAIS NON !!!!!
- 1127 Yves Mais non ! cas-témoins ! Il y a eu des cas et il y a eu des témoins !

- 1128 Yves (inaudible) il y a des cas et il y a des cas (?????)
- 1129 Arnaud Mais exposé non-exposé c'est rétrospectif aussi einh !
- 1130 Bruno Non, c'est prospectif !
- 1131 Yves Exposé non-exposé c'est prospectif
- 1132 Bruno C'est prospectif, tu es exposé à un facteur de risque et tu regardes l'apparition de la maladie
- 1133 Yves Bah regardes sur internet là ...
- 1134 Arnaud Non, parce que par exemple, dans son cours il [Laurent- tuteur 2] disait euh: ... exposé non-exposé, en prend euh:, par exemple les gars d'Hiroshima
- 1135 Bruno Bah oui ! [j'estime qu'il est d'accord avec le rappel de l'exemple, mais pas dans pour la réponse de Arnaud]
- 1136 Yves Non, non, ça c'est le cours de cohorte
- 1137 Bruno Mais oui, tu prends les gars d'Hiroshima et tu regardes l'apparition des cancers
- 1138 Bruno Ils sont exposés aux facteurs de risque de la radiation et tu regardes l'apparition des cancers au sens du groupe.
- 1139 Yves Mais tu peux regarder plein de trucs, tu peux non seulement regarder les cancers, tu peux regarder les cancers, le nombre de Hyperthyroïdie aussi si cela t'intéresse (inaudible). Donc, voilà c'est ça, c'est à dire que c'est pas que le cancer (inaudible).
- 1140 Arnaud donc par exemple ...
- 1141 Gaspard ... prospectif ...
- 1142 Bruno Il me semble que c'est ça, je ne suis pas (inaudible)
- 1143 Yves l'important d'une cohorte c'est que ...
- 1144 Bruno Il me semble que c'est du prospectif
- 1145 Yves Ouais, mais là c'est en anglais mon pote! [probablement à propos d'une page d'internet sur les cohortes trouvé sur Google]
- 1146 Yves On a qu'à demander à mon pote Charlotte, elle si connaît super bien
- 1147 Arnaud P R O S P E C T I V E [en imitant un accent anglais]

- 1148 Gaspard mon pote Charlotte ? [rire]
- 1149 Arnaud Exemple d'étude exposé non-exposé [probablement en lisant un site d'internet]
- 1150 Arnaud Regarde! [probablement en montrant un site d'internet] Ils te disent "entre 80 et 94, 1. survenu périodique de taux élevé d'admission pour crise d'asthme. Hypothèse (inaudible) à une étude ...
- 1151 Arnaud donc en fait... (3s) là dans ce cas-là, c'est prospectif, t'es d'accord?
- 1152 Gaspard bah c'est exactement ce à quoi t'étais pas d'accord tout à l'heure hein
- 1153 Arnaud non là c'est rétrospectif! Bah, ils te disent [les enquêteurs] qu'ils regardent les admissions, et ils regardent la météo le jour quand ils arrivent [les patients].
- 1154 Bruno non::: mec!
- 1155 Bruno Tu vas demander là ? [s'adresse à Yves qui appelle autre étudiant (pot Charlotte) pour leur venir en secours]
- 1156 Yves Charlotte, Exposé non-Exposé c'est prospectif ?
- 1157 Gaspard Je crois bien que exposé non-exposé c'est prospectif hein!
- 1158 Gaspard Arnaud [appelle par son prénom] !
- 1159 Arnaud Quoi?
- 1160 Gaspard Je crois bien que c'est prospectif.
- 1161 Bruno Exposé non-exposé c'est prospectif non? [Charlotte répond "est cas-témoins c'est rétrospectif!"]
- 1162 Bruno Voilà, là tu peux pas dire (inaudible)
- 1163 Arnaud Mais moi je suis sûr que c'est ... que ... non ... mais tu vois il te dit ... regardes ... attends mais regarde, attends... [Arnaud lit sur l'écran la définition]
- 1164 Bruno (inaudible) ... vérité absolument (inaudible)
- 1165 Arnaud "les études exposé non-exposé fournissent une situation jag(?) du risque de relatif de présenter les symptômes d'une maladie chez les sujets qui ont été exposé à la pollution par rapport à ceux qui non pas été" [lecture d'un document]. [Charlotte à extérieur de cet équipe dit "non, ça serait été témoins, je pense".]
- 1166 Arnaud Gaspard !!! Pourtant, ils disent exposé non-exposé [montre sur

- l'écran]. [Charlotte répond: "mais c'est dans le cours"]
- 1167 Arnaud [Arnaud lit probablement cette fois-ci dans le cours] "Le principe d'une étude exposé non-exposé à suivre dans une période habituellement longue le sujet sélectionné selon un ordre ..."
- 1168 Bruno donc c'est prospectif!
- 1169 Arnaud [continue sans s'interrompre] "pas avant à l'exposition du ... [hésite] à l'exposition donnée !"
- 1170 Bruno bah oui ! [rires]
- 1171 Arnaud Il y a compa... NON !!!
- 1172 Bruno tu les étudies sur un long terme, c'est prospectif. C'est pas rétrospectif, tu les étudies pas par rapport à leurs antécédents, tu étudies leur évolution.
- 1173 Bruno c'est prospectif, vers l'avant
- 1174 Arnaud ouais... ok ok
- 1175 Yves on est d'accord?
- 1176 Arnaud ok d'accord ok
- 1177 Bruno alors, comment on va recueillir l'information?
- 1178 Gaspard on prend les Urgences ou pas? moi je suis pour prendre les Urgences
- 1179 Bruno les Urgences... pourquoi?
- 1180 Gaspard parce que tu vas avoir... t'auras plein de gens, du coup tu auras plein de facteurs de risque différents, et ça va être plus représentatif des facteurs de risque qu'on prend parce que si tu prends la Chirurgie, le facteur principal sera la Chirurgie
- 1181 Bruno mais regarde, on peut prendre Chirurgie. Alors, dans la Chirurgie, âge, et y aurait quoi comme facteurs de risque?
- 1182 Bruno les maladies cardio-vasculaires
- 1183 Gaspard eh bah on met tout en Chirurgie
- 1184 Bruno bah y a des vieux... y a des mecs avec des pathologies cardio-vasculaire et y a des mecs qui sont en Chirurgie
- 1185 Gaspard sauf que si on prend les Urgences...

- 1186 Bruno et mais là y aura plein plein de facteurs de risque
- 1187 Gaspard oui mais tu prends que ceux que t'as choisi justement
- 1188 Bruno oui mais justement le problème c'est qu'il y aura des biais puisque y aurait d'autres facteurs de risque que t'aurais pas pris en compte et qui pourraient venir fausser le résultat alors qu'en Chirurgie y a moins de facteurs. Comme toi tu disais "Il y a moins de facteurs de risque à prendre en compte et donc il pourrait fausser la (inaudible)
- 1189 Arnaud (inaudible)
- 1190 Gaspard euh::, dans ce cas-là tu prends::
- 1191 Gaspard c'est des trucs que vont servir qu'à la Chirurgie
- 1192 Bruno ah GASPARD, c'est ce qu'elle a dit, donc on va se concentrer concentrer sur un service, on ne peut pas [être] trop généraliser
- 1193 Bruno Et moi je ne suis pas forcément pour la Chirurgie, moi je veux bien qu'on:: ... je suis pour rien de tout pour l'instant, mais c'est vrai que ... la Chirurgie ça pourrait être pas mal
- 1194 Bruno Il y a le plus de cas, donc la puissance de l'étude est la meilleure.

Appendix VI

On the race to 20

The race to 20 is a game Guy Brousseau (1997) applied to illustrate the Theory of Didactical Situations. The game intended to introduce to pupils in a mathematics class, a revision of the operation of division (under circumstances in which the meaning of these operations were not adapted to the previous learning) and favour the discovery and the demonstration, by other pupils, of a set of theorems.

The game itself is very simple, playing initially in groups of two students; the players have to succeed in saying '20' by adding 1 or 2 to the number given by the other.

- One of the pair starts by saying '1' or '2' (for example, '1');
- The other continues by adding 1 or 2 to this number ('2' for example) and saying the result (which would be '3' in this example);
- The first person then continues by adding 1 or 2 to this number ('1' for example) and saying the result (which would be '4' in this example); and so on".
- The winner is the first one who says "20".