

Emotions Awareness on virtual learning students



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Abstract

In Computer Supported Collaborative Learning (CSCL) contexts it is necessary to study new forms of interaction that stimulate and promote the necessary skills for human communication and critical thinking in order to improve learning experience. Consequently, we have to take advantage of the interaction data generated in CSCL activities to extract important information related to the emotions manifested by group members and build emotional intelligence that supports awareness and regulation of emotions at both individual and group level. This raises important issues that concern, on the one hand, the ways to label affective behavior in educational discourse and, on the other hand, the ways to present emotional information to group participants.

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Introduction

People often separate emotions and reason, believing that emotions are an obstacle in rational decision making or reasoning but recent work have shown that in every case, the cognitive process of an individual is strongly dependent on his emotions which can drastically influence performance [10,47]. Emotions arise to an internal or external event, producing a neurophysiologic response of the body and building momentum. The collaboration between rational and emotional mind helps that our behaviour is the result of a process that has involved a reflection about the situation that arises.

Students have to understand the influence of emotions on their behaviour, by developing a range of skills related to understanding their own affective states, responding appropriately to the moods of others, and identifying that each emotional behaviour has a purpose. This is the definition of emotional intelligence [44, 23]. In this sense, we can say that emotions are responses to significant stimuli that occur in three systems or components: a) the neurophysiological or biochemical, b) motor or behavioral (expressive) and c) cognitive or experiential (subjective).

From the neurophysiological point of view, emotions are located in the limbic system that links different parts of the brain system (amygdala, hypothalamus, hippocampus and thalamus) with the emotions [31]. According to [31] there are certain memories and emotional reactions that take place without any conscious cognitive engagement. He suggests that the hippocampus has less to do with the issue of emotional responses than with the fact to record and make sense of perceptions, i.e. with emotional memory. The main activity of the hippocampus is to provide a sharp memory of the context, which is vital to the emotional significance of events. In addition, the amygdala which

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specializes in emotional issues, it is directly related to the processes of learning and memory.

Regarding the behavioral component, emotions refer to the individual's adaptation to his social environment, being facial, body and verbal expression, the main means of communication of emotional state to others. Finally, the emotional experiences facilitate or impede social interaction.

1.1 Teaching-Learning Process

In a recent analysis of the state of educational research on emotions, [38] notes the limited attention paid in emotions at education during the twentieth century with two notable exceptions. The study of anxiety related to the assessment and performance (examinations, tests, etc.) and the study of the relationship between emotion and motivation related to academic success and failure (fault, pride, etc.). Pekrun, in an analysis of the state of educational research about emotions recognizes the limited knowledge still available in the occurrence, frequency and phenomenology of emotions in different learning environments and especially in online learning.

Users emotions and relationships are constantly present in e-learning environments, which are supported by new tools, and learning content; as such, they represent a new interesting research area [1, 12, 15, and 42]. Educational experiences carried out in virtual learning environments require a redefinition of the organizational elements of learning in relation to the agents involved (teachers and students), the spaces where they conduct training activities, time factor and learning sequences [40]. Table 1.1 shows the relationship between emotions and the processes of learning and teaching, respectively, and the relationship with students.

To sum up, in that respect, it comes to know the emotional states that are at stake in the online learning and behaviors that these processes generate. So that allows us to explore and deepen relations between emotion and virtual environment, being especially useful to describe how they happen and how emotions are addressed in virtual environments in reference to the different elements that compose them: tools, teachers and peers present in the learning process of this kind. This perspective allows us to understand the relationship between emotions, their management and the resulting learning in these learning environments.

Emotional relationship	
Learning Process	<p>In particular, it involves three cognitive processes: attention, memory and reasoning, with regard to each of which student's cognitive ability depends on their emotions [20]. According to them, emotions can be used in the learning content to increase students attention and improve their capability, memory and reasoning. In this way, relationships between objects or ideas are more easily performed and promote efficiency and rigor on decision making and problem solving [28].</p> <p>In general, these emotions lead to a more creative process of flexible and divergent thinking, while negative emotions cause a more linear thinking, convergent and sequential [38].</p>
Teaching Process	<p>Role of Tutor (new competencies and skills): should be prepared to generate an effective dialogue with the participants and between the participants. So it favors that active learning, building cooperative/collaborative knowledge, teacher know how to identify feelings and emotions, control and provide appropriate models of expression. Especially when it comes to negative emotions, which are often harder to communicate in a respectful way. Teachers emotional intelligence significantly influences the creation of a healthy emotional climate in the classroom, where they manage in the right way their emotions and where emotions can be expressed without fear of being judged or ridiculed [27].</p>
Students	<p>The study of resistance, attitudes and emotions regarding the use of technology as a learning resource is showed particularly necessary to reduce dropout rates and failure that present eLearning models show [4].</p>

Table 1.1: The relationship between emotions and the learning process, the teaching processes and students.

1. INTRODUCTION

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Proposal

2.1 Justification of topic interest

The research issue that we want to answer in this work is "the management of emotions during interaction of students in virtual collaborative learning environments." Our research, at theoretical-conceptual level, claims to build a solid theoretical base incorporating and expanding ideas and proposals for an innovative approach. Moreover, at technological level, it claims to translate this framework in the design and implementation of a robust computer system that captures and integrates all the theoretical ideas. It will also serve as an important media to test and evaluate the whole process in real situations of virtual learning environment. The management of emotions analyzes how knowledge and understanding of emotional states affects the processing of information, the quality of collaboration and the outcomes of a group. Following we delimit the objectives of this research for this approach, Table 2.1, as mentioned before as well as a proposed solution, Table 2.2, to design the conceptual model.

2.2 State of the art

According to [18], when it comes to the design of systems and learning environments with regard to the emotion there are two predominant approaches

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OUR GOALS	OUR SOLUTIONS
<p>(1) To show the emotions that students experience during their collaborative virtual learning processes and how these emotions influence the learning experience</p>	<p>With regard to (1) we need to</p> <ul style="list-style-type: none"> • Analyze educational discourse (text and conversation) through methods such as sentiment analysis or opinion mining. • Incorporate, through these methods, non-intrusive automatic detection and extraction of emotions from student-created discourse and then provide them with dynamic recommendations and affective feedback for the activities depending on those emotions at specific time intervals
<p>(2) To analyze what kind of approaches, tools or methods we can use to influence, model and manage these affective situations in the best possible way</p>	<p>With regard to (2) we need to</p> <ul style="list-style-type: none"> • Analyze and shape affective interaction, providing a graphical representation of the emotional structure of discourse in virtual and blended learning environments, in any spaces where emotions arise (debates, chat rooms, teamwork - e.g., a wiki creation, an evaluation task, etc.). • To this end, we apply an extension of the RST (Rhetorical Structure Theory), which was originally applied in Natural Language Processing area and was based on the use of coherent relations between two adjacent text units to analyze discourse (text and dialogue)

Table 2.1: To analyze how knowledge and understanding of emotional states affect the processing of information, the quality of collaboration and group results.

Our proposal pretends:
<ul style="list-style-type: none">• To add an important value to CSCL from the affective computing perspective, to try to offer solutions to the problem of students emotions management, which has an enormous influence in students' participation and performance.• To help teachers understand better the effect and the influence of the emotions in the learning processes and guide them to provide a better and more effective planning of such processes.
Focuses on issues such as:
<ul style="list-style-type: none">• To detect which emotions arise, when they occur.• To analyze the reasons that caused the emotions to arise and how we can transform them to achieve effective learning,• To consider that this transformation may depend on individual factors, such as a resistance to change, social and cultural factors, peer support to alter cognition, or the need to acquire new skills to overcome dissonance

Table 2.2: Conclusion.

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2.2.1 First approach

The first approach discusses not only how to educate by means of using emotion/affect, but also how to educate the emotions/affection. Substantial theories have recognized the existence of emotions in relation to learning and all of them have been collected under the term "Emotional Intelligence" (EI) [9, 22, 23, and 30].

EI is the basis of emotional competence, understood as an acquired capacity to identify, understand and manage emotions in one's self and others, which can be developed through education. In education, emotional intelligence reaches all stakeholders in the process of teaching and learning, teachers and students. In this regard, it is important to know what emotional skills the teacher must have regarding this new type of education, emotional education and which the emotional skills are that students should acquire during their learning processes. In regard of teachers, a requirement for teachers in order to develop the EI of their students is the compromise to develop their own emotional intelligence [23].

Regarding the use of the own emotional intelligence, educators must develop skills such as:

1. Expressing their feelings properly in the relationship with students.
2. Using the problem solving and goals oriented planning methodology.
3. Implementing motivational strategies.
4. Controlling their negative moods and properly manage their emotions.
5. Expressing their empathy and listening skills.
6. Developing assertive behaviors, besides of properly managing conflicts that occur in the classroom.

With regard to students, the skills that we should encourage may be divided according to [44] into two groups: interpersonal intelligence, skills related to effective social management, the ability to relate to those around us and creating a network of healthy interpersonal relationships, and intrapersonal intelligence, skills to determine how we relate to ourselves. In the first group, we can include empathy and social skills. And in the second would be consciousness in one's own strengths, weaknesses, moods, emotions and impulses, self-regulation and the same motivation.

2.2.2 Second approach

The second approach is based on recognizing, deciphering and exporting patterns of emotion/affect on the user-computer interaction. Thus, the study of the antecedents and consequences of emotions in a variety of situations and settings is essential for understanding how to create learning environments that can promote positive emotional experiences, which in turn enhance student learning and performance.

Emotion awareness and the ability to manage feelings appropriately is the basis for effective communication and can help to understand and empathize with what is troubling other people. As such, this research topic is gaining the interest and attention of more and more researchers in the field of affective learning. According to Feidakis et al. [19], emotion awareness entails the detection of emotion signals, recognition of emotion patterns and affective responses and plays an important role in both individual and collaborative learning. A change in the learners emotional state can reorient their attentional focus and can induce a change in the way they think, act and interact with others as well as regulate their behavior in a learning situation.

Since this research is based on managing emotions during interactions in virtual learning, his interest focuses on educational discourse, in which students are mostly involved in their learning tasks, may consist of text (e.g. a Wiki construction) and dialogue (e.g. debates and discussions in synchronous and asynchronous forums). The nature of emotional phenomena in both text and dialogue is very complex; it can be interpreted in different ways and be represented by different computational models.

2.2.2.1 Categorical and Dimensional Models

According to Feidakis et al. [19], labels (verbal or pictorial) can be used to classify emotions (into basic, secondary, tertiary, etc.) or to specify gradual emotion (i.e., arousal, valence, etc.) to show users state in an emotional space. Psychologists and affective computing researchers often use two distinct approaches in the modeling and classification of human emotions: A categorical model in which text data are associated with emotional labels (happy, sad, etc.) or a dimensional model where coordinates in a dimensional space represent data.

Research work on emotion awareness in eLearning, that deals with the issue of labeling affective behavior within a categorical model, has taken the next three models

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of emotions as a main reference: (1) Ekman Friesen [13] classified facial expressions that are linked to six basic emotions: (anger, disgust, fear, joy, sadness, and surprise). (2) Ortony et al. [34] in their OCC model have proposed 5 basic (anger, fear, happiness, joy, love) and 14 secondary emotions. (3) Pekrun [37] examined the impact of the so-called academic emotions (four positive: joy, hope, pride, relief and five negative: boredom, anger, anxiety, shame, hopelessness).

With regard to the dimensional models, research on learning theories revealed the following dimensions according to Hascher [53]: arousal, valence, control, intensity, duration, frequency of occurrence, time dimension, reference point and context.

Most research work in this category has taken as reference: (1) the model of Russell [43], where emotions are seen as combinations of arousal (high activation / low activation) and valence (positive/ negative). (2) the wheel of emotions of Plutchik [41] which consists of 8 basic emotions arranged as four pairs of opposites (joy-sadness, trust-distrust, fear-anger, surprise-anticipation), and 8 advanced emotions each composed of 2 basic ones. (3) Kort Reilly [30] suggested a model with 6x6 possible emotion axes (anxiety-confidence, ennui-fascination, frustration-euphoria, dispirited-enthusiasm, terror-excitement, humiliated-proud) that may arise in the course of learning ranging from negative (rank -1.0) to positive (rank +1.0) valence. And, (4) the Geneva Emotion Wheel (GEW) [54], where the emotion families are arranged in a wheel shape with the axis being defined by two major dimensions of emotional experience: Five degrees of intensity are being proposed, represented by circles of different sizes. In addition, "None" (no emotion felt) and "Other" (different emotion felt) options are provided.

The advantage of categorical representation is that it represents human emotions intuitively with easy to understand emotion labels. In contrast, a major benefit of dimensional models is that they are not correlated to a certain emotional state (e.g. angry or happy). Two or three dimensions of emotional meaning are commonly identified by means of rating. Due to their gradual nature, emotion dimensions are able to capture subtle emotion concepts that differ only slightly in comparison with broad emotion categories. Emotion dimensions can represent very specific identification and a large range of peoples emotion concepts. In particular, a dimensional description is well suited for the task of measuring the full-defined emotional states. Moreover, there are several shortcomings with the categorical model of emotions due to (1) the

limited number of labels. (2) Categories do not cover all emotions adequately because numerous emotions are grouped together under one category. And (3) the same affective states can be expressed by means of different emotional categories that are defined according to cultural, environmental, linguistic or personality differences, which leads to poor agreement among emotional categories.

Nevertheless, the categorical model has been dominant and there are many variations of the model due to its simplicity and familiarity. A categorical model is appropriate for capturing the affective states in the lower valence and higher arousal focus. In contrast, a dimensional model is better when emotions are high in valence focus and low in arousal focus.

2.2.2.2 Sentiment Analysis in text

Sentiment analysis and the recognition of the semantic orientation of texts is an active research area in the field of natural language processing [55]. The analysis of feelings and opinions towards an entity are classified on a scale that is similar to the valence scale used in emotion models, in order to determine for example whether it is a positive or negative critique. This new trend in emotion research consists in performing lexical analysis of texts with the aim of identifying the words that can predict the affective states of the authors [5].

The main problem of these systems is the lack of importance given to the semantic and linguistic aspect. On the one hand, most approaches do not take the emotional meaning of words into account, and they are simply based on the appearance and frequency of terms; however, the few approaches that use polar expressions usually work with terms instead of concepts, without taking into consideration, the multiple meanings a word can have. On the other hand, this type of systems do not usually take into account the linguistic constructions that can affect subjectivity detection, such as negation, quantifiers or modals; again, the few works that have addressed this issue usually identify only their presence, without studying or treating their effect [7].

2.2.2.3 Sentiment Analysis Tools

Several tools have been developed in the field of sentiment analysis and data mining. For instance, there are several dictionaries such as: (1) the WordNet Affect [56], an affective lexical resource that can be useful for affective computing, computational

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humor, text analysis, etc. It provides a lexical repository of direct affective words that has an emotional hierarchy of affective domain labels (A-Labels) and contains two types of tagging information as new extensions (stative/causative and valence tagging). (2) The Whissells Dictionary of Affect [57], an instrument designed to measure the emotional meaning of words and texts by comparing individual words to a word list for activation, evaluation and imagery.

Moreover, there are several tools such as: (1) Weka [58], a collection of machine learning algorithms for data mining tasks. The algorithms can either be applied directly to a dataset or called from ones own Java code. Weka contains tools for data pre-processing, classification, regression, clustering, association rules, and visualization. It is also well suited for developing new machine learning schemes. (2) TMG [59] is a Mat Lab toolbox for text mining, particularly appropriate for text mining applications where data is high dimensional but extremely sparse. The current version provides a wide range of tools such as Dimensionality Reduction, Clustering, and Classification. (3) FreeLing [60] is designed to be used as an external library from any application requiring this kind of service. Nevertheless, a simple main program is also provided as a basic interface to the library, which enables the user to analyze text files from the command line. Main services offered by this library are text tokenization, morphological analysis; WordNet based sense annotation and disambiguation, rule-based dependency parsing, etc. Currently supported languages are Spanish, Catalan, Galician, Italian, English, Russian, Portuguese, Welsh and Austrian.

Yet, in recent research work, [32] proposed a model that aims to describe subjectivity relations that exist between the different actors and are labeled with information concerning both the identity of the attitude holder and the orientation (positive vs. negative) of the attitude. The model includes a categorization into semantic categories relevant to opinion mining and sentiment analysis and provides means for the identification of the attitude holder and the polarity of the attitude as well as for the description of the emotions and sentiments of the different actors involved in the text. Furthermore, the study carried out by [3] for the development of EmotiNet represents an appropriate semantic resource to capture and store the structure and semantics of real facts and the prediction of emotional responses caused by chains of actions.

2.2.2.4 Discourse Analysis Methods

Another field of research in detecting emotions is through conversation analysis (CA) and discourse analysis (DA) methods, where text is an important modality for emotion detection [56]. Likewise, in order to achieve a precise evaluation of opinion in texts, Natural Languages Processing (NLP) systems must go beyond the expressions of positive and negative feelings and identify a wide range of expressions of opinion, including motivations, recommendations and speculations, as well as how they are discursively related in the text.

For instance, [16] created a useful framework that includes a catalog of codes and writing rules that serve to reinforce or "complement" virtual educational communication for the analysis of emotional speech in online communication, with the term "Complemented Language". These codes that users use include: emoticons, onomatopoeia (hahaha, lol, mhmm), acronyms, repetition of words (trolololololol), intensification and repetition of punctuation (thanks!!), use of capitalization (PLEASE), etc.

Finally, another theory widely used as a discourse analysis method is Rhetorical Structure Theory (RST). RST is a text organization theory, which has led to areas of application that are beyond its original objectives: discourse analysis and text generation. Some of these areas in which RST has been applied include the studies conducted in other media, such as dialogue and multimedia, [11, 61]. Although RST has never been applied to the study/analysis of emotions, we consider its inclusion in a comprehensive model and face it as an important challenge in our research.

2.2.3 Conclusion

In sum, the relationship between cognition and emotion allows to determine ones behavior as the result of a process that involves reflection about the situation that arises. Given that emotion and cognition are closely linked [20], there are also several mind states that we have to bear in mind in addition to affective states.

Therefore, we need tools, such as the ones presented before, that will enable us to label not only academic emotions as positive and negative (such as joy, pride, anxiety, shame) but also behaviors that arise during learners interaction, such as solidarity (shows/releases), suggestion (makes/asks), antagonism (shows/releases), opinion (asks/gives), etc. In addition, we need to label cognitive and motivational states such

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as certainty (or uncertainty), agreement (or disagreement), interest (or no interest), thoughtfulness (or not), concentration (or not), etc. [62].

To this end, we propose an Event-Condition-Action (ECA) rule system, based on tools such as WEKA [58]. The aim of this system is to obtain the affective relational attitudes of the teacher (friendly, dominating, paternalistic, secure base, etc.). Our ultimate aim in CSCL, as well as in other online communication situations, is to show how important emotion awareness is together with other types of awareness that are complementary to emotions, such as, opinion awareness. Based on the analysis made of the literature described in the this section, we proceeded to identify the following research questions that still remain open and for which we will try to provide some effective answers in our current and future work:

2.3 Research Questions and Goals

2.3.1 Research Problem

The research problem, that we are going to develop, is the emotions' management during interaction of students in collaborative virtual learning environments.

2.3.2 Objectives

- O1. Studying the kind of emotions that occur in virtual and blended environments of learning and in which spaces arise (debates in forum, teamwork -for instance, the development of a wiki, performing an assessment task, etc.-).
- O2. Analyzing and evaluating emotions during learning interactions. Observe its evolution within the period of time of the formative action, for instance, one term, using specific methods of analysis and evaluation.

2.3.3 Research questions

2.3.3.1 Objective 1:

- P1. How are the emotions that students feel for their learning environments shown? How to investigate the impact of emotions and in particular emotion awareness on collaborative learning processes and outcomes.

- P2. How can the study of emotions help us to establish criteria that would indicate the appropriate time to intervene and take monitoring actions? How can we make students react in time, guide them and help them in an appropriate way so they can come out of a negative affective state and move into a more positive one?
- P3. How do students manage time in their learning processes? How can we know if they feel that they have enough time to carry out a learning activity or whether they feel stressed and frustrated by the lack of time?

2.3.3.2 Objective 2:

- P4. What kind of approaches, methods and tools can be used to analyze these emotional situations in the best way possible?
- P5. How can we assess the detected emotions, classify them and observe its evolution within the period of time of formative action?
- P6. What kind of emotions do students express and how do these emotions evolve over a certain period of time? How do negative emotions turn into other (and possible more harmful) negative emotions over time? What time limits should we set to make them change to emotions that are more positive?
- P7. What are the factors that lead students to remain in the same negative affective state that is considered detrimental and dangerous for a certain period of time, leading to a significant reduction in the quality of their learning, failure and even withdrawal from studies?

2.4 Research Methodology

2.4.1 Methodology

2.4.1.1 Theoretical Framework

To provide an effective answer to the questions mentioned before, at a theoretical-conceptual level, it will be necessary to build a solid theoretical base incorporating and expanding ideas and proposals for an innovative approach. Moreover, at a technological

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level it is necessary to translate this framework in the design and implementation of a robust computer system, by capturing and integrating all theoretical ideas that will serve as an important way to test and evaluate the whole process in real situations of virtual learning.

Our emotions analysis conceptual model, focused on CSCL (Computer-Supported Learning Collaborative) contexts applies an extension of the Activity Theory (AT) [63] to a scenario which consists on making that several participants (teachers and students) collaborate and interact with specific objects (text and dialog) by means of using specific analysis tools of emotion to carry out goal oriented activities (creating wiki, discussion forums and chats). In addition to including the time factor as a tool to provide the teacher and students more control and flexibility in developing their respective tasks [64]. The architecture of our conceptual model of emotion analysis is shown in Figure 2.1.

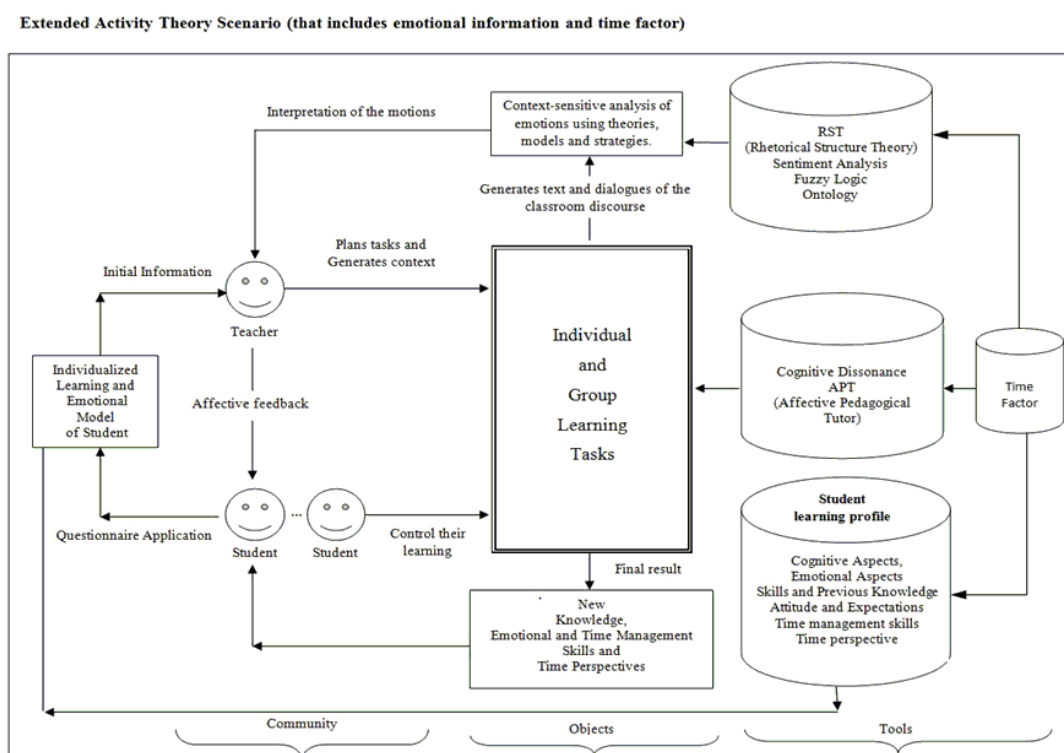


Figure 2.1: Graphic Representation of the Emotion Analysis Model based on an Extended Activity Theory Scenario [63]

2.4.1.2 Experimentation and empirical study

For this design, we have selected the study of cases, because it comes to perform a complex study whose core issue are the researchs goals, which involve a process of inquiry characterized by a detailed, comprehensive, systematic and in-depth review of a case of interest where data may be qualitative and quantitative. Our study will follow a multi-cycle model so that the second experiment will take as its starting point the results and experience of the previous one and will provide feedback to review / improve the model and complete a new cycle (as shown in Figure 2.2).

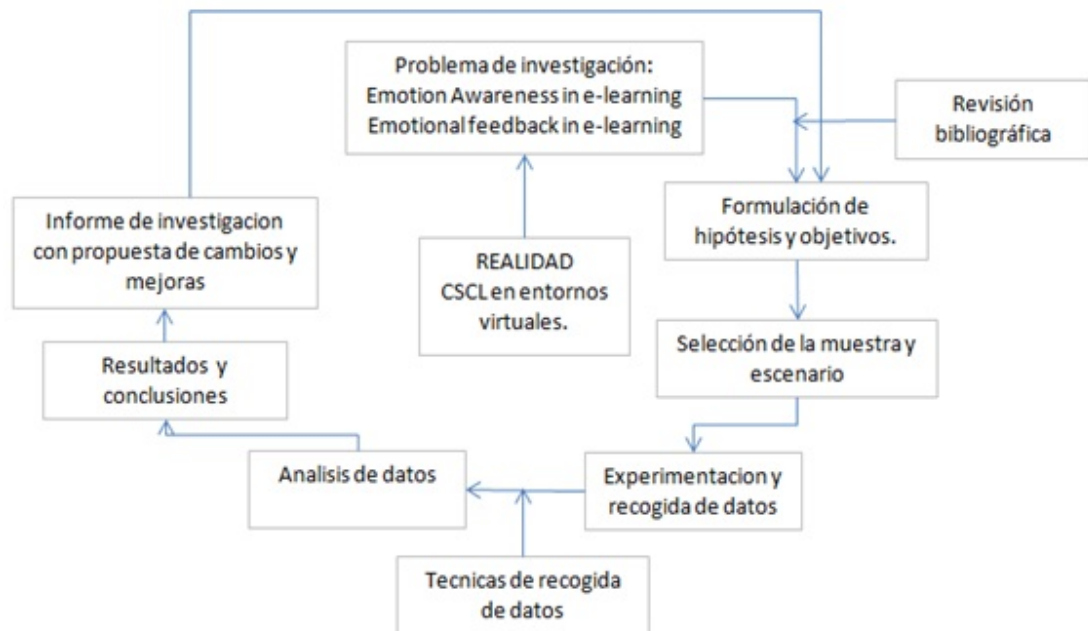


Figure 2.2: Multi-cycle process of our research

2.4.1.3 Development of a software prototype

Our purpose is to translate the conceptual model to a computational model that integrates a set of tools intended to achieve the proposed researchs objectives.

Regarding the first objective of our research, we will use Sentiment Analysis tools that already exist for identifying and labeling emotions in the educational discourse and we will propose an extension of the RST (Rhetorical Structure Analysis) tool to

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represent these emotions. For this task, we will use fuzzy logic methods to support our results as shown in deep at section 2.4.4.

In regard of the second objective of our research, the analysis of the emotional state takes also into account the context in which learning occurs. We understand as learning context all relevant information related to a student/group that participates in the learning activity. We use ontologies (see Appendix C) as a computational approach to represent this context.

2.4.1.4 Analysis of the results and feedback

From the data of student interaction, the goal is to detect the emotions that normally occur in shared workspaces (wikis and discussions) to ease their analysis and representation leaving for a later stage their qualitative interpretation. In order to achieve this, we will label:

- Academic, positive and negative emotions such as joy, pride, anxiety and embarrassment.
- Behaviors that arise during interactions between students as the solidarity (shown / not shown), the suggestion (made / ask), opposition (do / do not), and the opinion (ask / give)
- Cognitive and motivational states as security (or insecurity), the agreement (or disagreement), interest (or disinterest), reflection (or not) and the concentration (or not).

Through analysis of the data obtained we will develop a set of rules - Event-Condition-Action (ECA) rule - with the aim of identifying the relational affective attitude that has to keep the teacher with individual students (safe or friendly position or overbearing or patronizing).

2.4.2 Definition of the sample and / or research setting

2.4.2.1 Definition of experimentation scenarios

In order to assess the progress of this thesis and analyze their effects on the process of collaborative learning, we will develop at least two (2) experimental scenarios where it

will be checked and it will be evaluated all mentioned before. The scenarios will be in a context "blended learning", with high school students, who will participate in both classroom lessons as well as online learning activities on a platform of e-learning, such as Moodle. One of the two experiments will be devoted to achieving the first goal of the research, and the other will be held to address the second goal.

2.4.2.2 Defining samples

To ensure a correct population for the study and validate our model, our scenarios will include at least, one whole classroom.

We will divide our scenarios into two groups: experimental and control, ideally, both groups will have the same size and their population will be composed of the same number of students of each gender.

We will select people as sources of information within the proposed scenarios, with experience and knowledge of the virtual environment, ability to reflect and express clearly their experience and willingness to cooperate.

We will use the data only for academic purposes, ensuring anonymity and confidentiality of the people involved and informing of the possibility of revising the final report draft.

2.4.2.3 Design of experiments

In our experiments design, we will implement:

- a) Firstly, a learning scenario centered in designing an interesting learning situation in order to motivate students to participate in the course in which students are present. Furthermore, the scenario has to agree to the elements of our theoretical framework affecting the emotions. The purpose of the framework will be the activity that we need to develop, it will be a collaborative activity based on the paradigm of "Problem Based Learning" or "Project Based Learning" with several tasks that consist of creating a collaborative wiki (asynchronous), a discussion forum (asynchronous) and chat (synchronous). Therefore, the main work of the students will be reflected in the construction of Wikis and their participation in oriented-discussions so that students direct their own learning with the teacher as a guide and resource to help and meeting point, but allowing each

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group to choose the manner and order in their realization. In addition, it will apply the cognitive dissonance (which causes students to confront their perceptions and cognitive difficulties and try to overcome them) to show what kind of emotions occur in students.

- b) After that, the design and development of the learning activity will be conducted following the steps of the collaborative strategy JIGSAW grouping them into five stages that will run for the solution of the problem: a) First stage: Division of activity in themes and organization of the groups. b) Second stage: Individual elaboration of each topic. c) Third stage: Meeting of "experts". d) Fourth stage: Meeting of groups, presentation of each "expert" and unification of the activity's parts in one report. e) Fifth Stage: Preparation of the final report. (Appendix A: Collaborative Strategy JIGSAW).

2.4.3 Data collection instruments

2.4.3.1 Typology and Collection of data

The typology and collection of data from the experiment will be the speech (text and dialogue) generated by students in different virtual spaces (wikis, discussion forums, chat ...) of Moodle platform where they perform the proposed activity for its subsequent emotional analysis. Moreover, we will create three specific questionnaires to collect qualitative and quantitative data from the different experiments that will take place.

The first questionnaire will be used at the beginning of the two experiments as quantitative procedure with the aim of building the "Student learning profile" of Figure 2.1.

The second questionnaire will also be used at the beginning of the two experiments as quantitative procedure, with the aim of building the "Emotional profile of Figure 2.1, finally, the data collected from both questionnaires will be used to adapt the design of the experiment to the real profiles of students.

The third questionnaire will be used concerning the two objectives of this research, in the end of the two experiments, aiming to obtain quantitative and qualitative data on the experiences success, so it can be evaluated the individual emotional awareness that every student has carried out during the activity.

All questionnaires will measure certain indicators previously and conveniently defined with respect to each of the objectives and experiments. To validate our questionnaire this will be based on widely validated and already in the market questionnaires. The researcher will be present in the classroom as an observer but will not act as a teacher.

2.4.3.2 Preparing data for analysis

First, the speech (text and conversation) generated by students in different virtual spaces (wikis, discussion forums and chats) is divided into segments. Second, all segments are numbered sequentially and we refer to them as units of analysis, which will be analyzed in order to discover and show the relationship between the intentional and emotional discourse structure in both modes.

The objective of the final questionnaire will be to assess whether the graphic representation of speech that includes the emotions of the students has been satisfactory, whether it has helped students to know and understand the personal emotional states and of their group, and whether it has affected the processing information, the quality of collaboration and the results (yield learning) individual and group.

In total, the final questionnaire will consist of three questions of general data; six questions designed to measure and evaluate the aspects mentioned above through a Likert scale ranging from very unfavorable (1) to very favorable (5) and five open questions in which students can self-report their learning experience in their own words (Appendix B. Final questionnaire).

Given the multicycle process of our experiment, the questionnaire will be reviewed during the design stage for each new cycle.

Finally, the data of third questionnaire will also serve us to validate the data obtained from the automatic feelings analysis tools in relation to "Emotion Awareness" acquired by the students.

2.4.4 Procedure and Analysis Techniques

Both the text of the Wiki as the conversation texts are analyzed by segment, applying first, as an objective technique for the analysis of feelings, the Dictionary of Affection Whissell [57], an instrument designed to measure the emotional meaning of words and texts in natural language for activation, assessment and valence. By obtaining

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a series of numerically coded values for later correlation with the data obtained from questionnaires by means of standard statistical packages. The results obtained are shown graphically by applying an extension of the RST tool (Rhetorical Structure Theory). This extension allows the emotional structure of educational discourse to be constructed through a neat graphical representation of how emotions appear and evolve in the discourse.

Furthermore, given that the emotional state is not accurate, the analysis includes machine learning techniques (such as fuzzy logic) to derive emotional state and its relation to the context and learning outcomes.

For analysis of questionnaires, data, with regard to first goal, to find out the usefulness and effectiveness of our model of "Emotion Awareness", it will be performed the comparison between the results obtained in the experimental group (which use the model) and the control group (which do not use the model).

Regarding the use of statistical techniques in the analysis of the data, we will use descriptive statistics, through frequencies summation, relative frequencies calculus (

In addition, we will use bivariate correlations and variances analysis to find relationships between the variables studied for each of the objectives of our study.

2.5 Scheduling

For a justified research design and well temporalized, we will build on the order and purpose of the objectives and research questions posed above. In this way, we can obtain a research plan that can be made gradually and in a scheduled manner. In particular, the following actions and activities are proposed (Figure 2.3 and 2.4).

Task Name	Start date	Date of completion	Duration	2015		2016				2017				
				P3	P4	P1	P2	P3	P4	P1	P2	P3	P4	
Reviewing the scientific literature to know what has been said so far on the two objectives of our study	01/07/2015	31/10/2015	122											
Conducting an extensive and thorough research on how students' emotions influence their learning in virtual environments. In the end, by showing current trends and issues of our object of study.	01/07/2015	30/08/2015	60											
Exploring methods, technologies and tools needed to analyze and evaluate emotions.	01/09/2015	31/10/2015	60											
Planning's phase of the first experiment with respect to the first goal of "EMOTION AWARENESS"	01/11/2015	31/12/2015	60											
Specify the scenarios	01/11/2015	20/11/2015	19											
Elaboration of the questionnaires	21/11/2015	15/12/2015	24											
Selecting and preparing tools for emotional analysis	16/12/2015	31/12/2015	15											
Development phase first experiment (1 goal)	01/01/2016	30/04/2016	120											
Deciding when are we entering the scenario, when and how we should collect the data and how long should we invest in data collection and analysis.	01/01/2016	20/01/2016	19											
Planning the content	21/01/2016	15/02/2016	25											
Establishing control and experimental groups	16/02/2016	28/02/2016	12											
Initial data collection with the selected questionnaires	01/03/2016	07/03/2016	6											
Collecting data from virtual spaces (wikis, discussion forums and chat)	08/03/2016	30/04/2016	53											

Figure 2.3: Timing of the phases of research (I)

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Task Name	Start date	Date of completion	Duration	2015		2016				2017				
				P3	P4	P1	P2	P3	P4	P1	P2	P3	P4	
Completion phase first experiment (1 goal)	01/05/2016	31/07/2016	91											
Analysis of data collected with the configured tools	01/05/2016	31/05/2016	30											
Report findings and conclusions of the experiment	01/06/2016	30/06/2016	29											
Changes and enhancements proposed to the following experiment	01/07/2016	31/07/2016	30											
Planning's phase of the second experiment with respect to the second	01/08/2016	31/10/2016	91											
Deciding when are we entering the scenario, when and how we should collect the data and how long should we invest in data collection and analysis.	01/08/2016	31/08/2016	30											
Design and work on the new emotional analysis tools	01/09/2016	31/10/2016	60											
Development phase first experiment (2 goal)	01/11/2016	31/01/2017	91											
Specify the scenarios	01/11/2016	07/11/2016	6											
Planning the content	08/11/2016	30/11/2016	22											
Elaboration of the new questionnaires	01/12/2016	15/12/2016	14											
Initial data collection with the selected questionnaires	16/12/2016	17/01/2017	32											
Collecting data from virtual spaces (wikis, discussion forums and chat)	18/01/2017	31/01/2017	13											
Completion phase second experiment (2 goal)	01/10/2014	31/12/2014	91											
Analysis of data collected with the configured tools	01/02/2017	28/02/2017	27											
Report findings and conclusions of the experiment	01/03/2017	31/03/2017	30											
Study completion phase	01/04/2017	30/06/2017	90											
Triangulation of all data collected	01/04/2017	30/06/2017	90											
Development phase of the research report	01/07/2017	30/11/2017	152											

Figure 2.4: Timing of the phases of research (II)

3

PhD Supervisor

3.1 Director Proposal

Thanasis Daradoumis is Assistant Professor at the Department of Cultural Technology and Communication, University of the Aegean, Greece and Joint Professor at the department of Computer Science, Multimedia and Telecommunications at the Open University of Catalonia, Spain.

He is also Collaborating Professor at the Hellenic Open University.

He holds a PhD in Computer Science from the Polytechnic University of Catalonia-Spain, a Masters in Computer Science from the University of Illinois, and a Bachelor in Mathematics from the University of Thessaloniki-Greece.

His research focuses on e-learning, e-collaboration, e-learning communities, e-learning content-design, e-course design, synchronous and asynchronous communication, interaction analysis, e-assessment, e-monitoring and scaffolding, computer supported collaborative learning (CSCL), adaptive learning, emotional and affective learning.

He serves in the editorial board of several international conferences and journals, whereas he has coordinated or participated in various European and International R D projects.

He is co-director of the DPCS (Distributed Parallel and Collaborative Systems) Research Laboratory [<http://dpcs.uoc.es/>]. Finally, he has written over 100 papers.

3. PHD SUPERVISOR

3.2 Relation to UOC

Reasons related to the choice of director, research group, department and university to undertake my doctorate:

The Open University of Catalonia (UOC) is known for being a center of excellence in the field of e-learning with various international quality awards that make it an international leader in academia and research. For this reason, I chose the UOC for the Master of Education and ICT from September 2009 to June 2011.

Due to the very positive experience and the very high quality and rigorous studies that I undertook, I chose also its center research, eLearn Center, for my PhD. Motivated by these studies, my experience and constant interaction with my college students and my interest by virtual learning apart from my work as a researcher by directing and developing projects at my university. I seriously considered the completion of a doctoral thesis in the area emotional learning in e-learning, a field in which there are not many works that have treated and explored the emotional intelligence in real experiences so far.

For that, I got in contact with PhD Thanasis Daradoumis as supervisor because of his vast experience and scientific work both as teacher at UOC, during 15 years, and also for his long and important research work, recognized by Quality Research Agency, AQU. He has published more than 110 articles in international journals and conferences, and has coordinated and participated in numerous research projects, both national and international level.

I was admitted to the doctoral program "Education and ICT (e-learning)" in the eLearn Center (UOC) in the summer of 2011 and during the 2011-12 years I completed my research training with various courses and seminars (all qualified as Outstanding). I began to develop the research plan of my thesis framed in the fields of Processes of Teaching-Learning and Technological Resources for Education and enrolled into the Masters Degree in Multimedia Apps to successfully deal with the development of my thesis.

4

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5

Appendix

5.1 Appendix A. JIGSAW Method

This method is a technique of cooperation to resolve multiple conflicts that have been applied to learning with positive results. In it, each member (student) is essential for the realization and understanding of the tasks to overcome. The fact of making each student essential for solving the problem is what causes greater involvement in students and, therefore, better overall performance, constituting an effective learning strategy. Jigsaw was first used in 1971 in Austin (Texas) by Professor Aronson. In essence the method involves 10 steps:

1. Divide the class into groups of five or six people.
2. Appoint a group leader or spokesperson.
3. Divide the lesson or problem five to six parts.
4. Assign each student one of the parties.
5. Preparation by each student in his report.
6. Meeting of "experts" pre-group meeting, which will improve the individual reports.
7. Meeting of the working groups.
8. Exposure of each of the parties by the "expert" correspondent.

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9. Exhibition of the final work (usually through the "leader").
10. Evaluation of each of the groups.

5.1.1 Strategy implementation in our experiments

Based on the Jigsaw collaborative strategy, the learning activity is divided in ten stages, which in turn were grouped around five tasks to facilitate their implementation as shown in Table 1. For each task, the teacher provided all the necessary resources (documents and tools).

First Task	Division of the activity on topics and organization of groups (Initial chat)
Second Task	Individual development of each topic (Creation of the wiki)
Third Task	Meeting of "experts". Using the cognitive dissonance strategy, the teacher sets three questions about each topic of the activity to urge students to reflect upon specific issues of the activity (Use of an asynchronous forum)
Fourth Task	Meeting of the groups to determine how they will carry out the preparation and presentation of the final report. (Final chat)
Fifth Task	Preparation and presentation of the final report

Table 5.1: Five tasks of the Jigsaw collaborative strategy.

5.2 Appendix B. Final Questionnaire

Para una correcta obtención de los datos solicitamos que leas detenidamente las cuestiones planteadas y contestes de la forma más precisa posible. No te ocupes más de 15 minutos contestarlo. Los datos son confidenciales y es por ello que te ruego contestes con la mayor sinceridad agradeciéndote de antemano tu participación y el tiempo invertido.

5.2.1 Datos de Identificación

1. Edad:

2. Sexo:
3. Estilo de aprendizaje:

5.2.2 A. Emotion Awareness

4. Valora del 1 al 5 el grado de intensidad en que has experimentado las siguientes emociones durante la actividad . En caso de haber experimentado otras, especifica cuales.

- Alegra / Satisfaccion
- Tristeza / Vergenza
- Miedo / Angustia
- Enfado / Frustracin
- Otros:

5.- Valora del 1 al 5 el grado de intensidad en que has experimentado los siguientes estados de nimo durante la actividad. En caso de haber experimentado otros, especifica cuales.

- Motivado/a
- Concentrado/a
- Inseguro/a
- Aburrido/a
- Otros:

6.- Valora del 1 al 5 el grado de intensidad en que has experimentado los siguientes comportamientos respecto al profesor y/o compaeros durante la actividad. En caso de haber experimentado otros, especifica cuales.

- Has mostrado Solidaridad
- Has dado Sugerencias/Opniones

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- Has Hecho Oposicin
- Otros:

7.- Crees que las emociones experimentadas en el entorno virtual durante la actividad, tanto negativas como positivas, han afectado a tu proceso de aprendizaje? En caso afirmativo, explica de que manera.

5.2.3 B. Affective Feedback

8.- En relacin con el profesor, valora del 1 al 5 el grado de intensidad en que has experimentado las siguientes actuaciones.

- Ha usado metodologas dinmicas que me han motivado para aprender
- Ha atendido mis sentimientos o emociones en momentos de conflicto en la dinmica grupal
- Ha facilitado la discusin en el grupo para la gestin de las emociones
- Ha animado y motivado mi trabajo individual y mi puesta en comn con el equipo.
- Ha resuelto mis dudas y ofrecido consejos y sugerencias

9.- crees que el comportamiento del profesor durante la actividad ha fomentado o entorpecido tu proceso de aprendizaje? En caso afirmativo, explica de que manera.

5.2.4 C. Time Management

10.- El hecho de ser consciente de tus emociones te ha ayudado a:

- Auto-regular tu participacin en la actividad a tiempo
- Cambiar su comportamiento (a ms positivo) ms rpidamente
- Implicarte a tiempo en crear y compartir conocimiento
- Mejorar tu redimiendo antes que sea tarde
- Aligerar tu carga de trabajo

11.- El hecho de recibir feedback afectivo/cognitivo de tu profesor te ha ayudado a:

- Auto-regular tu participacin en la actividad a tiempo
- Cambiar su comportamiento (a ms positivo) ms rpidamente
- Implicarte a tiempo en crear y compartir conocimiento
- Mejorar tu redimiendo antes que sea tarde
- Aligerar tu carga de trabajo

12.- crees que el comportamiento del profesor durante la actividad ha influido en tu gestion del tiempo? En caso afirmativo, explica de que manera.

13.- crees que el comportamiento de tus compaeros durante la actividad ha influido en tu gestion del tiempo? En caso afirmativo, explica de que manera.

14.- controlar tus emociones durante la actividad ha influido en tu gestion del tiempo? En caso afirmativo, explica de que manera.

5.3 Apendix C. XML Ontology

¡rdf:RDF

xmlns="http://www.semanticweb.org/ontologies/2015/5/10/Ontology1433954321250.owl"

xmlns:webprotege="http://protege.stanford.edu/webprotege/"

xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns"

xmlns:owl="http://www.w3.org/2002/07/owl"

xmlns:xsd="http://www.w3.org/2001/XMLSchema"

xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema"

xmlns:dc="http://purl.org/dc/elements/1.1/"

xml:base="http://www.semanticweb.org/ontologies/2015/5/10/Ontology1433954321250.owl" ;

¡owl:Ontology

rdf:about="http://www.semanticweb.org/ontologies/2015/5/10/Ontology1433954321250.owl" ;

¡rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchemastring" / ;

¡webprotege:revision rdf:datatype="http://www.w3.org/2001/XMLSchemainteger" ;

162¡webprotege:revision ;

¡dc:date rdf:datatype="http://www.w3.org/2001/XMLSchemadateTime" ;

5. APPENDIX

Jun 16, 2015 6:21:11 AM;dc:date;

;rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchemastring";

This ontology was generated from an ontology revision in WebProtege

<http://webprotege.stanford.edu>

;/rdfs:comment;

;dc:creator rdf:datatype="http://www.w3.org/2001/XMLSchemastring";

martaarg;/dc:creator;

;dc:creator rdf:datatype="http://www.w3.org/2001/XMLSchemastring";

system;/dc:creator;

;/owl:Ontology;

Link of accessing to the ontology:

<http://webprotege.stanford.edu/Edit:projectId=3298a538-4bf8-4fef-9c8f-06101287dcae>