

Ubiquitous Learning – Treating the Context of Students Learning Styles

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Abstract— The increasing use of mobile devices and the wide dissemination of learning environments encourage educators to find methods that involve mobile and ubiquitous computing. This scenario allows the development of environments geared to teaching, in which characteristics of the context information from the student should be treated apart. Thus, it arises a new paradigm, ubiquitous learning, and enabling differentiated instruction. This article presents a survey that has founded, by analyzing evidential theory and practice, the similarity between the different dimensions of learning styles, presenting an adaptation of the ubiquitous environment seamlessly with the style of the predominant user.

Keywords-learning styles; ubiquitous learning; mobile computing.

I. INTRODUCTION

Technological development boosts the appearance of several tools that give students and teachers the ability to create various teaching methodologies in virtual learning environments, these in different ways to compose and accommodate formal education immersed in the educational environment.

However, by using new methodologies and aiming access everywhere at every moment, facilitates the unification of resources and experiences that are fundamental to identify the learning styles of the students, thus enabling the building of a customized environment, which can contribute to achieving good results in the educational process.

Mobile learning (of English Mobile Learning or m-Learning) allows learning to occur anytime and anywhere. However, despite providing mobility, it does not provide an apprenticeship able to consider the context-sensitive information of the student [1].

In this sense, through studies listed on the work of [2] and [3], there are some important questions: the use of various styles in the detection of student's profile can be an obstacle in the definition of his way to learn? Which style would be adopted in the adaptation of a virtual learning environment?

This article presents a survey that shows by evidential theory and practice analysis the similarity between the

different dimensions of learning styles, presenting an adaptation of the ubiquitous environment seamlessly with the style of the predominant user.

This paper is organized as follows. In Section II, we introduce the theory base for ubiquitous learning. In Section III, we introduce the study of learning styles. In Section IV, we introduce the results and discussions. In Section V, there are partial considerations and at the last Section are presented the references.

II. UBIQUITOUS LEARNING

Ubiquitous learning or u-learning is viewed these days as a new learning paradigm. This expansion of previous learning paradigms goes from conventional learning to e-learning (e-learning), as well as from e-learning to mobile learning (m-learning) and currently, called u-learning [1].

From Yahya et al. [4], the definition for ubiquitous computing environment is "an area that incorporates a set of embedded systems (computers, sensors, user interfaces, and service infrastructure), which is enhanced by computing communication technologies."

However, to provide customized environments according to the profile of each student, it is necessary to collect information from the technological context in which each is located. According to Gasparini et al. [5], in order to be considered U-learning a system must meet at least two requirements:

- It must capture the context of the student without him noticing through devices or command lines;
- It must adapt the interface, content, presentation or navigation considering the user's profile.

In turn, Quinta [6] points out in his system for capture of context that, first, must be considered "for whom" will be held this adaptation, bringing the capture of the user's context through the standards of the World Wide Web Consortium (W3C) XML reading. In second place, it is seen "where" content will be adapted that could happen on the server, the client or intermediary agent (proxy). The next stage acts "when" this adjustment is made, before the requisition, or during the two cases, and thus can take better advantage of each adaptation depending on the media file.

Then, it is chosen “**what**” will be adapted and if indeed this adaptation is necessary and lastly “**how**” will be realized this conversion.

III. LEARNING STYLES

Learning may be conceptualized as a natural process in the life of every human being and completed in adulthood. People of the same class, age, nationality, race and / or religion prefer to learn in different ways, in other words, they have their own preferences at the time of learning.

Is important to know how to identify the learning styles of students, since the more strategies he has developed, the chances of developing various forms of presentation of information in learning situations experienced by him will be greater [7]. Thus, the teacher is able to plan and encourage students to develop their skills according to their learning skills.

Learning styles are divided into dimensions in order to detect the prevalence of individual approaches of learning. A large number of them are available in the literature, with a tendency to merge styles presented by each author in their models.

According to Buther [8], "learning style is the consistent and personnel way in which people use their qualities and skills to define themselves, to find, evaluate and process information."

According to Honey and Mumford [9], "It is admitted also that each person is able to identify the characteristics of various learning styles, although generally, each person has a dominant style."

The author Felder and Soloman [10], understands the learning styles as preferences and dominant features in the way that people receive and process information. For him, "learning styles are skills that can and should be developed in the subject."

Already the author Kolb [11], "Notes that each individual develops a particular learning style, giving priority to certain skill."

According to Bariani [12], "examines that the forms are stable in relation to the characteristics of the cognitive structure of a person and which are modified from the direct or indirect influence of new events through culture and relate data of reality elaborating conclusions about them".

Table 1 shows the main characteristics associated with each of the styles.

The learning style refers to the preferences of the subject in the learning process. Based on the concepts of authors on learning styles, you can identify your own style.

IV. DISCUSSION AND RESULTS

The study consisted of a videntiary-theoretical – practical analysis of the similarity between different dimensions of learning styles in order to prove that a person can have interwoven styles, as well as detect which

dimensions are most suitable to use in a virtual learning environment.

The developed research integrated a master's dissertation entitled "Adaptation of Mobile Learning Engine Moodle (Moodle Mle) to different cognitive styles by using adaptive hypermedia" [2] in which the mobile MLE Moodle VLE it was adapted to different learning styles using adaptive hypermedia techniques. It was created and applied an Expert System for diagnosing styles, denominated SEDECA. The learning style was identified through the Instrument "Questionnaire" based on the research instruments proposed by [9], [12], [13] and [14]. The author Mozzaquatro [2], worked with four dimensions of learning styles: Reflective, serious, Holistic and Divergent in order to support the modeling process and implementation of the AVA to be adapted. The questionnaire was given to students of Undergraduate and Graduate distance learning mode.

The second work integrated to the research was the thesis entitled "Learning Styles and Strategies customized to students the methods and distance" [3] that addressed seventeen dimensions of learning styles, implementing a computer system that detects preferred styles and recommends different learning strategies to present educational materials and teaching resources according to the individual preferences of students. A system of objective questions was created: The SDLS (Learning Styles Detector System) consisting of a "Questionnaire", composed by sixty-one issues based in the research instruments proposed by [8], [9], [10], and [11]. The result of the test identified preferences regarding the following dimensions: Accommodating, Analytical, Assimilating, Active, Convergent, Divergent, Global, Intuitive, Personal, Pragmatic, Realistic, Reflective, Sensory, Sequential, Theoretical, Verbal, Visual.

The described researches have been validated by teachers and students of Graduate and Postgraduate modalities and distance education. After analysis of the characteristics, preferences and state of the different dimensions of learning styles, can confirm the similarity between of the aforementioned models.

The study shows that the styles are interwoven, and every person has more than one learning style, but each person has only one style of predominance, as shown in Figures 1 and 2.

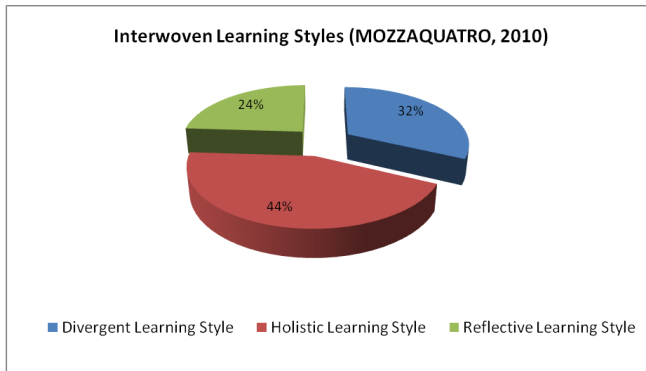


Figure 1 – Interwoven Learning Styles: Divergent – Holistic – Reflective.

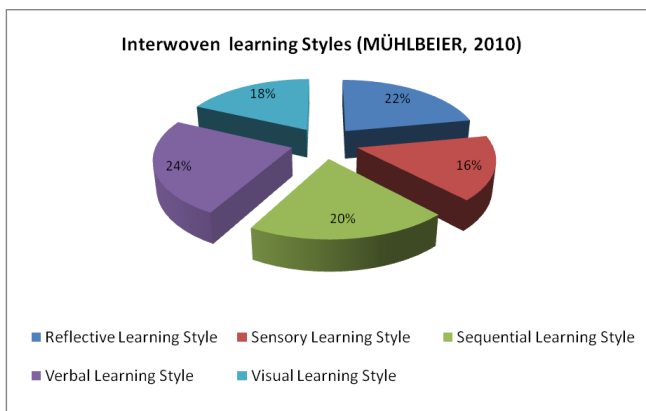


Figure 2 – Interwoven Learning Styles: Reflective- Sequential – Sensory – Verbal -Visual.

As shown in Figure 1, three styles have been interwoven, in other words, the results of the population on the survey showed by Mozzaquatro [2], demonstrate that subjects tended to predominate in the following styles: Holista (44%), Style Divergent (32 %) and reflective style (24%).

Figure 2 illustrates the analysis of the research developed by Mühlbeier [3], that presents the chance of the student to present learning style interwoven in which one style becomes predominant. It can be observed that the population interviewed presented five interwoven learning styles: Verbal (24%) Reflective (22%), Sequential (20%), Visual (18%) and Sensorial (16%).

As seen in Figure 3, the learning style Global approached by Felder and Silvermann [11], presents as the vision the whole approach. Compared to the learning Holistic style, integral of the Bariani Model [12], it was found that both have similar characteristics, with emphasis on the global context. Based on this assumption it is conclude that an individual with the Holistic Learning Style has the same preferences as a Global Style one.

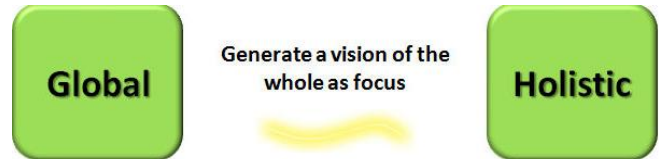


Figure 3 – Similarity Global and Holistic.



Figure 4 – Similarity Intuitive and Active.

Figure 4 illustrates the intuitive and active learning styles and members of the Felder and Silvermann Model [10], which mention individual characteristics motivated by new experiences and innovations. Concluding that people with such characteristics can suit both dimensions.

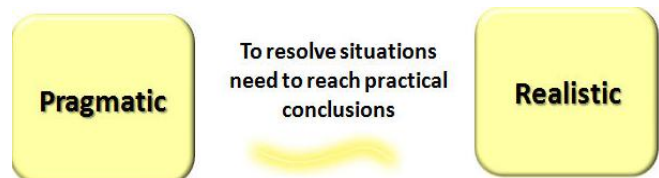


Figure 5 – Similarity Pragmatic and Realistic.

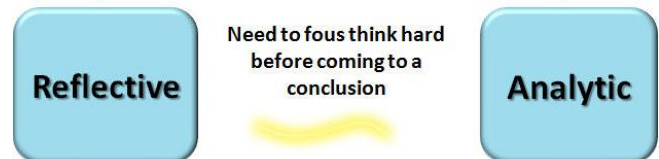


Figure 6 – Similarity Reflective and Analytic.

The realistic style of the Buther integral Model [8], presents itself as characteristic to resolve practical situations. The Honey and Mumford Model [9], shows the pragmatic dimension that has experience and theories applied to practice. It was noted that both dimensions have similarity between them, as shown in Figure 5. In Figure 6 we observe that Buther’s Analytical Model dimensions and Reflective Model Honey and Mumford, have as a common characteristic "focus", meaning that reflective or analytical individuals think hard before reaching a conclusion.

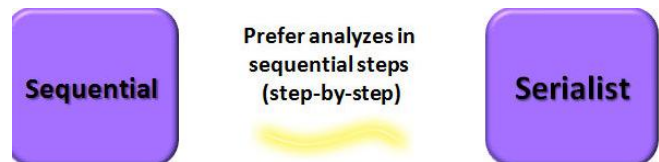


Figure 7 – Similarity between Sequential and Serialistic.

As shown in Figure 7, the sequential and serialist learning styles integrates Felder - Silvermann and Bariani

models present as individual preferences analysis in sequential steps, in other words, a step by step. Characteristics prevalent in individuals who are also sequential sequentialists.

After analyzing the similarities between all surveyed dimensions, it was proven that to adapt a virtual learning environment, it is necessary to build a system that detects learning styles using a wide range of dimensions, since both have similarities, influencing positively the relation cost-benefit.

V. CONCLUSION

Virtual learning environments have been lately focused to the functional aspects, looking to evolve through recommendations to become closer to classroom teaching with the use of mobile devices. A ubiquitous learning environment is able to meet the needs of students, exploring their preferences of learning styles.

It is believed that the presented research achieved its objectives, contributing to a development of the adaptation of virtual learning environments for different learning styles. The main contribution of this work was to prove the similarity between the different dimensions of learning styles addressed by the authors of the studied models, so there is no reason to use a wide range of dimensions of learning styles.

Based on the developed research, it was possible to verify the existence of interwoven styles, in other words, every person has predominance in one dimension, but integrates others in lesser extent. The study shows that diagnosing learning styles is a complex task, and requires analyzes in order to offer to the student an individualized learning experience, showing them the information in a personalized and targeted way. The identification of prevalent learning styles now has a key role on enabling more consistent educational practices with actions that prioritize autonomy and cooperation in the process of teaching and learning environment by adapting the student's predominant ubiquitous model.

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TABLE I. DIMENSIONS OF LEARNING STYLES.

	Dimensions	Characteristics
Butler Model	Realistic	Members with learning style Realist see the world as a place orderly and predictable facts, actions and results. They are guided by experience; follow guidelines and make sure that others are aware of the actions that practiced; dislike change for change or fix what is not in trouble.
	Analytic	The members of the analytical learning style perceive the world as a logical system that can be understood through analysis and constant study, have a theory for almost everything, like the scientific method, technical information and evidence.
	Pragmatic	Pragmatists members see the whole world to the parts and the parts to the whole world, simultaneously, have the ability to adapt and adapt; attribute the same weight to facts and values, formulate strategies and tactics to make things happen; suffer less with the incompatibilities of styles.
	Personal	Members with personal style have the following characteristics: to understand the world as a place where harmony is essential and the prevalence is up to the well. These guys love to be seen as helpful, supportive, open and trustworthy; welcome multiple points of view and then assimilate.
	Divergent	The divergent perceives the world as a place of infinite possibilities, where imagination and experimentation combine themselves to test and find out what may prove to be, like change, dissent and novelty seeking.
Honey and Mumford Model	Active	They prefer new experiences, have an open mind, are enthusiastic about anything new, are sociable and engage constantly with others, try to be the center of all activities, are interested in challenges and problematic situations, manifest strong implication in action.
	Reflective	The prioritize members observe before action, like to observe the experiences of diverse perspectives, focus on reflection and meaning making, gather information both from their own experience as the experience of others, they prefer to think before coming to any conclusion.
	Theoretical	Tend to establish relationships, deduce, integrating the facts in coherent theories, tend to be perfectionists, they like to analyze and synthesize. Their approach to problems are consistent and logical. They seek rationality and objectivity, they are uncomfortable with subjective conclusions, lateral thinking or surface appearance.
Felder and Silvermann Model	Sensory	Sensory members enjoy learning facts; solve problems with established methods without complications and surprises, they are more finicky, and do well in practical work (laboratory, for example).
	Intuitive	Members of intuitive group prefer to discover possibilities and relationships; enjoy newness and get bored with repetition, they feel more comfortable to deal with new concepts, abstractions and mathematical formulas, are faster and more innovative work.
	Visual	Members of the visual group remember more of what they see - pictures, diagrams, flow charts, films and demonstrations.
	Verbal	Members of this group take greater advantage of verbal words - written or oral explanations and mathematical formulas.
	Active	Active members tend to comprehend and retain information more efficiently discussing, applying concepts and / or explaining to others, enjoy working in groups.
	Reflective	Reflective members need time to reflect on the information received; They prefer individual jobs.
	Sequential	They prefer to learn sequential linearly, logically sequenced steps in; tend to follow logical paths to find solutions.
Kolb Model	Global	Global members tend to learn at random, forming a vision of the whole, are able to solve complex problems quickly, but have difficulty explaining how they did.
	Divergent	Divergent members prefer to learn by concrete experience and reflective observation. They show up skilled in situations that require new and creative ideas, are able to analyze situations from different points of view and relate them in an organized whole, comprise people. Question feature WHY?
	Assimilating	Assimilators members learn by reflective observation and abstract conceptualization. They use inductive reasoning, respond to information in a logical way, when they have time to reflect, they have facility to create abstract models and theoretical and they do not worry about the practical. Question feature WHAT?
	Converging	Convergent members use deductive reasoning, with practical application of ideas, learn by trial and error, are skilled to solve problems and make decisions. Question feature HOW?
Bariani Model	Accommodating	Members of these group prefer this style based on learning and active experimentation in concrete experience, adapt to immediate circumstances; like challenges, act more by feeling than by logical analysis. Question feature THAT WAY?
	Reflective	They reflect before taking a particular course of action, have more organized thoughts. People whose thoughts are more organized, sequenced and that are weighted thoughts, previous response, reflexives are considered.
	Serialist	The serialist people are tighter focus on separate topics and logical sequences, searching later, patterns and relationships in process to confirm or not their hypothesis. They choose simple hypothesis and a logical-linear (a chance to another step-by-step). They are often good and skilled analysts on solving problems.
	Holistic	The holistic group gives greater emphasis to the global context, from the beginning of a task, examining preferences in a large amount of data looking for patterns and relations between them. They can solve complex problems quickly or put together things and are often good with synthesis.
	Divergent	The members of divergent group perceive the world as a place of infinite possibilities, where imagination and experimentation combine to test and find out what may prove to be, like change, dissent and novelty seeking.

Source: Adapted from [2].