Analysis Learning Styles though Attentiveness

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Abstract. Attention is one of the most widely misused and overgeneralized constructs found in the educational, learning, instructional, and psychological sciences. It would be convenient for teachers if they could grasp the attentiveness states of learners in their classes precisely so that they could try to improve the way to deliver the course material in a manner that could attract more learners. When students are doing learning activities using the news technologies is very hard for the teacher detected if each student her/his level of attentiveness. Furthermore, different student learn in different ways, each one preferring a different learning style. This paper presents an experience using different learning styles with a system that monitoring attention, with the aim of providing a non-intrusive and non-invasive way, reliable and easy tool that can be used freely in schools, without changing or interfering with the established working routines. Specifically, we look at desk students in learning activities, in which the student spends long time interacting with the computer.

Keywords: Learning Style, Attention, Behavior Biometrics, Technologies in Learning, and Ambient Intelligent System.

1 Introduction

Learning activities can occur in class in an on-line context, which is usually used to practices online teaching exercises. Basically, they all refer to learning processes that use information and communication technology to facilitate synchronous as well as asynchronous learning and teaching activities.

Learning theories provide insights into the very complex processes and factors that influence learning and give precious information to be used in designing instruction that will produce optimum results. The learning models are designed in order to supply to the students with practice, evaluation and improvement procedures which will adjust the model [1].

Many contemporary educators argue the value of a constructivist approach to teaching. One of the central arguments for the use of Web-based resources in the classroom is that it gives learners access to information resources in ways that allow them to search for relevant data, synthesize that information, and draw their own conclusions.

The teaching process first requires that the instructor creates a pedagogical design of the objectives and determines the content to be taught. Second, a pre-assessment is used to determine learning abilities. Third, pedagogical procedures are used when teaching is initiated. Finally, assessment is applied to determine what learners have achieved, and, according to the assessment results, instructors should use feedback to determine the cause of ineffective instruction [2, 3].

Furthermore, for various reasons, students may not be predisposed to learning. In this sense, and in bigger classes, it is important that the teacher has instruments to point out potential distractions (namely in what concerns the applications being used by the students) that may indicate a lack of predisposition to learning.

Another important aspect is the type of exercises that is given by the teacher. Some students may prefer exercises with visual context and other exercises only with text contents. For this reason it's important have the background behavior learning style of the class and each student.

The goal of this paper is to propose an ambient intelligent (AmI) system, directed at the teacher that indicates the level of attention of the students in the class when it requires the use of the computer connected to the Internet. This AmI system captures, measures, and supervises the interaction of each student with the computer (or laptop) and indicates the level of attention of students in the activities proposed by the teacher. When the teacher has big class, he/she can visualize in real time the level of engagement of the students in the proposed activities and act accordingly when necessary. Thence it was applied in four different lesson in the same class with the same subject. The purpose was verified the learning style which had better results in attention level.

This paper is organized as follows. In the next Section the related work with learning styles and AmI system where scientific literature is reviewed. Section 3 contains the study outline, and section 4 presented the results. In section 5 discussion and some conclusions of this work are presented.

2 Related Work

It is crucial to improve the learning process and to mitigate problems that might occur in an environment with learning technologies. To explain how learning is processed it is possible to use the learning cycle shown in Figure 1. The learning cycle has five steps: Engagement, Exploration, Explanation, Elaboration, and Evaluation [4].

The first step of the learning cycle is the engagement step where the student's attention is focused on the subject. In this step prior knowledge is explained and the student is reminded about topics that she/he should already be familiar with. The evaluation of this step consists in pre-assessing the prior knowledge of the subject.

The second step, the exploration step, has students gathering information that they can use to solve the problem that was proposed. The evaluation of the exploration step is carried out through the evaluation of the gathering information process.

In the explanation step the students use the gathered information to solve the problem and report what they have done and also try to work out the answer to the presented problem. The evaluation of explanation focuses on how well the students are using the gathered information and what new ideas they have come up with.

The elaboration step is where the student has new information that extends what they have been learning. Also, in this stage students are solving problems that require the knowledge acquired during the learning process in order to solve them. The evaluation of the elaboration step usually is the test at the end of the subject, which measures how well students understood what they have learned.

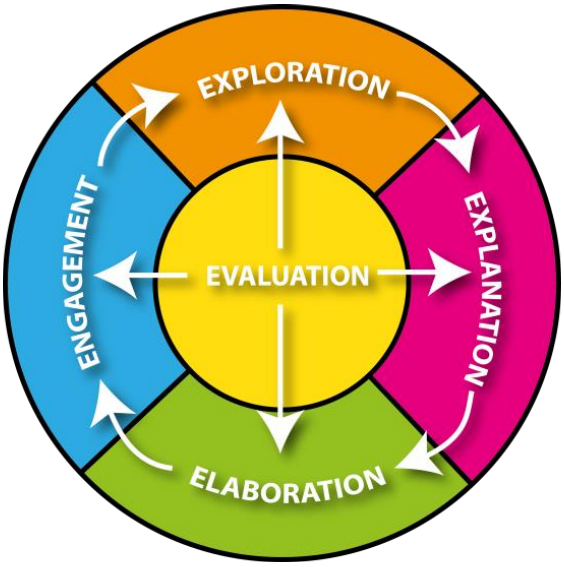

Fig. 1. Learning Cycle [4].

Based on Kolb framework it's necessary that student stay engaged in the subject in order to improve all the step of the framework. Another aspect that is necessary to be consider is that the degree of the learner's attention affects learning results, where the lack of attention can define the success of a student and in learning activities. So the level of attention is very important in order to perform a task in an efficient and adequate way [5].

2.1 Learning Styles

In order to maximize the learning is also important to consider the concept of learning styles. A learning style is the method that allows an individual to learn best. Different people learn in different ways, each one preferring a different learning style.

Learning style not only specifies how a student learns and likes to learn, but it can also help a teacher to adapt to individual students, so that they might learn successfully. When the teacher's methodologies do not support a specific learning style, the student will find it more difficult to learn and acquire knowledge. Everyone has a mix of learning styles, but some people may find that they have a dominant style of learning. Others may find that they have different learning styles in different circumstances.

Learning styles can be defined as cognitive, affective, and physiological features that serve as relatively stable indicators of how learners perceive interaction and respond to their learning environments [6].

There are several models developed by several authors that try to represent the way people learn [7]. Previous research suggests that, in the context of learning activities, different learning styles can influence learning performance [8, 9]. Learning styles are considered one of the more important factors influencing learning [10].

Some researchers have argued that learning style is also a suitable indicator of potential learning success because it provides information about individual differences in learning preferences and information-processing [11, 12].

However the field of learning styles is a very controversial field, because there are some authors that consider that scientific support for learning styles theories is lacking [13].

2.2 AmI System

When students are doing learning activities using new technologies and connect to the Internet, it is extremely important that the teacher has feedback from the students' work in order to detect potential learning problems at an early stage so he can choose the appropriate teaching methods.

The learning is improved if the teacher has a system that can detect and classify the learning preferences of students and provide advice from potential learning problems at an early stage in order to choose the most appropriate teaching methods.

For this reason we propose a AmI system that uses the information of a software that run in a parallel and transparent process, while student conscientiously interacts with the system and takes his/her decisions and actions.

This work was detail in [14], but briefly the devices in which students work have software that generates raw data, which store the raw data locally until it is synchronized with the web server in the cloud. After the raw data was stored in a data store engine, the analytic layer provides powerful tools for performing analytics and analyses in real-time, where the system calculates, at regular intervals, an estimation of the general level of performance and attention of each student, based on work-related tasks defined by the teacher. In the classification layer the indicators are interpreted. Based on data from the attentiveness indicators and building the meta-data that will support decision-making. When the system has a sufficiently large dataset that allows making classifications with precision, it will classify the inputs received into different attention levels in real-time, creating each student learning profile. With these results it is possible to obtain a profile of the learning style. Finally, the actual students' attention information is displayed in the visualization layer, and can be used to personalize instruction according to the specific student, enabling the teacher to act differently with different students, and also to act differently with the same student, according to his/her past and present level of attention.

3 Study Outline

The present work adds a new feature to this previously existing framework, by providing the learning styles theory, where the applications of different type of exercises obtained different results of level of attentiveness. It constitutes a much more precise and reliable mechanism for attention monitoring, while maintaining all the advantages of the existing system: nonintrusive, lightweight, and transparent.

3.1 Methodology

This work was applied on a vocational course while performing an activity based on Adobe Photoshop at the high school of Caldas das Taipas, Guimarães, Portugal. We want to determine how the class reacts during the lessons and the effect on mouse and keyboard dynamics, and attention level.

For this purpose one group of 22 (9 girls and 13 boys) students were selected to participate in this experience. Their average age is 17.6 years old (SD = 1.4 years). The experiment was applied in four different lessons, where they have access to an individual computer and 100 minutes to complete the task. Students received, at the beginning of the lessons, all necessary data with the goals of the task.

To quantify attentiveness the following methodology was followed. Apart from capturing the interaction of the students with the computer, the monitoring system also registers the applications with which students are interacting. Attention is calculated at regular intervals, as configured by the teacher (e.g. five minutes). The teacher may also want to assess, in real-time or a posteriori, the evolution of attention of the whole class.

In order to determine the learning style of each student, four different exercises were applied in four different days where the room had similar conditions in terms of lightning, temperature and humidity. The exercises applied were the following: on the first day a video exercise without audio; on the second day, an exercise only with images; on third day, an exercise only with text; and on the fourth day an exercise only with audio. In the end of each class, the exercise was saved in order to be assessed by the teacher.

3.2 Features Extraction

The process of feature extraction starts with the acquisition of interaction events, which is carried out by a specifically developed application that is installed in each of the computers, laptops or tablets. The first stage in the life cycle of the proposed system takes place in the data generating devices, which was designed and implemented using a logger application.

The data collected by the logger application characterizing the students' interaction patterns is aggregated in a server to which the logger application connects after the student logs in. The privacy of the students is ensured, since the necessary data that is collected in the registration process are an ID that does not identify the student, password, and gender. Furthermore, the privacy issues of the system are assured, since the teacher will only have access to the final results on the level of attention.

The Mouse and Keyboard Sensing layers are responsible for capturing information describing the behavioral patterns of the students while interacting with the peripherals [5].

4 Results

During the lessons the monitoring system was used to assess the interaction of the students with the computer and to quantify their level of attentiveness as well.

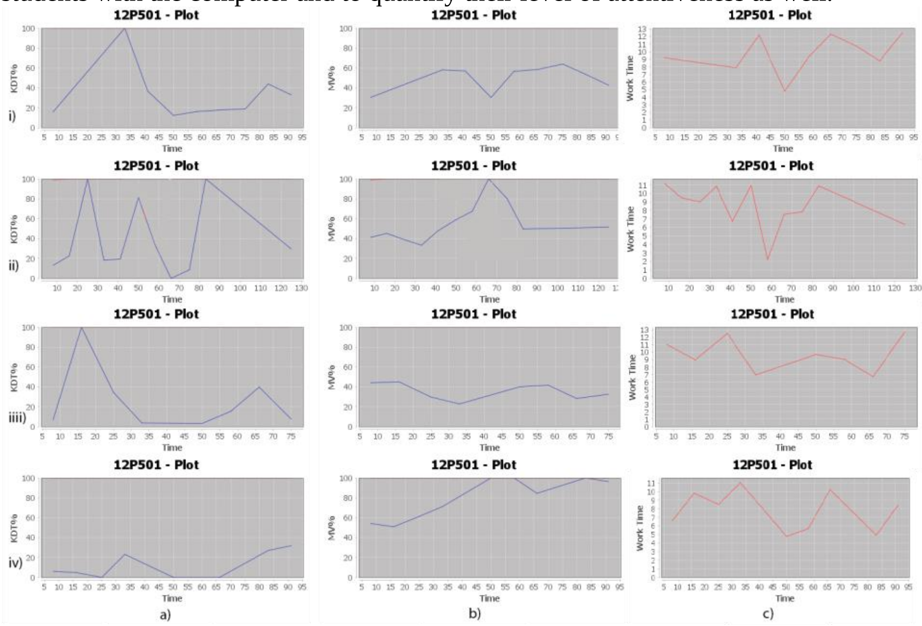

Fig. 2. Detail of evaluation of Keyboard (a); mouse (b) and attention (c) for a specific students in the four different lessons.

On each lesson the level of attention of each student was quantified. However, at the beginning it is necessary that the teacher define the task-related applications that the students will use during the class. For that he/she uses a graphical interface to set rules such as "starts with Photoshop" or "Contains the word Photoshop" which are then translated to regular expressions that are used by the algorithm to determine which applications are and are not work-related [14]. In this sense it is necessary to measure the amount of time in each interval, which the student spent interacting with task-related applications. By default, applications that are not considered task-related are marked as “others” and count negatively towards the quantification of attention. The teacher may also determine the regular intervals at which attention is calculated.

Figure 2 shows the output of the evaluation of keyboard ((a) KDT, the number of time that keys are press), mouse ((b) MV, the velocity of the mouse movement), and attention ((c) worked task-related) of a specific student in the four different lessons.

The first lesson (i) was a video exercise without audio; the second lesson (ii), was an exercise only with images; the third lesson (iii) was an exercise only with text; and the fourth lesson was an exercise only with audio.

In each of these lessons it’s analyzed: the interactivity with the keyboard, by measuring the keys press during the lesson; the movement of the mouse, measuring the mouse velocity; and the level of attention, which is measuring with the work task-related.

This is an example of a student, but the teacher had access to all students and the global of the class, which allows the teacher to assess the temporal evolution of attention. These results consider the entire length of a class and give the percentage of time spent in task-related or other applications, for each student.

5 Discussion and Conclusions

The main goal of this paper was to present an AmI system approach that analyzed the interaction of student’s in learning activities using technologies connected to the Internet. In this case, a specific subject was focused (Adobe Photoshop) and it was analyzed in four different lessons, using four different learning style approach. For this case it was observed the performance of the class and each student. An example of the results of one student was showed and we can observe that this student’s for the same subject react differently depend on the leaning style applied. In the first lesson, with the exercise of video without audio, this student had a similar decrease in evolution in the attention level, keyboard, and mouse velocity. However, this was not observed in the other lessons. In case of lesson two, exercises only with images, we can observe that when the level of attention is lowest is where the mouse velocity is higher. That might indicate that this student is in other application where the mouse velocity is needed.

Related with the level of attention in the four lessons for this student, we can conclude that is more homogeneous in three (exercise with only text) and have a better average in lessons one (exercise only with video) and three (exercise only with text).

This approach was implemented in the form of a distributed architecture that constantly collects, processes, stores, analyzes and monitors data describing individual behavior.

Regarding learning styles, the system only analyses the student’s actions by the percentage of work-related tasks and the interaction with the mouse and the keyboard. When the system has enough data for each student, it will be possible to advise the teacher with the aim to improve the attention level. It will also be possible to analyze the students’ profiles, taking into account their individual characteristics, and to propose new strategies and actions. Given that the teacher is informed about the behavior of each student and each one's learning style, she/he will be able to maximize students' attention and, consequently, the performance of the teaching-learning process**.**

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