A STUDY ON STUDENT'S LEARNING STYLES USING FELDER-SILVERMAN MODEL

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Abstract: Students often come from different backgrounds, with different knowledge level and different learning styles. Some of them learn better in active environments, interacting with others, whereas some of them learn better alone, analyzing things deeply. There are also students that learn better using visual graphs or schemas, and lose their interest if they are given long texts materials. It is difficult for lecturers to identify these differences, and to adapt the lectures to every student needs. In this paper we will show a study made at Faculty of Natural Sciences in Albania, with Informatics department students. The aim of this study is to identify student's differences in their learning styles. To classify student's learning styles, Felder-Silverman model was used. In this model learners are classified as: Sensing-Intuitive, Visual-Verbal, Active-Reflective, and Sequential-Global. In this study 106 students participated. They filled out a questionnaire, which determined their learning style based on Felder-Silverman model. The questionnaire was mostly based on questions from Index of Learning Style questionnaire, an online survey used to find learning styles based on Felder-Silverman model. Students were from three different master courses of Informatics department, 64 of them were females and 42 were males. The results showed that 24.5% of them were sequential learners, 40.6% global and 34.9 % were balanced. 67.9% were visual learners, 13.2 % verbal and 18.9 neutral. 27.4 % of them were sensing learners, 17.9 intuitive and 54.7% were balanced. Results also showed that 31.1% were active learners, 25.5% were passive and 43.4% were balanced. Based on these results, we cannot determine student's learning styles very clearly. As we can see a high number of students appeared to be balanced for any of the four dimensions, meaning that they did not show clear preference on one dimension. Visual-Verbal model was the only model which showed a clear result. Students preferred to learn most with visual information rather than verbal information. But, we cannot clearly determine their style based on other dimension's results. This indicates that it is very difficult for lecturers to satisfy all their needs in learning style. Based on these results, the paper proposes that using an adaptive e-learning system as a pedagogical tool would be very useful to help students and their learning style, and to help lecturers in their job. This system could adapt to their learning style and present materials according to them. This would help that students don't lose interest and it could have a positive effect on their performance. Also, considering the large number of balanced students on this study, using an adaptive e-learning system can also help better identify their learning style. The system can use questionnaires not only at the beginning of the course, as their preference can change with time but also during the course. The system could also track student's behavior in the e-learning environment, to detect their learning style. This approach would be useful especially to those balanced students, who do not have a very clear preference on their learning style.
Keywords: e-learning, learning styles, Felder-Silverman model, adaptive systems

INTRODUCTION

Lecturing in higher education institutions is very challenging. Students come from different backgrounds and have a lot of differences in learning styles and in thinking styles. So incorporating learning styles in teaching plans might make learning easier and leads to better achievement. Researchers have developed many different models for identification of learning styles. In general, a learning style model classifies students according to where they fit on a number of scales pertaining to the ways they receive and process information [1]. There are many ways of detecting learners learning style, but the most used method is by questionnaires. Effective learning depends on whether a learner is active, highly motivated and in possession of the right strategic knowledge. In order to help university students to learn effectively, instructors need to know and adapt to different styles of learning [2]. There are some ways that can use learning style data to enhance student's learning experience. Learning style data can be used to guide the student toward more effective study habits and that data can be used to help instructors in their selection of instructional strategies [8]. Learning styles are also useful in building adaptive e-learning systems. LMS are widely used nowadays in learning environments, even at universities. Students like to learn using the internet. In these platforms digital contents are offered in the same format to all learners within a particular course. LMSs tend to be course centric rather than learner centric [9]. Identifying learning styles could be useful in extending LMS to display

content based on student's learning styles. In this paper a study with Informatics department graduate students is done, in order to identify differences in their learning styles. In the last sections results of this study are shown and analyzed. The aim of this study is to find pedagogical techniques that need to be used in this department, in order to help students learn better, and have better results.

LEARNING STYLES

Learning styles have been defined as the different ways or means by which student learn [2]. Each individual has various ways to learn. Some like to learn by seeing, hearing, responding, giving logical reasons, remembering and learning by using graphics [3]. There are several different learning style models. In this paper, the Felder-Silverman learning style model (FSLSM) is used. According to FSLSM, each learner has a preference on four distinct dimensions: active/reflective (ACT/REF), sensing/intuitive (SEN/INT), visual/verbal (VIS/VER), and sequential/global (SEQ/GLO) [1] .

Active/Reflective Learners

Active learners are students who like to try something through experiments and do not like to learn through lectures. Reflective learners refer to students who prefer to learn through thinking. They mostly like to learn and work independently [3]. Active learners do not learn much in situations that require them to be passive , and reflective learners do not learn much in situations that provide no opportunity to think about the information being presented. Active learners work well in groups, reflective learners work better by themselves. Active learners tend to be experimentalists, reflective learners tend to be theoreticians [4].

Sensing / Intuitive Learners

The sensing learners are students who are more likely to involve learning facts only [3]. Sensing involves observing, gathering data through the senses; intuition involves indirect perception by way of the unconscious—speculation, imagination, hunches. Everyone uses both faculties, but most people tend to favor one over the other [4]. Intuitive learners refer to students being conceptual, innovative and orientated towards theory and purpose. They do not like it when the teacher reiterates learning that has been studied previously. They understand new concepts better and are always comfortable with abstract ideas and mathematical formulas [3].

Visual/ Verbal Learners

Visual students are those who can remember very well what has been seen as photographs, drawings, diagrams, series, films, and demonstrations [3]. "Visual" information clearly includes pictures, diagrams, charts, plots, animations, etc., and "auditory" information clearly includes spoken words and other sounds. Written words are therefore not equivalent to real visual information: to a visual learner, a picture is truly worth a thousand words, whether they are spoken or written [4].

Sequential/ Global Learners

Some students learn sequentially, mastering the material more or less as it is presented. Others, however, cannot learn in this manner. They learn in fits and starts: they may be lost for days or weeks, unable to solve even the simplest problems or show the most rudimentary understanding, until suddenly they "get it"—the light bulb flashes, the jigsaw puzzle comes together. These are the global learners [4]. School is often a difficult experience for global learners. Since they do not learn in a steady or predictable manner they tend to feel out-of-step with their fellow students and incapable of meeting the expectations of their teachers. Some eventually become discouraged with education and drop out. However, global learners are the last students who should be lost to higher education and society. They are the synthesizers, researchers, the systems thinkers, the ones who see the connections no one else sees. They can be truly outstanding engineers—if they survive the educational process [4].

METHODOLOGY

In this study a questionnaire was done, at Faculty of Natural Sciences in Albania, with Informatics department students. 106 students participated, 64 of them were females and 42 were males. Students were at their first year of master studies. 31 of them were students at "Professional Master in Informatics", 41 were at "Professional Master in Information Technology", and 34 of them at "Master of Science in Information Technology". The questionnaire was based on Index of Learning Styles (ILS). The ILS is the instrument that Felder uses to evaluate a student's learning

style. The ILS is conveniently available on the Internet and consists of 44 multiple-choice questions. The 44 questions have two possible answers ('a' or 'b'). The intensity of a dimension can vary from 1 to 11. This is because each dimension has 11 questions [5]. The questionnaire also had some other questions, such as their average grade, their gender, and their field of study. The aim of this questionnaire was to identify student's learning styles, in order to take better decisions for new pedagogical approaches. The results of this study will be used for adaptation of an e-learning system to students learning styles. The identification of their learning style is necessary for designing the adaptation of this system. Being designed for different learning styles, the system can offer insights and advices to a wide range of stakeholders such as students and teachers to effectively organize their learning materials and studying activities to optimize the learning paths. For example, under Felder-Silverman learning styles frameworks [5], students may prefer to process information actively or reflectively. For "active" students, they perform better through interaction with other students compared to the traditional classroom. Thus, it is advisable for teachers to provide such group the opportunity to interact and discuss the learning topic [6].

RESULTS
Fig. 1 shows the results of distribution of learning styles among students for each dimension. Each dimension is encoded from -11 to +11. The calculations for each dimension (for example active/reflective) are done in this way: a negative number less than -2 indicates that the learner is predisposed towards a reflective style of learning and is assigned the final value -1. A positive number more than 2 indicates that the learner is mostly active in his or her learning style and is assigned the value 1. Values between 2 and -2 were considered to indicate that the learner does not have any marked preferences on a particular dimension and the assigned value for them is 0. They are considered as balanced for that dimension.

We can see that most students are visual learners, with 67.9 % against 13.2% for verbal learners. 40.6 % of them are global learners, but considering the fact that 34.9 % of them are balanced, we cannot come to a clear conclusion for this dimension. The distribution of active and reflective students is also nearly equal or balanced. Also for the sensing dimension, as shown, the majority of students are neutral or balanced.

Based on these results, it is difficult to determine the pedagogical tools or ways to use in classrooms. So, even if we applied some techniques based on the majority distribution of the students, it would not have the effect desired, because a very high number of students are not clear about the way they prefer, or have tendency to change it with time.

Sequential

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-1	43	40.6	40.6	40.6
	0	37	34.9	34.9	75.5
	1	26	24.5	24.5	100.0
	Total	106	100.0	100.0	

Aktiv

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-1	27	25.5	25.5	25.5
	0	46	43.4	43.4	68.9
	1	33	31.1	31.1	100.0
	Total	106	100.0	100.0	

Sensing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-1	19	17.9	17.9	17.9
	0	58	54.7	54.7	72.6
	1	29	27.4	27.4	100.0
	Total	106	100.0	100.0	

Visual

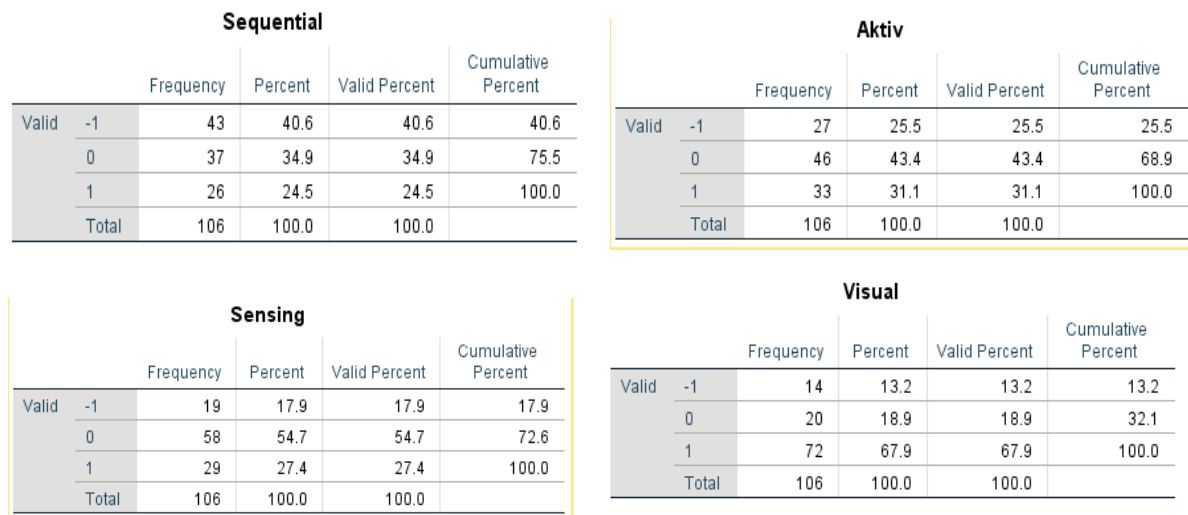|		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-1	14	13.2	13.2	13.2
	0	20	18.9	18.9	32.1
	1	72	67.9	67.9	100.0
	Total	106	100.0	100.0	

Fig 1. Results of questionnaire

We also analyzed results for each course. For the course: "Professional Master in Informatics", 70% of the students were visual learners, only 7 % of them were verbal and 23 % were balanced. 19.4% of them were active learners, 32.2% were reflective and 48.4% were balanced whereas for the sequential dimension 45% of them were balanced, 19% of them were sequential and 36% global. For the course: "Professional Master in Information Technology":

29% were sequential learners, 34% were global and 37% were balanced. 56% were visual, 24% were verbal learners and 20% were balanced. 32 % were sensing learners, 15 % intuitive and 53% were balanced. 41% were active learners, 15% were reflective and 44% were balanced. For the course: "Master of Science in Information Technology": most students were global learners (53%), whereas 23.5% were balanced and 23.5% sequential learners. Most of them were also visual learners, with 79.4 %, only 5.9% were verbal and 14.7% were balanced. They were very balanced for the sensing dimension: 26.5% sensing, 23.5% intuitive and 50% balanced. The same thing was for the active dimension with: 29.4% active, 32.4% reflective and 38.2% balanced.

Based on these results we can say that most of students are balanced in most dimensions. We can see clearly that there are more visual learners, in each course, so it would be good to include pedagogical ways to support them more, for example to include graphical presentations of lectures, real demonstrations or use presentation software. At Master of Science in Information Technology we can see that there are more global students, although the difference is very tight. For these students, the content must be written in big leaps, and almost randomly.

Although we can change some pedagogical tools to support students about the visual dimension, or we can change lectures contents to support global learners in the "Master of Science in Information Technology" course, for other dimensions we can see that most students are balanced, so we would need to use different techniques to meet their needs. This is very difficult in classrooms, because of the limited time and resources to support all their different styles. E-learning systems are a good tool to use in universities, in order to help students to better learn and understand courses materials. E-learning systems are widely used in universities, as a tool for teachers to deliver materials to students, to assign assignments or to discuss different topics with students. In our departments we do not use a single e-learning system, but different professors choose one of the open source e learning system such as Google Classroom and Piazza. Therefore, based also on these results, we propose to use an adaptive e-learning system, to adapt to the students learning style. In the future we will choose an open e-learning system and extend it in order to be able to adapt to the students learning styles.

CONCLUSIONS

In this paper we aim to discover the learning style of the graduate students in the Department of Informatics, Faculty of Natural Science. The result of the questionnaire that we used for this purpose are displayed and analyzed. We found that most students were visual learners, for other dimensions most students were balanced. We also analyzed results of learning styles for each course, and showed them. Previous studies reported in the above sections have demonstrated that learning styles are a very important factor in student's motivation and their performance. We therefore aim to design in the future an e-learning system that will adapt to student needs. One of the adaptations could be their learning style, so each student would learn in the style they perform better, increasing their motivation and helping them to have better grades.

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