

LEARNING STYLES METHODS FOR STUDENTS CLASSIFICATION

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Abstract: *In this paper we will discuss about learning styles methods student classification. The objective of this classification is to achieve a better adaptation of interfaces and classes in the order to create adaptive e-learning materials used by the Metropolitan University of Belgrade. Learning styles represent an individual's habitual way of organizing and processing information and habits of students for learning. Students can use this model to determine which learning style fits them personally. Implementing this mechanism can improve their experience in education by a wide margin, focusing on what benefits each individual student.*

Keywords: *e-learning, learning styles, student classification*

1. INTRODUCTION

Personalized learning is an imperative in the transformation of education. This form of learning can be explained as determination of student interests and possibility for offering opportunities for a progress of this interests. This form of learning is focused on the student and controlled by student himself.

In sum, to create a personal learning, it is required:

- *Get to know students very well.* If we want to personalize lesson for each student, it is necessary for us to know them well. To achieve this, teachers need to create bases which contain personal information about the students.
- *Adapt lessons.* The next step is to create personalised adaptive lessons.

The art of teaching is frequently defined as forming and couching of educational environment and experience of the person who teaches with the purpose of archiving and accomplish desirable result of learning. Thus, we can say that precondition for successful education is to familiarize process of learning and factors which facilitate or aggravate studying.

Each man is an individual. The fact is that people are not capable to accept new information in the same way, thus, there are tendencies to define styles of learning. That includes the description of attitude and behaviour which is

determined the way of studying which students have chosen. Technology plays an important role in personalized learning, but to create the technical base it is necessary to design mode of work. For purposes of BMU it is necessary to defined by classification of students based on the style of learning. The importance of the division of students according to style of work and studying is for achieving better adaptation of interface and lectures. The goal is to create high – quality and adaptive lessons.

There are controversies about the classification according to styles of learning. Pashler's research from 2008. [1] in which he had demonstrate that teaching whit applying appropriate style won't contribute for individual for better and easier acceptance of knowledge.

At site [2] as explanation about controversy of the learning styles we cite: "There is a very simple explanation why learning styles have no influence on effectiveness of learning. The most popular classification, according to learning styles, means individuals who prefer visual learning (V), the ones who prefer audio learning (A), the ones who learns by reading/writing (R) and the ones who prefer kinaesthetic learning (K – combination with previous styles). For example, learning to play guitar. Pupils can't learn to play guitar unless they take it in their hands and start to play (K), unless they listen how to play it in the proper way (A), unless they don't follow sheet music (R), and if they don't follow notes and watch photos which shows proper position of fingers during

playing. That means that the content which we learn is more complex than it looks like. Thus, any of this four styles of learning, is not enough for a good result. In much simpler examples, we can notice the same. Does priority for auditory style, the learning style by listening, means that person is not going to prepare properly for drivers license practice test, because they need visual identifying traffic signs? Information which are represent visually, must be adopt by visual way and after that, they must be identify than on the same way. According to this two examples, only, it is clear that to this idea about learning styles is missing basic validity. "

Studies of Coffield [3] and Pashler [2] unequivocally confirm not to resort using of styles of learning. Effectiveness of style of learning could be tested easily. In this purpose we can form two groups of students. Each of this group uses different style of studying (for example one group with visual study, the other kinaesthetic), and then each group should learn a new lesson, using style of learning from opposite group.

In spite of researches, many educational institutions, such as Barkly, Yale, UCLA and Harvard, classified their students based on this theory of students classification. According to research of this institutions, students had better and higher results if they studied by their own personalised style of learning. Also, there are many science papers which support classification of students by the style of learning and they will be shown in this paper.

In this paper, at the begging section of different styles of learning is going to be explained. After that, we are going to recommend style of learning which could be useful at BMU. The goal is to personalize and adapt our traditional and e-learning education. Afterwards, we are going to show the way of grouping students which is designed by the division and in the end the suggestion of adaptation of education program is going to be represented. The chosen way of studying is going to be applied on students volunteers in purpose of determining effectiveness of the style of learning. Effectiveness of style of learning is going to be tested in the following explanation: ten groups of students are going to be form for every faculty. Every group have two members. Every group is going to learn using different style of studying, and lecture is adapted for one of the group member. At the end we are going to match the results. For example: unless both of students from every groups are going to learn the same content with visual style, by the supposition that learning style are useful, and student which is disopset to visual style should achieve better results, and vice versa.

2. AN OVERVIEW OF LEARNING STYLES

While researching science works which consider learning styles, we realised that there are many divisions. Some classifications might not be suitable for purposes of BMU, some classifications are strictly oriented to certain sciences, others are general. Considering that different groups of students will be testing during research, it is neceserry that some general classification should be used.

Metropolitan University, except engineering Science at Faculty of Information, also has Economic Sciences at Faculty of Management, and Faculty of Digital Arts. Thus learning styles must be generalised. In this chapter well-known classifications of learning styles will be presented. Many classifications have similarities, to a certain extent.

The Myers-Briggs Type Indicator [4]

This model classifies students according to the theory of Psychological Types, created by Carl Jung [5].

- **extraverts** (trying out, focused on external world and other people) ili **introverts** (they think about problems solving, their focus is on internal world of ideas).
- **sensors** (practical, oriented on details, focused on facts and procedures) i **intuitors** (imaginative, oriented on concepts, focused on the possibilities and meanings).
- **thinkers** (skeptical, they making decisions based on logical rules) ili **feelers** (they prefere to make decisions based on personal and humanistic considerations)
- **judgers** (they follow agendas and terms, demand closure of projects with incomplete data) ili **perceivers** (adaptable to changing circumstances, postpone the closure of projects until they collect more data).

Classification itself gives 16 different learning styles. For example(extravert, sensor, thinker, perceiver), it could be ESTP or IIFJ(introvert, intuitor, feeler, judger).

Kolb's Learning Style Model [6]

This model classifies students according to:

- concrete experience or abstract conceptualization (how they take information in)
- active experimentation or reflective observation (how they internalize information),

There are four types of students in this classification:

- **Type 1** (concrete, reflective) Typical question for this type of students is „Why?“ Students in this group respond to how teaching material, in relation with their experience, their interests, can influenced their carrier. To be effective, their teacher should be acting as a motivator.
- **Type 2** (abstract, reflective) - Question that describes this group is „What?“ Students from type 2 reacting to given information which are logical and useful. They think about problem solving. To be effective, teacher should be acting as an expert.
- **Type 3** (abstract, active) - “How?“ is typical question which describes this type of students. (These students are fond of active work on good-defined tasks and they learn with trial-and-error method. Teacher should act as a coach, leading practice and providing information about success of students.

- **Type 4** (concrete, active) Question that describes this group is „What if?“ Students of this group like to solve real problems according to lectures. Teacher should give real problems with solutions in lectures, and to assign tasks of that type.

Herrmann Brain Dominance Instrument (HBDI) [7]

This method classifies students according to their ways of thinking with regard to brain function. Classification consists of:

- Quadrant A (left brain, cerebral). Logical, analytical, quantitative, factual, critical;
- Quadrant B (left brain, limbic). Sequential, organized, planned, detailed, structured;
- Quadrant C (right brain, limbic). Emotional, interpersonal, sensory, kinaesthetic, symbolic;
- Quadrant D (right brain, cerebral). Visual, holistic, innovative.

Most engineering instruction consequently focuses on left-brain Quadrant A analysis and Quadrant B methods and procedures associated with that analysis, neglecting important skills associated with quadrant C (teamwork, communications) and quadrant D (creative problem solving, systems thinking, synthesis, and design). This imbalance is a disservice to all students, but particularly to the 20-40% of entering engineering students with strong preferences for C and D quadrant thinking.

Felder and Silverman Model [8]

Firstly developed by Dr. Felder and dr. Lynda K. Silverman (educational psychologist), for students and teachers purposes in engineering and science, but today is widely used. Classification itself divides students in four groups, with the fact that each group additionally has two classifications.

Groups of students are:

- Active or reflective learners
- Sensing and intuitive learners
- Visual and verbal learners
- Sequential and global learners.

This model seemed appropriate, and it was using for student's questionnaire.

3. FELDER AND SILVERMAN LEARNING STYLES MODEL

Questionnaire and classification of students are based on Felder-Silverman model [8]. Precisely, after detailed studies of classifications, these authors presented this universal classification for students who are on different study programs. Other classifications can be applied only to certain groups, or applied incompletely. Regardless of intentions that classification should be universal because of testing students from a different colleges and universities, decision was that this model of testing should be used because it is suitable for purposes of BMU.

Active or reflective learners

Active learners have tendency to receive and keep info information during active work, discussion, or applying of knowledge. Reflective learners prefer to think about new information. Active learner's phrase is "Let's try it to see how it works", and Reflective learner's phrase is "Let's think about it". Going through lessons without any practical work is difficult for both learning types, especially for active learners. Each one of us is sometimes more active, sometimes more reflective. Therefore classifying is necessary. Balance between two types is most desirable. If you always go to action without thinking, you could find yourself in a problem, if you spend too much time thinking, perhaps you wouldn't do anything. If you are an active student in a class which allows little time for discussion or creating a strategy for solving problems, you could have problems during learning, because you try to guess a solution. Or you could forget some facts because you didn't have enough time to think about them. Anyway you will keep information more likely, if you try to do something with it. If you are reflective learner, you could help yourself if you don't waste too much time on it, anytime you gather new information. Goal is not only to read or to memorize information you don't have always to recall what have you read and which questions could emanate from new info. It is necessary to write notes with your own words. It will take more of your time, but at least you can keep new information for a long period of time.

Sensing and intuitive learners

Sensing learners favour facts, but intuitive learners prefer to discover relations and possibilities. Sensitive learners solve problems using well-known pattern, they avoid complications and surprises, while intuitive learners like innovations and do not like repetitions. More than intuitive learners, sensitive learners like to test material which is not presented at a class. They can be patient with details and laboratory work, they tend to be more practical; intuitive learners are better with innovations, they work faster and tend to be more innovative than sensitive learners. Everybody can sometime be more sensing or more intuitive. Effective learners and problem solvers are able to function both ways. If the information is connected to the real world, sensitive learners can easy remember and understand it. They may have difficulties if material is abstract and theoretical. They should ask their instructor for examples of concepts or try to find some in other references or during discussions with their classmates. Intuitive learners may have problems with memorization and repetition because they are impatient with details, therefore their instructors must always link theories and facts.

Visual and verbal learners

Most people are visual learners, they learn best through what they see, pictures, films, flow charts, practical demonstrations, etc. Verbal learners learn best while reading written and spoken explanations.

Everyone can learn more if information is presented both visually and verbally.

Visual learners should always find or make some diagrams, schematics, or any visual representation if material is predominantly verbal.

Verbal learners should write materials in their own words or to work in groups.

Sequential and global learners

Sequential learners learn in linear steps, through pattern in which each step emanate from the previous one in a logical way. Global learners absorb learning material randomly, without seeing connections, until they finally learn it. Sequential learners may not understand material completely, but they can almost always do something with it, because the pieces they have absorbed have logical connections. Global learners are able to solve complex problems quickly, but they may have difficulties to explain how they did it. Most of college courses are written in a sequential manner. Sequential learners could strengthen their global thinking skills if they relate new topics to the facts they already know. Global learners should realize that they need the big picture of a subject before they master details. New topics must be somehow related to familiar topics.

4. TESTING RESULTS

Students of BMU from Faculty of Information Technology and students University of Nis, Faculty of Medicine, took a part in this research. 40 students in total were included: 20 students from Faculty of Information technology from BMU (from Belgrade and Niš) and 20 students from University of Nis, Faculty of Medicine. To compare results, the same learning material will be given to students of similar educational profiles from Faculty of Medicine and from Faculty of Information technology.

Review of testing students from Faculty of Information Technology

To determinate his learning style, it is necessary that each student fulfill the questionnaire. This questionnaire is created by author of classification itself, and it can be found on website of NC State University. [9]

As we can see, questionnaire includes 44 questions. For each of the 44 questions below, they must select either "a" or "b" to indicate their answer. They must choose only one answer for each question. If both "a" and "b" seem to apply to them, they must choose the one that applies more frequently. Students answers should be gathered and scaled from 11 to 1 and from 1 to 11. If your result is between 1 and 3, you are well balanced on both dimensions of this if it is between 5 and 7, you have the advantage of one dimension of these scale, and you will easily learn in teaching environment which favored this dimension, if your result on scale is between 9 and 11, one dimension of the scale is favoured.. Overview of students scaling is presented in image 1.

Results are as follows:

- ACTIVE / REFLECTIVE - neutral,
- SENSING / INTUITIVE - weakly sensing,
- VISUAL / VEBAL - weakly visual,
- SEQUENTIAL / GLOBAL - weakly sequential

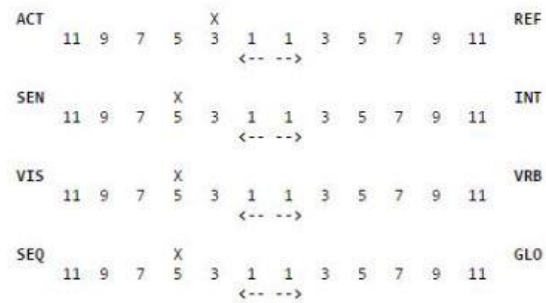


Image 1: Result - Scaling in the Felder-Silverman principle of classification

Put differently, student doesn't matter if he is working active or reflective, he adapts to it depending on situation. Results also prove that student is weakly sensing, which means that he prefer lectures with facts, clear methods, but if there are no facts, he will not have problem to check new possibilities for solving problems. Due to fact that student is weakly visual, it means that he can learn better by watching videos, diagrams, images. And he wouldn't have problem sometimes to learn without visual effects. In result where student is weakly sequential, we can say that he prefer learning in logical steps in which material in each step is more logic than in a previous one. This student can sometimes learn material "randomly". Presented student is a student of Software Engineering. Considering that goal is to adapt lectures connected to scientific areas represented on BMU, it is necessary to adapt lectures to student, according the result.

Lecture adapted to this student is:

- Lecture which can consist practical tasks inside of lesson, but doesn't have to
- Most part of lecture will be based on facts and presentations of possible solutions, and only one part will have types of tasks which solutions are not given in lecture. This is to force student to find solutions in similar situations (because he is weakly sensing).
- Lecture will comprise videos and diagrams because that is more appropriate to student
- Lecture will consist of linear steps and gradually learning (from intro to complex facts)

Subject chosen for lecture is from basis Ruby on Rails, because students on BMU haven't met this material yet. Student chosen to visit the same lecture is also Software Engineering student who has total opposite results on Felder-Silverman test:

- ACTIVE / REFLECTIVE - strongly reflective
- SENSING / INTUITIVE - weakly intuitive
- VISUAL / VEBAL - neutral,

- SEQUENTIAL / GLOBAL - weakly global

To create adaptive lessons, we used:

- Book - Learning Rails [10]
- Video - Ruby on Rails Tutorial [11]

Combination of book and video material, and tutorial for adoptive style learning, lectures were made with different content, which have for basis introduction in Ruby-programming. Time interval for this material was equal to 3 school-classes. After that, a test was given. The test given to students after lecture, can be seen on the following link [12]. Maximal result on test was 100 points. Student, after whom the lectures were adapted has result of 87 points, while student after whom lectures were not quite adapted has 74 points. According this principle, 10 groups were created, and each consist of a pair of students. None of chosen students has ever before met this lecturing material. This is related to students of Informational Technologies. It is important to say that all of chosen students has average marks over 8.5, which means that students of the same level were tested. They are all students on the 2nd and 3rd year basic studies Faculty of Information Technologies.

Students of Information Technology on BMU testing results

8 of 10 pairs that consist of a students to whom lectures were adapted, were with a better results.. Student I in each group is the student, at whose profile lectures is adapted. Results marked with star presents the deviation from expected - students with adapted lectures had poorly results, but students in group III have similar profiles so deviation is not unexpected.

This is the chart with abbreviations:

n-neutral, w - weakly, s - strongly, a - active, r - reflective, s - sensing, vi - visual, ve - verbal, s-sequential, g-global.

To get more representative results, it is desirable to create more groups and make another tests where, for example, groups will consist of more than two of students. . Because only 2 of 10 groups had unexpected results, conclusion is that student of Information Technologies to whom lectures are adapted, can make better results on control examinations.

Group	I	II	III	IV	V	VI	VII	VIII	IX	X
Student I	ACT/REF SEN/INT TW.S VIS/VRB FW.VI SEQ/GLO TW.S	ACT/REF SEN/INT TW.S VIS/VRB FW.VI SEQ/GLO TW.S	ACT/REF=s SEN/INT=f W.S VIS/VRB=n SEQ/GLO=s	ACT/REF=n SEN/INT=w W.S VIS/VRB=n SEQ/GLO=w.g	ACT/REF SEN/INT TW.S VIS/VRB FW.VI SEQ/GLO TW.S	ACT/REF SEN/INT TW.S VIS/VRB FW.VI SEQ/GLO TW.S	ACT/REF= w.f SEN/INT= n W.S VIS/VRB= vt SEQ/GLO= s.g	ACT/REF SEN/INT TW.S VIS/VRB FW.VI SEQ/GLO TW.S	ACT/REF SEN/INT TW.S VIS/VRB FW.VI SEQ/GLO TW.S	ACT/REF SEN/INT TW.S VIS/VRB FW.VI SEQ/GLO TW.S
Student II	ACT/REF SEN/INT TW.S VIS/VRB FW.VI SEQ/GLO TW.S	ACT/REF SEN/INT TW.S VIS/VRB FW.VI SEQ/GLO TW.S	ACT/REF=s SEN/INT=f W.S VIS/VRB=n SEQ/GLO=s	ACT/REF=n SEN/INT=w W.S VIS/VRB=n SEQ/GLO=w.g	ACT/REF SEN/INT TW.S VIS/VRB FW.VI SEQ/GLO TW.S	ACT/REF SEN/INT TW.S VIS/VRB FW.VI SEQ/GLO TW.S	ACT/REF= w.r SEN/INT= n W.S VIS/VRB= j SEQ/GLO= s.g	ACT/REF SEN/INT TW.S VIS/VRB FW.VI SEQ/GLO TW.S	ACT/REF SEN/INT TW.S VIS/VRB FW.VI SEQ/GLO TW.S	ACT/REF SEN/INT TW.S VIS/VRB FW.VI SEQ/GLO TW.S
Result	87/74	77/70	73/79 (*)	88/75	79/76	90/77	85/89 (*)	77/72	77/73	86/74

Image 2: Table of results for tested BMU students

Testing presentation of Students of Medical College, University of Nis

During their education, Medical students have pre-clinical and clinical subjects. Teaching on Medical College consists of lectures, interactive seminars, and practical exercises. According to complexity and volume of lecturing material, creating of adaptive material is not applicable to all subjects. It is necessary to carefully choose a subject on which adaptation of lecturing unit will be made. Based on the content of lecturing subjects, we have concluded that is possible to apply adaptive learning on pre-clinical subjects, while in clinical subjects which demand interactive approach and contact with patients during practical work, it is feasible with limitations and deficiencies.

We chose for lecturing unit “Disorders in body fluids and hemodynamic” on College subject Pathology. Pathology is subject on 3rd year of Medical College, and volunteering group of students included in this research are students on 2nd year of Medical College This group of students shouldn’t have problem with terminology during lessons, and also they have never before heard or read this lecturing unit. 20 volunteering students divided in 10 groups were tested. As BMU students, these students also have average marks over 8.5, which means that these two categories of students are similar. Time interval for this material was equal to 3 school-classes. After lecturing, students solved questions which related to topic.

Former students who had this subject during education on Medical College were included in realisation of lecturing and thereafter creating test-questions.

To create lectures and tests, the following material was used:

- 1.) Books: Pathology, 4th edition [13], General Pathology[14]
- 2.) Videos about oedema [15], dehydration, hyperthermia, Congestion, Deep Vein Thrombosis, Pulmonary embolism [16]...

Medical College students testing results

Testing results are presented in the same way as the testing results of BMU students. Unlike previous testing, 6 of 10 groups have expected results, as it were, students with adaptive lectures have better results. 4 groups have opposite results, and students with adapted lectures were better on testing. Results are presented on Image 3. Forasmuch that the Medical College student has different learning habits than student of Engineering Science, results are not unexpected.

Conclusion is that learning styles are not very helpful to Medical College students.

Group	I	II	III	IV	V	VI	VII	VIII	IX	X	
Student	ACT/REF =w.a SEN/INT =s.f VIS/VRB =n.l SEQ/GLO =n.s	ACT/REF =s.f SEN/INT =s.l VIS/VRB =n.l SEQ/GLO =n.s	ACT/REF= s.b SEN/INT= n VIS/VRB= n SEQ/GLO= s	ACT/REF= w.b SEN/INT= n VIS/VRB= w.vi SEQ/GLO= s.g	ACT/REF= n SEN/INT= w.s VIS/VRB= s.vi SEQ/GLO= n.g	ACT/REF= s.b SEN/INT= n VIS/VRB= s.vi SEQ/GLO= n.g	ACT/REF= s.f SEN/INT= n VIS/VRB= s.vi SEQ/GLO= n.g	ACT/REF= s.b SEN/INT= n VIS/VRB= s.vi SEQ/GLO= n.g	ACT/REF= s.l SEN/INT= n VIS/VRB= s.vi SEQ/GLO= n.g	ACT/REF= n SEN/INT= n VIS/VRB= s.vi SEQ/GLO= n.g	ACT/REF= n SEN/INT= n VIS/VRB= s.vi SEQ/GLO= n.g
Result	71/74 (*)	82/79	80/82 (*)	86/75	89/76	90/87	72/89 (*)	77/72	77/81 (*)	76/80 (*)	

Image 3: Table of results for tested Medicine students

5. CONCLUSION

Some students tend to focus on fact, data and algorithms; others are more comfortable with theories and mathematical models. Some respond strongly to visual forms of information, like pictures, diagrams and schematics; others get more from verbal forms written and spoken explanations. Some prefer to learn actively and interactively, others functions more introspectively and individually. However, a prosperous student, scientist, or engineer, requires good resourcefulness in every learning style: they have to be methodological, thoughtful, innovative, curious and must be good interpreters. Also they have to develop visual and verbal skills. Information routinely comes in both forms, and much of it will be lost to someone who cannot function well in both of these modes.

If professors teach exclusively in a manner that favors their students' less preferred learning style modes, the students' discomfort level may be great enough to interfere with their learning. On the other hand, if professors teach exclusively in their students' preferred modes, the students may not develop the mental dexterity they need to reach their potential for achievement in school and as professionals.

In this paper it is shown that the success of using learning styles is primarily in the choosing of aim of research. Some fields of science are more suitable and easier for adaptation to learning style, and some of them are not. In this paper it is shown that at BMU, on Faculty of Informational technology, technology and classification can advance learning. Also, testing showed that learning styles are not adequate division for students of medicine, because there is no progress in learning. Except that, after testing students we got lower scores and lower connection successfulness of test with the adaptation by the style of learning. Of course, we suggest that it is necessary to test more students in purpose of getting exact results.

Our research has shown that it is only a question to what extent and on which university or school, this model of classification can be useful, because some field of science are not suitable for applying classification of students based on the styles of learning.

We can say that models that have been used effectively in engineering education.

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