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Learning styles of students of different professions

Biljana Kuzmanović[1], Marija Blagojević[1] and Momčilo Vujičić[1]
[1] Faculty of Technical Sciences Čačak, University of Kragujevac, Serbia
e-mail biljana.kuzmanovic@ftn.kg.ac.rs , marija.blagojevic@ftn.kg.ac.rs, momcilo.vujicic@ftn.kg.ac.rs

Abstract: *The teaching process in higher education, in addition to teaching requires careful planning because of the specificity of different study programs, also requires consideration of personal characteristics of students, such as learning styles. The aim of this paper is to investigate the differences in preferred learning styles between students of integrated academic studies of Techniques and Informatics (TI) and the undergraduate academic studies of Information technology (IT) where Kolb's model of learning styles has been used. The sample consisted of 51 students. The research results showed that there are differences in the preferred learning styles between these two directions, and also that the majority of students prefer a convergent learning style.*

Keywords: *Kolb's model of learning styles, organization of teaching, learning styles of students*

1. INTRODUCTION

When talking about the teaching and learning process in higher education, numerous questions are set concerning the planning and organization of teaching, especially because of the specificity and diversity of educational profiles. Also, abilities of students, previously completed school, pre-existing knowledge and skills, affinities, technical possibilities of teaching and learning styles can be taken into account as well as personal characteristics of students.

Learning styles which are defined as individual preferences of the ways in which an individual collects, processes, interprets, organizes and analyzes information (Kharb, Samanta, Jindal & Singh, 2013) or the ways in which an individual concentrates on some content, efficiently and effectively perceives information (Slater, Lujan & DiCarlo, 2007), and processes, internalizes and remembers new academic skills and knowledge (Csapo & Hayen, 2006), may have a significant impact on the process of teaching practice but also student activities and learning outside it.

2. LEARNING STYLES

Different authors emphasize different aspects of learning styles in which definitions with a focus on preferred sensory modalities are allocated (visual, auditory, kinesthetic... etc.), then the definitions of styles as personal characteristics that affect the behavioral patterns in situations of learning, as well as the definitions which primary focus on cognitive

processing (Smith & Renzulli, 1982). Some authors observe learning styles in a broader context, taking into account the cognitive (the way of perceiving and processing information), affective (attention, emotion and evaluation) and physiological aspect (fatigue, habits, daily rhythm of activity ...) (Keefe, 1987, according to Leite, Svinicki & Shi, 2010), which are important indicators of how an individual will perceive and react to the learning environment (Keefe, 1991, according to Wang, Wang, Wang & Huang, 2006).

In the literature, the following models of learning styles are commonly distinguished: MB model (Chaterine Briggs & Isabele Myers, according to Bjekić and Dunjić-Mandić, 2007) which determines learning styles on dimensions of extraversion-introversion, sensitivity-intuitiveness, thinking-emotions, trial-observation; Fielder-Silermanov model (Felder & Silverman, 1988), which classifies styles on dimensions of learning sensitive-intuitive, visual-verbal, inductive-deductive, active-reflective, sequential-global learning and Kolb's model (Bjekić and Dunjić-Mandić, 2007).

Kolb's definition of learning describes learning as a process where knowledge is built up through the transformations of experience through the personal and social knowlege (Kolb & Kolb, 2005a; Coffield, Moseley, Hall & Ecclestone, 2004). Kolb suggests four-phase hypothetical circle of learning, where learning is seen as a continuous, interactive process because an individual durnig learning goes through all four phases (Cassidy, 2004). Four stages of the experiential learning model is described as a concrete experience (CE – experiencing), abstract conceptualization (AC – thinking) if an individual prefers conceptual and analytical thinking in order to understand, active experimentation (AE – doing) which includes learning using attempts and error and reflective observation (RO – reflecting) which includes paying attention to the task and consideration of potential solution before the attempt of solving (Figure 1). The concept of learning styles Kolb describes as individual differences in learning that are based on the preferences of an individual to the different stages of learning.

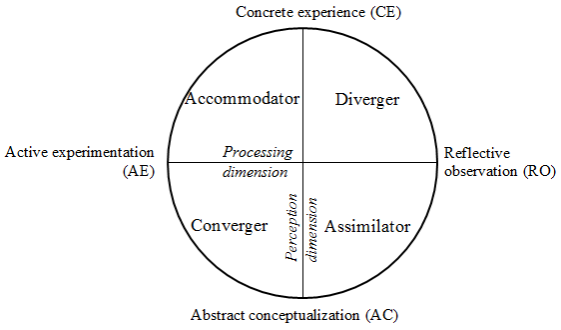

Figure 1. *Display of four-phase circle of learning (Bjekić and Dunjić-Mandić, 2007)*

All four learning styles are described by Kolb in two dimensions (Bjekić and Dunjić-Mandić, 2007; Rayner, 2015): processing dimension (horizontal dimension) that includes a reflective observation and active experimentation (RO-AE) and dimension of perception (vertical dimension), which defines the source of information or dimension of concrete experience - abstract conceptualization (CE-AC). According to this model there are four learning styles that are defined by preferred stages of learning (Kolb & Kolb, 2005a; Wang et al., 2006; Coffield, Moseley, Hall & Ecclestone, 2004; Cassidy, 2004; Hawk & Shas, 2007): divergent style, convergent style, assimilation and accommodation.

Individuals with divergent style (reflective thinker) prefer CE pole of dimension AC-RO, and RO pole of dimension AE-RO. This style is characteristic of individuals who are the best in observing the concrete situation from different points of view; who have the ability to generate a large number of ideas, have a tendency for imagination and emotionality, prefer to work in groups, they are openminded for different points of view and receiving of feedback; they require consideration of learning objectives at the beginning; they work harder under time pressure; they are considered to be very creative because they have the ability to solve problems in different ways.

Individuals with assimilatory style of learning (theorist) prefer AC pole of dimension AC-RE, and RO pole of dimension AE-RO. Individuals with this learning style are the best in the understanding of wide rank of information and their organization into logical form; they are less focused on people and more interested in ideas and abstract concepts; they are prone to analysis, separation of elements and determination of relationships; prefer theories, models and systems; faster devise content on the logical speculative level than in practical application; they are more inclined to scientific disciplines and mathematics.

Individuals with convergent learning style (ractitioner/pragmatist) prefer AC pole of dimension AC-CE, and AE pole of dimension AE-RO. This learning style is characterized by the application of certain theories and ideas in practice. For the practitioners, the best are tasks that require problem solving; they have a tendency to hypothetical-deductive reasoning and experimentation; they prefer solving of technical problems rather than social and interpersonal.

Individuals with accommodative learning styles (activist) prefer CE pole of dimension AC-CE, and AE pole of dimension AE-RO. Individuals with this learning style prefer learn from concrete experience; they are prone to accommodating, ie. adapting their behavior to a new experience, practical activities and slower devise the content on the logical plan; they learn using attempts and error; they prefer to use ready-made information than to analyze.

In his research, Kolb has proved that professions and choice of study largely determines the preferred learning style (Kolb, 1981; Kolb & Kolb, 2005). The research results, using the LSI scale (Learning Style Inventory) showed the following:

- Accommodative learning style prefer individuals educating for business, education;
- Individuals with convergent learning style study medicine and engineering, technology;
- Individuals with divergent style are represented in the following areas: history, psychology, English, political science, art;
- Assimilative learning style have students who are educated in the fields of economics, foreign languages, mathematics, sociology, chemistry, physics.

Kolb's research has shown that female gender prefers specific activities in contrast to men, who are more inclined to abstraction (Kolb 1976b, 1985b, according to Kolb & Kolb, 2005), and also that individualss with ages increase the level of abstract learning.

2.1. Possibilities of Adaptation of Teaching to Student Learning Styles

As already stated, the appreciation of students' learning styles requires a serious approach to the planning of activities within each subject taking into account the characteristics of the study program and the profession for which the students are trained. Accordingly, Kolb et al (according to Hawk & Shah, 2007) connect learning styles with learning activities in which they propose the following activities for all four poles of two dimensions:

- concrete experience: dealing with the problems reading, simulations, laboratories, observation, practical work...
- reflexive observation: puzzles, brainstorming, discussions, personal magazines...
- abstract conceptualization: lectures, papers, analogies, texts reading, projects, models of creation, model of criticism...
- active experimentation: labs, case studies, homework, projects, practical work...

Other authors (Bjekić, 2007a) who were engaged in organization of teaching practice, taking into account learning styles propose similar activities emphasizing desirable forms of learning and ways of checking the achievement for all styles separately:

- converger should learn all forms of practical learning, while checking the outcomes must be realized on practical examples, implementation and analysis of application;
- diverger should learn through discovering, while checking should be based on issues / tasks about cause-and-effect relations, generating new ideas;
- asimilator should learn through meaningful verbal receptive learning, reading, while checking should be organized as an interpretation of the theory and generalization;
- accomodator should learn by solving problems, while it should apply the same method of checking the achievement.

3. ORGANIZATION OF RESEARCH

Research question: whether there are differences in preferred learning styles according to Kolb's model, depending on the orientation of the students?

Subject of research is the difference in the preferred learning styles of the students of different orientations.

Aim of Research: To determine differences in the preferred learning styles between the students of integrated studies of Techniques and Informatics (future teachers), and basic studies of Information technology (future engineers).

Research variables: dependent - learning styles according to Kolb's model - converger, diverger, assimilator and accomodator and independent - study program: Techniques and Information (TI) and Information Technology (IT).

Hypothesis: There are differences in the preferred learning styles between students of Techniques and Informatics and Information Technology.

For research purposes, a non-experimental method was applied, and the data were collected using the Kolb learning style inventory (Kolb's Learning Style Inventory - LSI3) in electronic form. Inventory includes 12 particles for 4 dimensions (concrete experience, reflective observation, abstract conceptualization and active experimentation) that determine learning styles.

For data processing SPSS statistical software was used. Descriptive statistics was used for determining the degree of severity of certain variables, while comparing statistics was used for determining the differences in learning styles between groups, that is. ANOVA.

The sample consisted of 51 students of the Faculty of Technical Sciences in Čačak, of which 20 students are attending a study program of Information Technology, and the remaining 31 are students of integrated academic studies of Techniques and Informatics. The research was conducted in March and April 2016.

3.1. Research findings and discussion

The research results did not confirm the hypothesis that there are differences in the preferred learning styles among students, future professors of Techniques and Informatics and future engineers of Information technologies.

When taken into account both study programs together (Figure 2), it was obtained the highest percentage of the students who prefer convergent learning style (56,9%). The number of simulator is expressed in a significantly lower percentage (23.5%), while the divergent learning style is the least represented.

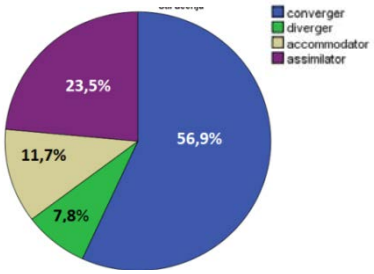

***Figure 2**. Percentage of representation of learning styles*

The following table shows the representation of individual learning styles in both directions (Table 1).

***Table** 1. Frequency of learning styles in the study programs TI and IT*

SP	Frequency	N	Converger	N	Diverger	N	Accomodator	N	Assimilator	N
TI	60,8%	31	58%	18	6,5%	2	12,67%	4	22,6%	7
IT	39,2%	20	55%	11	10%	2	10%	2	23,5%	5

Statistically significant differences were not found by comparing students according to preferred learning styles depending on the study programs which they attend.

The results of this study are not in accordance with other research conducted with future professors of Techniques and Informatics. The studies that have dealt with similar issues (Marentič-Požarnik, 1995, Bjekić, 2006, according to Bjekić and Dunjić-Mandić, 2007) showed differences between members of different professions, but also between persons the same professional orientation prior to the completion of studies and during professional engagement. Students of pedagogy prefer divergent style, while graduated pedagogues have accommodative learning style; and students of Techniques and Informatics prefer divergent learning style, but mixed style is the most common (which can be attributed to the multidisciplinary nature of the study program); students of mathematics are prone to the convergent learning style, while professors of mathematics prefer assimilative learning style. The same survey conducted among high school students showed significant differences in the dominant styles between students of socio-linguistic direction and natural-mathematical direction (Bjekić and Dunjić-Mandić, 2007). Research (Bjekić, 2007b) which did not dealt only with the preferred learning styles of students of Techniques and Informatics, but also with connection of represented styles with their achievement in the subjects of Psychology and Pedagogy, and also with overall average mark (which did not include two subjects dealt with), also showed that students prefer this direction divergent learning style, and that these students have achieved better end results in the

Pedagogy. The results of the same research showed that students of mixed learning style have higher achievements compared to students who prefer individual styles.

Other research has shown (Dille & Mezack, 1991, according to Diaz & Cartnal, 1999) that less successful students prefered more concrete experience, and that the majority of students possessed accommodative learning style (Wang et al., 2006).

The similarity in preferred learning styles between students of Techniques and Informatics and Information Technology can be explained, regardless they are students of TI teaching education, by the similarities of the two study programmes, because both are focused on information content during the study.

Of course, these two preferred learning style has its advantages when it comes to the teaching of information technology: the possibility of logical thinking at assimilates, ie. possibility of abstract thinking and problem solving in teaching of programming work on practical tasks in groups allowing the realization of projects, for example software design, implementation of practical solutions, tendency towards experimentation and solving technical problems which are actually common in the field of informatics and computing.

However, we should not neglect the students who have the assimilative learning style, which is represented in slightly less than a quarter of students in both study programs, which is not a small percentage.

4. CONCLUSION

It can be concluded that there are visible changes in learning styles between students of the same direction but different generations. It is necessary for a teacher to continuously monitors and gets to know his students in order to successfully organize education. Learning styles, to a large extent can contribute to the efficiency and effectiveness of teaching.

The research results showed a discrepancy in comparison to other similar studies conducted. Differences between students - future professors of Techniques and Informatics and future information technology engineers are not shown even though the previously conducted studies have shown differences in preferred styles from different professions.

So, students at both study programs prefer convergent learning style which is not optimistic result to be taken into consideration when it comes to the teaching process because of the limitations of teaching activities which help students to learn the easiest way. The representation of this learning style is about the lack of creativitybut also the independence of students in finding original solutions. This is particularly devastating for students of teaching orientation by the fact that the work in teaching requires a high degree of flexibility, imagination and creative way of thinking. However, a number of students with assimilative learning style is not small, reflecting the presence of two completely different approaches to learning, ie. the most distinguished are learning through practical activities (converger) on the one hand and learning through adoption and analysis of theoretical and logical based content (asimilators) on the other side.

Both mentioned study programs, given the multi and interdisciplinary, which are characterized by (especially TI) allow the implementation of different activities in the teaching process. For IT students but also for TI students laboratory exercises, problem solving, tasks (eg. in teaching for TI students), lectures, studies of cases, projects and so on as applicable, which would be in accordance with the represented learning styles also with an incentive for development of other styles.

However, as applications for further research it can be used checking of learning styles of the same current students after graduation and after a few years of work experience in the profession considering the fact that the learning styles are changeable category due to the acquisition of different experience.

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