

SELECTED LEARNING STYLES AND COGNITIVE STYLES IN FURTHER PROFESSIONAL EDUCATION UNDER CONDITIONS OF DIGITALISATION OF THE ECONOMY

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Abstract:

The digitalisation of the economy requires the development of educational activities with focus on knowledge and skills that support innovation in ICTs. The aim of this paper is to identify the type of further education participant based on Fleming's learning styles (VARK learning styles), and to characterise the achievement of set educational goals in the development of ICT knowledge and skills, broken down into cognitive, psychomotor, and affective educational goals in further professional education, and to focus on the applicability of some learning and teaching styles in continuing professional education. The focus of analysis is on two higher education fields of study, namely Social, economic and legal sciences (6213 – Economics and Management) and Education (7605 – Teacher Training and Educational Sciences), pursued by learners who are economically active in sections P – Education of the Statistical classification of economic

activities SK NACE Rev. 2, 2007. Basic concepts and selected learning and cognitive styles are explained in the theoretical part of the research paper. Results of the questionnaire survey carried out from April to June 2025 and distributed in person or online are presented in the paper. Replies of 200 respondents from three countries (the Slovak Republic, the Czech Republic and the Hellenic Republic) were processed prevalently by means of statistical methods and then verbally interpreted. The Jamovi, Version 2.3.26 statistical software and MS Excel were used for data processing. To analyse data frequency tables, contingency tables, descriptive statistics, and correlation coefficients were applied. Results of analysis show that most participants belong to visual types. Respondents' replies indicate the learning style models are mainly applied in the field of study Teacher Training and Educational Sciences. Kolb's model is applied in the field of study 6213. When verifying correlation dependences, the relationship between the fulfilment of cognitive goals of education the visual participant type was corroborated as well as in the achievement of psychomotor goals of education and the reading/writing participant type. The research paper is written in accordance with the aims of the primary research project VEGA No. 1/0198/25 "Emergence, development and sustainability of innovative enterprises".

Keywords: Cognitive style, learning style (LS), model of learning style, employee education, further professional education

Introduction

Apart from the content aspect, the process of education includes various approaches and mechanisms, which support the acquisition of employees' knowledge and skills, affect their behaviour and this way contribute to an overall performance of human resources in organizations. Researches indicate that the application of learning and cognitive styles can be useful in education and applied both in formal as well as in further professional education in organizations. Of particular importance are the education and training activities focused on the development of creativity, teamworking and innovation skills, based on critical thinking, as well as the employee training supporting digital skills (Sheehan et al., 2014; Tan et al., 2023).

The aim of further education is to continuously develop and improve both the content and process aspects of education. In this paper, we focus on the implementation aspect of education, where the dynamic element of education lies in applying selected learning and cognitive styles. In our opinion, these styles

serve to improve the education process and facilitate the acquisition of knowledge and skills. There are several types of learners (in terms of VAK, VARK, and others). Our analyses are based on Fleming's VARK model. (Fleming, 2001). We explore whether other selected learning and cognitive styles characterized by the theory are also used in the practice of further education. We analysed the applicability of learning style models from the perspective of graduates in social, economic, and legal sciences (6213 – Economics and Management) and education (7605 – Teaching and Educational Sciences). The aim of the paper is to identify the type of further education participant based on Fleming's learning styles (VARK learning styles) and to describe the fulfilment of the set educational aims in the development of information and communication knowledge and skills, broken down into cognitive, psychomotor, and affective educational aims in further professional education, as well as to deal with the applicability of some learning and teaching styles in further professional education.

Learning style (LS) is the manner in which each learner starts to concentrate on new and complex information, processes them, absorbs and stores them in memory (Keefe, 1988; Dunn, 1990; Alabi, 2024). The interaction of these elements varies with each learner; for this reason, it is necessary to determine what it is that with the highest possible probability triggers the concentration of each student, how to maintain it and how to respond to the learner's natural style of processing information, in order to store the information in long-term memory and retain the content. There are several learner types specified on the basis of learning style (VAK, VARK models and others). The starting point of our analyses was Fleming's VARK model (visual, auditory, reading/writing, and kinesthetic learning styles). We were interested if and to what extent theoretical models of learning are applied in further professional education. (Fleming, 2001; Cherry, 2023; Keefe, 1988). The applicability of learning models was analysed in terms of fields of study. Aims of the research paper are formulated in accordance with the objectives of the primary research project VEGA No. 1/0198/25 "Emergence, development and sustainability of innovative enterprises".

DESCRIPTION OF LEARNER TYPES AND LEARNING MODELS

For the needs of empirical analyses, we apply the classification of learners according to sensory preferences, developed by Fleming and marked by the abbreviation VARK (Fleming, 2001), which represents the first letters of four English words: Visual, Aural, Read/Write (verbal), and Kinesthetic (movement). Subcategories of this classification include: visual–nonverbal (visual-image)

learning style, visual-verbal (visual-verbal) learning style, auditory (aural) learning style, and kinesthetic learning style.

Learners with the visual-nonverbal learning style prefer sight when learning. Their preferred learning aids usually include pictures, diagrams, graphs, maps, photographs, films, or various symbols. These learners like richly illustrated and structured texts and even create diagrams and concept maps themselves and use them to explain concepts or ideas. They tend to highlight important parts of the text they study in colour and graphics (arrows, blocks, or circles).

Visual-verbal learning style learners prefer working with written text when learning. They can store verbatim in their memory what they have read and then precisely present the content. Having recorded in writing what they have heard they can work independently. These learners have a well-developed abstract thinking. The teacher can support these learners with worksheets and various sources of supplementary study materials. (University of Pennsylvania, 2009).

Auditory learning style is preferred by learners who learn best by listening and verbal communication and discussions; therefore, they enjoy working in groups. These learners remember what they have heard and repeat the material aloud while learning. They have a musical ear as well as the talent and prerequisites to successfully learn foreign languages. While learning, they are not distracted by background sounds; on the contrary, music supports their learning processes.

Kinesthetic learning style is preferred by learners with a need for physical activity. When learning, these learners enjoy moving around; they cannot sit still for a long time and like to learn while walking and often need a break for a short movement rhythmic exercise, and only then can they continue learning. They enjoy learning by doing and like laboratory work, practical exercises, field trips, role play, or project learning. When working with this type of learners, lecturers/instructors should consistently apply the didactic principle of connecting theory and practice. (Fleming, 2001; Keefe, 1988; Dunn, 1990)

The issue of learning styles has been addressed by numerous authors who present their opinions and research results in comprehensive theories (models). To reveal these natural learners' preferences and learning styles, it is important to use a comprehensive learning style model that identifies each individual's strengths and preferences across the spectrum of physiological, sociological, psychological, emotional, and environmental elements. In this research study selected learning styles are explored in the following structure:

- The Curry Onion Model contains four layers: instruction preference, social interaction, information processing, and cognitive personality style;

- The Riding's and Cheema's model is based on two dimensions:
 - a) organizing information: wholist – analytic dimension
 - b) representation of information: verbalizer – imager dimension (with focus on verbal expression, speaking versus presenting information by means of pictures, graphs or diagrams);
- The Rayner and Riding's model of cognitive styles focus on learning, personality and cognition and contains two dimensions, namely wholistic versus analytical and verbal versus imagery. The first one deals with the issue if individuals tend to process information in a holistic way or on the basis of analysis. The second one focuses on the way information is processed by individuals based on verbal stimulus or imagery. The two dimensions are not contingent. (Hattie, 2025; Rayner, 2015)
- The Myers and Briggs model is focused on the influence of personality types on learning styles. This model consists of processes (perception and processing of information); preferences (situations in which learning takes place, e.g., lightening, temperature, and social interaction); and cognitive skills (application of cognition models to learning environment).
- The Kolb Experiential Learning Model contains four cycles: concrete experience, reflective observation, abstract conceptualisation, and active experimenting) (Farid, & Abbasi, 2014; Faisal, 2019).

Thus, educational psychology students and teacher trainees learn that students have specific learning styles, and believe these styles should be in harmony with methods of instruction. (Rogowsky, et al., 2015). Some of the most popular learning styles schemas include Dunn's Learning Styles Model (Dunn, 1990) and Kolb's (1984) Learning Styles Inventory (Paschler et al., 2008). Kolb's (1984) learning styles inventory is popular especially in the United States. Its author claims that the learning processes of individuals differ in two dimensions, namely in the preferred ways of perception (concrete to abstract) and in information processing (active experimentation vs reflective observation). In Kolb's inventory, individuals are classified into four types: divergers (concrete, reflective), assimilators (abstract, reflective), convergers (abstract, active), and accommodators (concrete, active) (Pashler et al., 2008).

Learning style theories are applied in LS inventories, and these can be used in the world of commerce. For example, Hay Group distributed teaching materials based on LS theory as well as an information brochure (2008), the title of which says that people learn in various ways, thus a single learning style cannot be suitable for all learners. According to the brochure, practical advantages of

learning style classification include their application in learning and in working contexts, as well as harmonizing the learning style and one's learning experience. (Hay Group, n. d.).

Most LS taxonomies are "type" theories, classifying people into different groups according to their approach to learning. The origin of these theories may be traced to the ideas of C.G. Jung (1964) in the area of personality types. Jung's ideas (1964) were included in psychology test developed in the United States, namely Mayers–Briggs Type Indicator test popular in the 1920-ies. A successful application of this test contributed to the development of learning style taxonomies. Based on Myers-Briggs test, people can be categorised into several groups; this test provides useful information in decision making on one's employment (Faisal, 2019).

Despite a widespread distribution of learning styles theories, they are viewed as a controversial issue by numerous authors. Although it is admitted that learning style models offer variability and recognition for learner's preferences, they have been criticized for the failure to provide a clear proof that the consideration of learner's style of learning contributes to a more effective education (Cletus & Eneluwe, 2020; Sun, et al., 2023). On the other hand, according a report of the Department for Education and Skills British teachers a high percentage of British teachers apply their students' preferred learning styles in their teaching. Another survey (2012) found that more than 90% of British teachers believe in the existence of learning (Children have different learning styles. Now updated). Chinese scholars point to the importance of the learning style approach for future research in the learning and teaching of Chinese as a foreign language (Xing, 2023). Karimian and Zolfaghari (2024) explore learning styles in the context of virtual education.

METHODS OF EMPIRICAL RESEARCH

In empirical research, we focused on issues related to learning styles and application of LS models in education. During the preliminary research stage carried out using the interview method, we found out that several learning models are used in the practice of education, and based on empirical research, these learning models were included in our questionnaire. The interview conducted during the pre-research stage on a sample of 32 respondents became the basis for designing the questionnaire empirical research. This information was used as the basis for the construction of the research model:

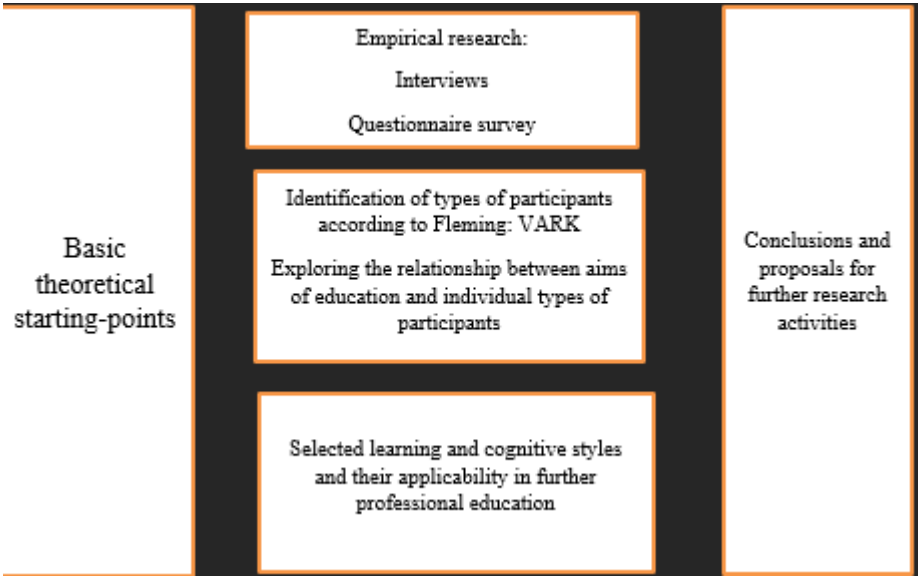


Figure 1: Research model

The aim of the empirical research was to identify the opinions and attitudes of lectors/instructors in further professional education/training in the assessment of types of students, and the level of applying learning and cognitive styles based on a sound theoretical background.

Table 1a. Description of respondents by country and field of study

Lectors/Instructors	Number of respondents from country			
	Slovak Republic	Czech Republic	Hellenic Republic	Total
Certified lectors	49	51	49	149
Uncertified lectors	18	12	21	51
Total	67	63	70	200

The research was conducted using the questionnaire method. Questionnaires were distributed in person and electronically. Empirical research is applicable in all the fields of study listed by the Ministry of Education, Science, Research and Sport of the Slovak Republic (2019). We used the above classification not only for the Slovak Republic but for other countries. Due to the extensive scope of the issue, for the needs of the present research paper, we selected the following

groups of study fields: Social, economic and legal sciences (6213 –Economics and Management) and Education (7605 – Teacher Training and Education Sciences).

The research sample of respondents was created by deliberate selection. Nominal and ordinal variables were observed in the questionnaire. Nominal variables were described by means of artificially (arbitrarily) created codes, which were assigned to individual categories and related to respondents' academic rank divided into assistant, assistant professor, associate professor, professor, lecturer and other options, as well as the designation of the field of study and the country in which the educational activity is carried out. Ordinal variables were characterized by the five-point Likert scale. The Likert scale of ordinal variables was used for student types in terms of Fleming's VARK model and selected learning models. (Fleming, 2001). To analyse the results, opinions of 200 respondents from three countries, i.e. the Slovak Republic, the Czech Republic, and the Hellenic Republic were analysed.

The research sample in terms of the country and field of study is described in contingency Table 1b.

Table 1b. Description of participants analysed in learning and cognitive styles by country and field of study

Field of study	Number of respondents from country			
	Slovak Republic	Czech Republic	Hellenic Republic	Total
Economic, social and legal sciences	33	31	31	95
Education	34	32	39	105
Total	67	63	70	200

The research was conducted in the period from April 2025 – May 2025. The data collected were then analysed in the statistical software Jamovi Version 2.3.26 and MS Excel. To analyse data, we used contingency tables, and descriptive statistics in this paper. Results of statistical processing are presented in statistical surveys in tables and the findings are interpreted.

RESULTS OF EMPIRICAL RESEARCH

In the empirical research the focus was on respondents' (lectors') opinions of types of learners (in terms of LS). Learner types in terms of Fleming's VARK model and the Likert scale (1-5) are characterized in Table 2.

Table 2. Respondents' opinions of participants' types by selected countries

Country/Indicator		Number of respondents from country			
		Visual	Reading/ Writing	Auditive	Kinesthetic
Czech	Mean	4,06	3,33	3,79	3,35
	Median	4	3	4	3
	Modus	5	3	4	5
Slovak	Mean	3,73	3,43	3,81	3,09
	Median	4	3	4	3
	Modus	5	3	4	5
Hellenic	Mean	4,13	3,39	3,73	3,20
	Median	4	3	4	3
	Modus	5	3	4	5

Note: results of empirical research (evaluation in 0-5 interval, according to assumed number of occurrences).

The modus (or mode) characterizes the most frequently occurring value of student types. Based on the data from the calculation of the modus and median, it can be concluded that the types of students are the same in all the three countries of the sample. Most students belong to visual and kinesthetic types, followed by the auditory learner type, while the least common in the respondent sample is the reading/writing learner type. Based on the research, we conclude that neither the territory nor the field of study affects the composition of students in terms of learning style.

When monitoring educational goals in digital knowledge and skills, we verified the dependences of types of further education participants and the achievement of cognitive, psychomotor, and affective educational objectives, which were evaluated on a Likert scale (1–5).

Hypothesis 1:

H1: There is a statistically significant dependence between the achievement of cognitive educational objectives and the visual type of participant.

H0: There is no statistically significant dependence between the achievement of cognitive educational objectives and the visual type of participant.

Hypothesis 2:

H1: There is a statistically significant dependence between the achievement of psychomotor learning objectives and the kinesthetic type of participant.

H0: There is no statistically significant dependence between the achievement of psychomotor learning objectives and the kinesthetic type of participant.

Hypothesis 3:

H1: There is a statistically significant dependence between the achievement of psychomotor learning objectives and the kinesthetic type of participant.

H0: There is no statistically significant correlation between the achievement of psychomotor learning objectives and the kinesthetic type of participant.

Hypothesis 4:

H1: There is a statistically significant dependence between the achievement of affective learning objectives and the auditory learning style of participant.

H0: There is no statistically significant correlation between the achievement of affective learning objectives and the auditory learning style of participant.

Tab. 3 Correlation matrix (Fleming's types of learners and aims of instruction)

Types of participants/Aims of instructions	Cognitive	Psychomotor	Affective
Visual	Pearson's r: 0,145 p- value: 0,040	Pearson's r: 0.059 p- value: 0,404	Pearson's r: 0.133 p- value: 0.061

Reading/Writing	Pearson's r: 0,031 p- value: 0.665	Pearson's r: - 0,236 p- value: < .001	Pearson's r: - 0,063 p- value: 0.374
Auditive	Pearson's r: 0.082 p- value: 0,250	Pearson's r: - 0,127 p- value: 0,074	Pearson's r: - 0,054 p- value: 0,444
Kinesthetic	Pearson's r: 0,106 p- value: 0,136	Pearson's r: 0,104 p- value: 0,143	Pearson's r: -0,097 p- value: 0,171

Based on the calculation of Pearson's coefficient and the p value, the following can be stated: For hypothesis 1, the alternative hypothesis is accepted, just like for hypothesis 2.

Hypothesis 1:

H1: There is a statistically significant dependence between the achievement of cognitive educational objectives and the visual type of participant.

Hypothesis 2:

H1: There is a statistically significant dependence between the achievement of psychomotor learning objectives and the reading/writing type of learner.

For hypotheses 3 and 4, null hypotheses are accepted.

Hypothesis 3:

H0: There is no statistically significant dependence between the achievement of psychomotor learning objectives and the kinesthetic type of participant.

Hypothesis 4:

H0: There is no statistically significant dependence between the achievement of affective learning objectives and the auditory learning style of participant.

The following table lists the modus value in the interval (1–5), which describes the level of applying a given learning style.

Tab. 4 Selected learning styles v further professional education (the table lists the modus of results)

Country	Czech Republic		Slovak Republic		Hellenic Republic	
	A	B	A	B	A	B
Field of study/ LS models						
Curry Onion Model	1	3	2	2	1	3
Riding & Cheema's LS taxonomy	1	1	1	1	1	1
Rayner & Riding's taxonomy	1	1	1	1	1	1
Myers & Briggs' model	1	1	1	1	1	1
Kolb's Experiential Learning model	2	2	4	2	2	2

Note: Results of own empirical research. Field of study: A – Social, economic and legal sciences; B–Education

Based on the research results, it can be concluded that the selected LS models are applied at a very modest level, with the exception of Kolb's model and the Curry Onion Model. In the Social, economic and legal sciences field of study, the application of the learning styles (listed earlier) is evaluated based on the modus and their frequency of occurrence achieved the modus value of 1. In the study field of Education, the Curry Onion model and Kolb's Experiential Learning model are used to a greater extent in the Czech Republic and the Hellenic Republic, where the modus value 3 was most often reported. In the case of the Slovak Republic, the most frequent occurrence of application was reported in the case of the Curry Onion model that achieved value 2 and Kolb's Experiential Learning model value 4 in the field of study Social, economic and legal sciences. The other styles were assigned modus value 1.

Conclusions

Based on the calculation of the modus and median, it can be concluded that in all the three countries the types of learners (distinguished in terms of Fleming's VARK learning styles) are the same: most participants belong to visual and kinesthetic types, followed by the auditory learner type, and the least common is the reading/writing learner type. Further, we conclude that neither the territory (country) nor the field of study affects the composition of participants/ learners in terms of learning style. The analysis of respondents' replies in questionnaires shows the Curry Onion model and the Kolb Experiential Learning model are used to a greater extent in formal university education in the Czech Republic and the Hellenic Republic; the Curry Onion model was reported to be the most frequently applied model in the Slovak Republic. Based on the calculation of

Pearson's coefficient and the p value, the alternative hypotheses are accepted both in the case of hypotheses 1 and 2: H1. There is a statistically significant dependency between the achievement of cognitive educational objectives and the visual type of participant; Hypothesis 2. H1: There is a statistically significant dependency between the achievement of psychomotor learning objectives and the reading/writing type of learner.

Despite their popularity and widespread distribution in the world, learning styles theories are often viewed as a controversial issue or even referred as a myth. On the one hand, these styles offer variability and recognition for learner's preferences; on the other hand, LS theories have been criticized for the failure to provide a clear proof that the consideration of learner's style of learning may result in improving the quality of education.

However, there are reasons to believe that other factors, apart from those analysed in the paper (country, field of study, and application of LS models), may have contributed to the widespread distribution of the approach based on learning styles. In our future studies on learning styles, we intend to deal with these factors as well as with the application of LS theories in meta-learning, since we believe that the awareness of one's preferred learning style in the context of the learning environment and the learning content can increase the participant's efficiency of learning, both in the case of individual learners as well as learning teams.

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