Research of Learning Styles – Getting to Know Students' Individualities

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ABSTRACT In the first part of this contribution, the researcher introduces a short review of the different approaches to learning styles, their definitions and some available tools for their research. In the second part, the researcher presents the research conducted with an Index of Learning Styles questionnaire (ILS) and the results obtained by addressing the ILS to 1006 students from 27 high schools in the Czech Republic. The research found that the Czech students are rather active than reflective learners with students of technical schools being even more active than the others. The respondents are rather visual than verbal learners on average, with males being more visual than females. Lastly, Czech students are rather sequential than global learners and this preference is more pronounced among students of technical high schools.

INTRODUCTION

The aim of this paper is to introduce the topic of learning styles and document possible difference between male and female high school students and between those who choose to study a technical high school and those who chose the humanities for their high school studies. To achieve this, the researcher presents a short overview of several existing questionnaires for the research of learning styles and illustrates the main differences between these questionnaires with several examples of actual items. The research part of this paper presents and comments on the results obtained by addressing the Index of Learning Styles questionnaire (ILS) to 1006 students from 27 technical and non-technical high schools in the Czech Republic. The paper aims to motivate teachers to become good leaders by getting to know the individual learning needs of their students.

General Introduction to Learning Styles

The theory of learning styles maps the different ways in how people learn new things. The knowledge of these learning styles provides important insights into the ways in which individual students process information. Teachers naturally direct the way in which knowledge is transferred. A teacher aware of this fact tries to behave like a good leader. He cares about students' motivation toward the subject, their success in understanding taught concepts, their development etc. Several different approaches to learning styles and their definitions can be found (Cassidy 2004; Hartley 1998; Curry 1983). They differ in a number of topological variables; different authors include different aspects and processes in the definition of learning style.

A theory that tries to describe all the dimensions of learning styles is expected to be impractical because the possible differences between the learning preferences of any two individuals are innumerable. Every learning style model is thus formed by a selection of a limited number of dimensions that together provide a good description of the investigated theory and enable the formulation of specific instructions. "Like all models in the physical, biological, and social sciences, they are incomplete but potentially useful representations of reality, and should be judged by how well they characterize and interpret observations and inform professional practice" (Felder 2010).

Learning Style Definitions

In the literature there are several delimitative definitions of the term learning style. Hartley limits his definition to the active participation of the learner in the learning process: "Learning styles are the ways in which individuals characteristically approach different learning tasks" (Hartley 1998). Sarasin sees learning styles rather as certain predispositions: "Learning style is the pref-

erence or predisposition of an individual to perceive and process information in a particular way or combination of ways" (Sarasin 1998). James and Gardner also include the learning conditions in their definition of learning style: "Learning style is a complex manner in which, and conditions under which, learners most efficiently and most effectively perceive, process, store, and recall what they are attempting to learn"(James and Gardner 1995).

Hereafter, and for the purpose of our research, the learning style is understood in a relatively broader context, as defined by Keefe: "the composite of characteristic cognitive, affective and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment" (Keefe 1982).

Learning Style Classifications

Learning styles can be classified from many points of view. Some systems take into account the neurological and neuropsychological characteristics of the learner, others describe the ways individuals perceive, organize and process the information. The most well-known systems are:
- *The Four Modalities Classification*–visual, auditory, kinaesthetic and tactile learners; depending on the sensory system they prefer during their learning process
- *Hemisphere Dominance Classification* – distinguishing the group of analytical, logical and systematic processes that are attributed to the left brain hemisphere from the group of holistic, intuitive and imaginative processes that are attributed to the right brain hemisphere.
- *Problem Approach Classification* – distinguishes between impulsive and reflective learners based on their approach to finding solutions to a problem.
- *Classification of the In/tolerance to Ambiguity*–how learners work with a piece of information that disagrees with their existing knowledge and concepts.
- *Field-Dependency Classification* – deals with how learners perceive individual components of the task relative to the whole task and its wider background.
- *The Index of Learning Styles* (*ILS*) – which is discussed later, classifies in four

dimensions: active/reflective, visual/verbal, sensing /intuitive, global /sequential.

Learning Style Diagnostics

Quantitative evaluation of the characteristics of learning styles and learning style diagnostics is a sophisticated process because of the complexity of this issue (many variables that are hard to control). Various qualitative and quantitative methods are used by psychologists in their learning style research. They include observations, interviews and questionnaires.

The researcher chose to diagnose learning styles by a learning style questionnaire with forced choice. The researcher considers it advantageous because of the complex nature of the obtained data, and because there is a variety of questionnaires the validity and reliability of which were tested and studied thoroughly. The researcher finds the questionnaire to be the most proper form of measuring (and comparing) learning styles of multiple subjects from the point of view of practical utilization of obtained knowledge in the leadership process (getting to know the target group of the teacher and adapting his teaching methods appropriately). Moreover, the results of a questionnaire are easily evaluated by a set of clearly defined rules (the scoring of the questionnaire given by its authors and checked by a pilot study and previous studies using the same questionnaire).

The researchers' learning style research forms a part of a wider project aimed at improving the teaching of the sciences, and physics in particular (Zajacová 2013). Below, the researcher provides a short overview of the questionnaires that were investigated in the above-mentioned project.

Learning Style Questionnaires

In this section, the researcher introduces three learning style questionnaires and compares the information they provide about the respondents. These particular questionnaires were chosen with respect to the research area of the above-mentioned project (sciences), but the researcher found it useful for teachers of all subjects to get a picture of the tools that are available in this field and of the information that these tools provide about the students.

The teacher is seen here as a leader of a wider teaching/learning process who can affect many of its variables. He obviously controls directly the methods he uses in his lessons and the learning environment in the classroom, but he can also teach the students how they should learn outside the classroom (whether doing homework or preparing for examinations alone or in a workgroup). The latter part of the learning process is of no less importance than the teacher's performance during the lessons because most students need to review the taught matter before they use it. Teachers who understand the learning abilities of their learners can adjust their teaching style to make their learners understand the subject matter better. Moreover, they can encourage them to use learning methods that better suit their learning styles and thus better realize their potential.

The purpose of using the tools introduced in this section or similar ones is to get to know and understand the individual learning needs of the respondents. Already realizing different needs is a valuable outcome of working with these tools. Furthermore, the teacher can then take the obtained information into account in lesson planning and preparation, and also in "action" during lessons. He may also dedicate a certain amount of time to presenting the results of the questionnaire to the students and providing them with recommendations on how they can improve the efficacy of their home/peer learning based on their individual preferences. Two approaches can be found both in theory and in practice - either to teach for all styles or to promote selected ones (Mareš 1998). The researcher recommends a combination of both: providing enough impulse for all the learning styles present in the class and encouraging the use of individuals' strong abilities.

Using methods, sensory channels and an environment that is more suitable for the learners' needs is expected to increase the amount of time they experience the joy of learning and cognition and to decrease wasted time when the subject matter is felt to be meaningless due to an inappropriately chosen teaching method. Together, the success of the students in a given subject can be increased, which will lead to greater motivation, and vice versa.

A good leader is naturally expected to review the changes he carried out in teaching and possibly reevaluate some of them according to his experience and the students' feedback.

Learning Styles Inventory (LSI)

The LSI questionnaire was developed by R. Dunn, K. Dunn and Price. The strengths and preferences of each individual are identified by the LSI across a spectrum consisting of twenty elements. The structure of the questionnaire and the information it is looking for stems from the authors' specification of learning style: "The way in which each learner begins to concentrate, process and retain new and difficult information. That interaction occurs differently for everyone." (Dunn et al. 1989) One hundred-and-four questionnaire items comprise 20 elements that are divided into four categories: environmental, emotional, sociological and psychological stimuli.

The LSI questionnaire was developed in different versions for primary and secondary school children and for adults. The learners indicate the level of their agreement with the statements on Likert scales with 3 (primary school) and 5 points (secondary school and adults). Reasonable reliability of the questionnaire was demonstrated and a good validity of the data was shown in existing studies (Mareš 1998; Cassidy 2004).

The LSI questionnaire was also translated into the Czech language by J. Mareš and V. Slavík. This Czech version was made for 3rd to 12th grade students, and it was verified in a study with 891 secondary level students and 402 high school students (Mareš 1998). Compared to the original version, this adaptation has only 71 items and a modified scoring scale for 5th to 12th grade students.

Motivated Strategies for Learning Questionnaire (MSLQ)

The MSLQ tool was designed by P. R. Pintrich and T. Garcia for the testing of secondary and high school students (Pintrich 1991). It is developed to measure the motivational orientation of the students and the different learning strategies they use. The respondents expressed their agreement with each of 81 items (statements about their learning process) on a 7-point Likert scale with 1 labelled as "not at all true of me" and 7 labelled "very true of me". The components of the MSLQ are grouped into two broad sections: motivation and learning strategies.

Several Examples of Actual Questionnaire Items

For example, item 50 asked on the opinion of the respondent to the statement: "When study-

ing for this course, I often set aside time to discuss course material with a group of students from the class." As is obvious from the text, the MSLQ is related to the content of specific course – learners' answers thus reflect the learning processes in a particular subject.

In contrast with the LSI, the MSLQ is more narrowly focused. While the LSI questionnaire can provide answers to the questions about the broader learning environment, learners' preferred learning situations or about their reactions to the assigned tasks, the MSLQ targets students' motivation and their learning strategies.

The Index of Learning Styles (ILS)

Primarily, the researcher focuses on the ILS questionnaire, which is used in this research. The ILS was originally developed and validated by researchers at the State University of North Carolina. It was designed to investigate students' learning preferences, their needs and habits during the learning process. The ILS is aimed at high school students.

This questionnaire covers four learning style dimensions that were taken from a model developed in 1987 by Dr. Felder and Dr. Linda K. Silverman (Felder and Silverman 1988). It remains to be frequently used to determine the learning styles of students of engineering and generally technical schools (Shaikh and Waychal 2015).

The ILS is a forced-choice instrument and consists of 44 dichotomic items. Students complete all the sentences concerning their personal learning experience with one of two options that represent opposite ends of one of the learning style dimensions. The four scales represent the students' learning preferences during their learning process and differentiate between:

- *active and reflective* – distinguishes learners who act directly and those who reflect first and describes their un/favorable attitude toward group work;
- *sensing and intuitive* – distinguishes learners who prefer concrete information (facts, data) and those who prefer abstraction (theories, models and interpretations);
- *visual and verbal* – describes which information format is preferred for input and for recalling memories for these two groups of learners;
- *sequential and global* – distinguishes learners who think in linear steps and con-

crete detail, and holistic thinking learners with the overall idea in mind.

Each of the dimensions is characterized by 11 questions and can be scored separately. Each item choice is then binary scored (-1) or 1, so the total score of the learner in each dimension can range from (-11) to 11.

The modified version of the ILS was developed and presented by Litzinger et al. (Litzinger 2007). This version offers the respondent the possibility of choosing a neutral answer or partial or complete agreement with one of the two options from the original version of the ILS.

A comparison of the modified version to the original one was done in the study by Litzinger (2007). For example, the respondents were asked to complete the statement "I understand something better after I," with one of the two following possibilities "(a)try it out." and "(b) think it through." in the Original ILS. In the Modified version, the respondent was given a 5-point scale spanning between "try it out" and "think it through" to express after which of these possibilities he/she understands something better more often. Most recently, the ILS questionnaire was examined by advanced statistical methods with the aim to distinguish learning styles of respondents who seem "neutral" in a dimension after direct ILS evaluation (Jing et al. 2015).

This Research with the ILS Questionnaire

For this research, the researcher used the modified version of the ILS. Dichotomic and modified versions of the ILS gave similar results in the pilot study, but the modified version provided better resolution and lower variance of the respondents' scores in investigated learning style dimensions, consistent with Litzinger's Psychometric Study of the ILS (Litzinger 2007). More information about the translation of the ILS into the Czech language, the assignment of the pilot version and processing of statistical data (including item analysis), the interpretation and adaptation of this tool can be found in (Zajacová 2014).

METHODOLOGY

Sample and the Questionnaire Assignment

The research sample consisted of 1006 high school students from 27 high schools (59 class-

es) from different geographical parts of the Czech Republic. The participants were chosen from both non-technical (grammar, language and economic) and technical secondary schools from 17 to 19 years of age. The data for this research were collected over 2 months (March 2014 and April 2014) and were statistically evaluated.

Table 1 characterizes the gender of the participants in this research. Some participants did not state their gender; the researcher marks these cases in the "Missing" row. As is obvious from Table 1, the male participants are in the majority in the total count due to the inclusion of 11 technical schools. In the Czech Republic, male students prevail in these types of schools. This composition of the research sample was intentional as the use of learning styles in physics is expected to be of greater importance in technical than in nontechnical schools.

RESULTS

The means and variances of all the dimension scores, averaged by the sex of the respondents and the type of school they attend, are summarized in Tables 2 and 3. Table 4 shows the distribution of the respondents' scores for each of the four dimensions of the ILS questionnaire. From the actual results the researcher has chosen the following significant findings:

On average (2nd column in Table 3), Czech students are more active than reflective learners, which means they understand information bet-

ter by doing something active with it, for example, talking about it in groups, explaining their ideas to an audience, rather than thinking about it quietly. Students in technical schools (2nd and 4th column in Table 2) are more active learners than students in non-technical schools (3rd and 5th column in Table 2); the most active students are female respondents from technical schools.

With regard to the ILS scoring, Czech students are also more visual than verbal learners (2nd column in Table 3). They gain more from adding visual material (diagrams, graphs) to a lecture. Male respondents are more visual learners than female ones. Female learners from schools with a non-technical character are the least visual students from our research sample (3rd column in Table 2).

In total, sequential learning (a linear approach to the subject's curriculum, more emphasis on detail) is slightly more preferable than global learning (random but holistic to the subject, more emphasis on the overall picture) among Czech students. It is interesting that students from non-technical schools are more global learners than those from technical schools. Girls are more sequential than boys in both types of schools. The tendency to perceive taught material in isolated elements without a wider overview was already indicated in our previous EBAPS research (Zajacová 2015).

The prevailing inclinations for Active, Sensing, Visual and Sequential learning already indicated in the pilot study were confirmed in this research.

Table 1: Gender stated by the participants

Gender	Non-technical		Technical		Total	
	Count	Percentage	Count	Percentage	Count	Percentage
Male	248	40.9	339	84.8	587	58.3
Female	321	53.0	31	7.8	352	35.0
Missing	37	6.1	30	7.5	67	6.7

Table 2: Means of the dimension scores for different sex/school types

Dimension	Female		Male	
	Technical	Non-technical	Technical	Non-technical
Active (–) / Reflective (+)	-3.40 (10.46)	-1.83 (10.30)	-2.18 (9.60)	-1.34 (12.20)
Sensing (–) / Intuitive (+)	-1.77 (7.05)	-1.52 (10.01)	-1.67 (9.45)	-1.27 (10.90)
Visual (–) / Verbal (+)	-3.39 (8.48)	-2.45 (9.92)	-3.87 (8.17)	-3.63 (10.04)
Sequential (–) / Global (+)	-1.90 (3.88)	-1.30 (7.16)	-1.07 (7.32)	-0.70 (6.27)

Note: Variances are given in parentheses.

Table 3: Means of dimension scores for different sexes in total

Dimension	Average score all	Average score male	Average score female
Active (–) / Reflective (+)	-1.84 (10.78)	-1.83 (10.87)	-1.97 (10.51)
Sensing (–) / Intuitive (+)	-1.57 (10.12)	-1.50 (10.11)	-1.55 (9.75)
Visual (–) / Verbal (+)	-3.22 (9.76)	-3.77 (8.98)	-2.53 (9.87)
Sequential (–) / Global (+)	-1.13 (7.01)	-0.91 (7.01)	-1.36 (6.90)

Note: Variances are given in parentheses.

Table 4: Distribution of scores of all respondents for individual dimensions of ILS

Dimension score	Active (–) / Reflective (+)	Sensing (–)/ Intuitive (+)	Visual (–) Verbal (+)	Sequential (–)/ Global (+)
-11	2	2	5	0
-10	1	0	9	0
-9	10	3	19	1
-8	16	15	49	2
-7	34	32	52	12
-6	49	32	69	18
-5	84	71	116	44
-4	100	101	122	75
-3	120	118	135	128
-2	111	120	115	130
-1	120	132	106	178
0	111	112	84	136
1	83	97	54	116
2	52	69	35	72
3	42	34	12	33
4	32	23	8	32
5	20	17	8	18
6	7	10	2	3
7	7	10	4	3
8	3	3	2	3
9	0	4	0	2
10	2	0	0	0

The prevalences found in the final sentence above were also found among American students who were also tested with the modified version of the ILS (Litzinger 2007), but Czech students show stronger preferences in all four dimensions. A study on Greek students of education, business and finance also showed the same preferences (Platsidou and Zagora 2006). Moreover, the latter study was the first to consider the effects of discipline. Polytechnic students were found to be even more active and sensitive than the other groups (Platsidou and Zagora 2006), which is in perfect agreement with our results (Table 2). The impact of discipline on learning style preferences described in this paper shows similar tendencies as found recently by Wang and Mendori (2015) with the Mandarin version of ILS.

The reliability of the individual axes are given in Table 5 together with those of other stud-

Table 5: Cronbach's alpha coefficients for the ILS

Dimension	This study	Litzinger (2007)	Livesay (2002)	Zywno (2003)	Platisdou (2009)	Van Zwanenberg (2000)
Active / Reflective	0.58	0.61	0.56	0.6	0.45	0.51
Sensing / Intuitive	0.59	0.77	0.72	0.7	0.62	0.65
Visual / Verbal	0.61	0.6	0.6	0.63	0.51	0.56
Sequential / Global	0.38	0.54	0.54	0.53	0.45	0.41
Respondent count	1006	448	242	557	136	284

ies that used the ILS questionnaire. As Tuckman (1999) suggested, a Cronbach's alpha of above 0.5 is satisfactory for attitude and preference assessments. In our case, the reliability of three of the four axes are comparable to those that can be found in the literature. The Cronbach's alpha of the Sequential/Global scale fell significantly below the recommended value of 0.5. Previous studies also reached only slightly over 0.5, indicating the low reliability of this axis. Validity results do not differ from those reported on ILS by Litzinger (2007) or Wang and Mendori (2015).

CONCLUSION

In this study, the researcher demonstrated the topic of learning styles and its possible usefulness in the field of leadership in education. The researcher also provided selected interesting results from this research of learning styles using the ILS questionnaire in the Czech Republic.

It was found that using learning style characterizing tools allows teachers to choose more suitable methods to provide an inspiring learning environment for various types of students and to increase the effectiveness of their education.

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