Exploration of Learning styles and Digital Literacy for Innovation in Designing E-learning Courses

by
Ľubica Knošková, Lujza Jurkovičová,
University of Economics in Bratislava
lubica.knoskova@euba.sk, saok@vnet.sk

Abstract. This paper analyzes influence of multiple intelligences to learning efficiency. Authors analyze the learning styles and their strengths and weaknesses that may be utilized in education. Student centric classroom allows creating flexible programs based on deep understanding, exploration and creativity in learning process. Computer supported learning brings disruptive innovation in education forms great opportunity that can lead to reaching high performance in education and acceptance of different learning styles. E-learning in last decade undergoes expansion and utilizes diverse forms that give students unprecedented control over their education. Further the model of strategic learning is presented together with major strategic domains that need to be developed for efficient e-learning. At present, we observe an increasing level of use of ICT, which is related to increasing computer skills. In recent years 2005, 2007, 2009 and 2011 were realized in Slovakia Institute for Public Affairs sociological research on digital literacy and information society. The research results showed that digital literacy of the Slovak population, as one of the key indicators of the information society, comes out in quite internationally standard. For this reason, we refer to the possibility of development of education through e-learning. What could be the answer to finding solutions to help streamline and improve the quality of the educational process and on other site will be not difficult by cost. In this paper, therefore, devote a premise for the development of e-learning - digital literacy and informatization of society and the need for reforms in education that this development could take place. The article also point out the main reasons for refusing to learn and adapt to new ICT, creating one of the brakes to further develop e-learning.

Key words: digital literacy, e-learning, learning styles
JEL classification: A20, L86

1 Introduction

At present we observe increasing level of use information and communication technology (ITC), which is related to increasing computer skills. Computer supported learning introduces disruptive innovation in educational process. E-learning in last decades undergoes expansion and reaches different forms. The greatest advantage of e-learning is that it gives students active learning opportunities. Students are able to gain greater control over their learning process compared to traditional learning. Number of online instructional systems constantly increases but the studies show the systems do not bring consistent results in supporting students’ learning. This may be related to student learning strategies on internet base. Looking for information on internet is complex process. Student self-efficacy play important role too. The most significant social problem relates to feeling of isolation resulting form online learning. For successful on line education just positive attitude to online learning is not enough. It is necessary to work out new approaches and cognitive strategies. Students need to develop new skills for learning in new online environment. They need to take their own responsibility for increased control of learning process, reflection skills, planning skills, search skills, self-evaluation skills to make their learning effective. Metacognitive perspectives represent the ability to understand own learning process, own motivation and control (Tsai, 2009).

The goal of our paper is to analyze learning styles and strategies in e-learning environment and potential of digital literacy for effective e-learning and discuss the need for novel forms of education that need to be implemented in Slovakia due to lack of financial resources.

2 Intelligence types and styles of learning

According to research in cognitive psychology and neuroscience, the way we learn is not in
compliance with the way we are taught. If we want to be competitive on the country level in academic, economic, and technology perspective we have to reevaluate our educational system with shared understanding that people learn in different ways. In the past, academics reduced intelligence to a number, considered it unitary intelligence quotient (IQ). Later they added reevaluation by age groups. Newer research indicates that intelligence is much broader. It resulted into proliferation of definitions of intelligence. P. Salovey a J. D. Mayer propose new category – emotional intelligence (Salovey – Mayer, 2004), D. Goleman proposes among emotional intelligence also social intelligence (Goleman, 2006/3), R. Sternberg created the theory of multiple intelligences, which specifies three intelligence types – analytical, creative, and practical – based on his own definition of culturally dependent intelligence (Sternberg, 1985). Individual aptitudes and specific talent of individual are primer factors influencing identification of those skills, that we can expect to be learned the soonest and the easiest way. That is the predictor of tasks that the individual might like most.

H. Gardner in 1980s introduced his theory of multiple intelligences. Examination of his definition of intelligence and his categorization scheme uncovers how the learning experience can be tailored to the needs of different learning styles and strength of different people. Gardner defines intelligence as (Gardner, 2006):

- the ability to solve problems that one encounters in real life,
- the ability to generate new problems to solve,
- the ability to make something or offer a service that is valued within one’s culture.

Gardner established criteria for deciding whether the talent observed was a distinct intelligence. Each intelligence must have a developmental feature, be observable in special populations such as prodigies or savants, provide some evidence of localization in the brain, and support a notational or symbolic system (Campbell, 2004).

In table 1 we specify eight Gardner’s intelligences with short description and example of a person that represents the type.

<table>
<thead>
<tr>
<th>Gardner intelligence type</th>
<th>Characteristic</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linguistic</td>
<td>Ability to think in words and to use language to express complex meanings</td>
<td>Walt Whitman</td>
</tr>
<tr>
<td>Logical-mathematical</td>
<td>Ability to calculate, quantify, consider propositions and hypotheses and perform complex mathematical operations.</td>
<td>Albert Einstein</td>
</tr>
<tr>
<td>Spatial</td>
<td>Ability to think in three-dimensional ways, perceive external and internal imagery; re-create, transform or modify images; navigate oneself and objects through space; and produce or decode graphic information.</td>
<td>Frank Lloyd Wright</td>
</tr>
<tr>
<td>Bodily-kinesthetic</td>
<td>Ability to manipulate objects and fine tune physical skills.</td>
<td>Michael Jordan</td>
</tr>
<tr>
<td>Musical</td>
<td>Ability to distinguish and create pitch, melody, rhythm, and tone.</td>
<td>Wolfgang Amadeus Mozart</td>
</tr>
<tr>
<td>Interpersonal</td>
<td>Ability to understand and interact effectively with others.</td>
<td>Mother Teresa</td>
</tr>
<tr>
<td>Intrapersonal</td>
<td>Ability to construct an accurate self-perception and to use this knowledge in planning and directing one’s life</td>
<td>Sigmund Freud</td>
</tr>
<tr>
<td>Naturalistic</td>
<td>Ability to observe patterns in nature, identify and classify objects, and understand natural and human-made</td>
<td>Rachel Carson</td>
</tr>
</tbody>
</table>
individual intelligences during creation of new skills do not act separately, they complement one another. When educational process builds upon strengths and aptitudes of individual, he/she learns the subject easier and with pleasure. Learner reaches intrinsic motivation based on his/her own strengths.

In traditional approach to education there is a conflict between dominant teaching style that often uses logical-mathematical and linguistic intelligences, and individual learning styles of students based on their dominant intelligence (Christensen – Horn – Jonson, 2008).

Potential for customizing education to learning style of the student lies creating in student-centric classroom on the contrary of broadly used teacher-centric classroom. Gardner’s theory of multiple intelligences used in pedagogic helps to create localized flexible programs, based on deep understanding, exploration and creativity in learning process. Computer supported learning seems to be disruptive innovation in education that represents promising opportunity for reaching high performance in education and accepting diverse learning styles.

1.1 Learning styles and experiential learning model

Kolb’s experiential learning model forms a parallel to Gardner’s multiple intelligences. Experiential learning is encouraging students to observe, think, analyze, synthesize, evaluate and apply what they have learnt. It is not just about having practical experience but using them to move through to higher levels of learning. It is based on four elements: (1) concrete experience – sensing/feeling, (2) reflective observation – watching, (3) abstract conceptualization – thinking (4) active experimentation in new situations – doing. Effective learning styles are based on ability to utilize all four elements in learning process. Learning process may start in any of the four elements and it should be understood as a continuous spiral. Experiential model is based on direct involvement, on direct contact with studied element, and getting practical experience. D. Kolb and R. Fry identified four learning styles that represent different utilization of four given elements in learning process. Enriched with N. N. Manonechr findings, they are featured in table 2.

<table>
<thead>
<tr>
<th>Learning style</th>
<th>Learning characteristic</th>
<th>Strengths/skills</th>
</tr>
</thead>
</table>
| Logical analytical – theorist (Assimilator) | abstract conceptualization and reflective observation, thinking and watching | • strong ability to form theoretical models,  
• induction ability,  
• higher interest in abstract models than in people |
| Imaginative type reflector (Diverger) | learns by concrete experience and reflective observation feeling and watching | • strong imaginative skill,  
• creates new ideas, sees new perspectives,  
• interested in people,  
• broad cultural interests |
| Pragmatic (Converger) | abstract conceptualization and active experimentation thinking and doing | • strong impractical application of new ideas,  
• concentrated on deductive reasoning on specific problems,  
• unemotional,  
• narrow interests |
| Activist (Accomodator) | concrete experience and active experimenting feeling and doing | • ability to realize things,  
• risk taking,  
• high performing when needed |

Table 2 Learning styles
Kolb’s and Fry’s approach to education forms a challenge for models reducing human potential to unitary dimension of intelligence. They identify strengths and weaknesses of each learning style and they conclude that using just one learning style may bring disadvantages to learner. Analytical model that fits theorists is broadly used in comprehensive educational process. It looks like the goal of education is to produce analytical theorists, although 70 % of people do not use analytical learning style. We learn better and we feel better when we are educated in our most comfortable style. On the other side, the students will not develop other skills, if they are taught just in their preferred style. Process that best develops different skills uses all learning styles. Form own experience we observe and reflect so that we can formulate new concepts, principles and strategies for action. Finally we experiment and practice them in new situations. That represents Kolb’s experiential learning style. Experiential learning encourages students to observe, think, analyze, syntetize, evaluate and implement what they have learnt. It is enriching for students to use all four learning styles in their learning process, so they can feel comfortable and gain successes in certain model, and also be stretched to develop other learning abilities. Students can also learn from others as different people excel in different parts of learning cycle.

<table>
<thead>
<tr>
<th>to react to changed conditions,</th>
</tr>
</thead>
<tbody>
<tr>
<td>• solves problems intuitively</td>
</tr>
</tbody>
</table>

2 Strategic learning

Metacognition refers to self-awareness of the individuals about their knowledge and self-understanding, self-control and self-manipulation of the process of their own cognition. Students with high metacognitive abilities are of their learning objectives and also know effective approaches to obtain knowledge. Strategic learning is focused on students as self-determined and active individuals who process information and construct knowledge. The learner is in the core of the model of strategic learning surrounded by three interactive components that explain successful learning (Tsai, 2009, s. 36):

- **skill**,
- **will**,
- **self-regulation**.

**Skill** refers to action and thinking processes related to key concepts and processes and how meanings are constructed. **Will** indicates individual learning attitude, acceptance of information, will to concentrate and make efforts in learning. **Self-regulation** describes how individuals manage their personal learning process, how they plan, monitor and evaluate their learning.

To diagnose strengths and weaknesses of students, diagnostic instruments were developed. Picture 1 shows the model conceptualized by M. J. Tsai. He modified the skill domain to **perceived skill**, he included **anxiety** of novice online learning learners into the will, and replaced it by **affection**, that has broader meaning. Finally time management element was drawn from self-regulation to self-management domain.

On-line educational space involves several environments, including www, e-mail, asynchronous discussion forum (mailing lists, newsgroups) and synchronous discussion forum (on-line chat rooms, video conferences and online games). Characteristic of on-line learning space are identified as follows (Tsai, 2009):

1. **Flexibility in time and space**: Major revolution of e-learning is that it overcomes the limits of time and place for learning. Students become free and flexible but they have to overcome the challenge of self-control, self-evaluation and time management.

Worked out based on sources: Learning styles and Experiential Learning.
2. **Indirect social interaction**: Absence of direct interaction becomes one of most criticized feature of e-learning, though it may reduce anxiety of some students to answer direct questions in traditional classroom. Synchronous communication techniques overcome the effect of isolation. Asynchronous applications as e-mails, blogs and online discussion board are still used as primer source of communication at schools in e-learning process. Teachers’ role is changing to more facilitating and supportive.

3. **Abundant information resources**: Diversity of resources is great advantage of internet based learning but the quality of on-line information varies significantly. Students have to learn how to evaluate quality of retrieved information. Abundance of online information may cause anxiety and loss of interest.

4. **Dynamic learning interface**: Rapid changes in technology require dynamic changes of interfaces between student and teacher. Hardware and software is often updated or replaced. The interface design and system function influence student motivation, attitude and results of online learning. Online learners also need to know how to solve problems and ask for help (online assistant).

Online learning environments challenge students with flexibility of time and space, indirect social interactions, abundant information sources and dynamic learning interfaces. To perform online learning effectively, different online learning strategies are needed for students.

From in-depth interviews three domains for online strategies were identified as follows:
- **perceived skills**,
- **affection**, and
- **self-regulation**.

**Perceived skills domain** includes comprehension skills, internet skills, and self-awareness. **Affection domain** comprises elements of attitude, motivation and anxiety form unknown. **Self-regulation domain** that includes elements of self-monitoring, time management and concentration is especially important for online learners because they need enormous control over their time and online schedule.

### 3 Digital literacy in Slovakia

Digital literacy is a relatively complex phenomenon, which generally includes the ability to understand and use their information in different formats from different sources presented by modern information and communication technology (ICT). Digital literacy can be effectively expressed by synthesizing indicator - index of digital literacy (Digital Literacy Index - DLI). The index includes 28 indicators (questions) measuring the level of working with modern information and communication technology, its applications and services. The indicators are divided into four main segments - control work with hardware and software, control information management in virtual space and the ability to communicate through ICT. Index values are reported on a scale from 0 (digital illiteracy) to 1 (maximum level of digital literacy).
In recent years 2005, 2007, 2009 and 2011 sociological researches on digital literacy and information society were carried out in Slovak Institute for Public Affairs. The research results showed that digital literacy of the Slovak population, as one of the key indicators of the information society, comes out in quite favorably internationally. Studies of the European statistical office (Eurostat) in the years 2005 to 2009 showed the proportion of population in Slovakia with the digital skills for all the periods of the European Union average (EU 25).

Surveys showed strong links between levels of digital literacy and capacity to adapt to ICT. In principle, people who are easier to learn and adapt, are able to achieve much higher digital literacy.

3.1 Reasons for refusing to learn and adapt to new ICT

In terms of further development of e-learning in education it is important to know the reasons why some people refuse to learn and adapt to new ICT. The research results show that it is precisely that part of the population of Slovakia, which is in the overall progression of the biggest "drag". The answers of 27 % respondents who do not learn and do not adjust ICT showed that the fundamental problem is their intrinsic motivation given life situation (more charts 1 and 2).

As seen from previous charts 1 and 2, the major reasons for the indisposition to learn to control or work with ICT is primarily age and structure of arguments "why do not learn or refuse to learn" is essentially the same.

As seen from the data presented in chart 1, 56 % in 60 years is the main reason for disinterest or redundant ICT in everyday life and also references to the "other interests and priorities." For 79 % of respondents over 60 years (chart 2) is redundant or lack of interest in ICT as often justified in "unusefulness in their age."

![Chart 1](http://www.ivo.sk/buxus/docs/publikacie/subory/Digitalna_gramotnost_2011.pdf)

**Chart 1. Reasons for unwillingness to learn ICT skills or work with ICT for people aged 60 years (in %)**


![Chart 2](http://www.ivo.sk/buxus/docs/publikacie/subory/Digitalna_gramotnost_2011.pdf)

**Chart 2. Reasons for unwillingness to learn ICT skills or work with ICT for people aged over 60 years (in %)**


As seen from previous charts 1 and 2, the major reasons for the indisposition to learn to control or work with ICT is primarily age and structure of arguments "why do not learn or refuse to learn" is essentially the same.

Another finding was that respondents the 60 years stated that they do not feel the need to learn and improve use of ICT and the reasons as they claimed are particular that:

- are not forced mainly for work reasons (often not working or perform work that involves that),
- lack of funds,
- lack of time,
• lack access to ICT or the opportunities to learn to work with them,
• are unable to learn to control ICT,
• ICT replace other sources (television, reading, etc.).

Conversely, respondents over 60 years indicate that lack of funds, access to ICT or inability to learn to work with ICT, they have other sources instead of ICT. Frequently their functions and services mediate their family members - children or grandchildren. Other reasons are the inability to learn to work with ICT because of advanced age or lack of knowledge of their benefits.

3.2 Analysis of the ability of different social groups learn to control ICT

In this part of the paper we will focus on closer analysis of the abilities of different social groups to learn and control ICT, which is very important to the further development of e-learning. The following charts 3-4 show that the adaptation of ICT particularly sharply drop with increasing age, decreasing education, declining social status of households, type of household and economic activity.

As shown in chart 3 in the age limit from 14 to 17 years ICT easily adjusts up to 90%. Conversely, respondents between 60 and more years adaptation of ICT is only 6% of respondents. Similarly, the ability rapidly decreases by education (see chart 4). Between people with higher education are those 83%, while among people with primary education only 34%. Also relevant differences are found in terms of type and household status. For example, household of younger people and financially better-off households have better adaptation of ICT like the household of the elderly and poorly financially well-off households.

At the level of the whole population, the level of socio-demographic groups confirmed the close relationship between the level of adaptation and digital literacy. In other words, which is the ability to learn and adapt in the group above (less problematic), they have better digital skills. Self-obviously the ability and willingness to adapt is only one factor in increasing digital literacy. In terms of further development of digital literacy we can identify also the so-called risk groups from charts 3-4. As clearly seen, the percentage “hardly adaptable and inadaptable” of some groups are highly above average. In particular, people over 55, people with elementary education,
unemployed, retired, financially badly secured to poor households and elderly households. Adaptation of the population in this view is an important parameter, which is involved in the creation of so-called “digital divide in society”.

4 Advantages and benefits for establishing the model of e-learning education in commodity science

E-learning is accelerating the transfer of information in education and also indicates enrichment of its new activities. Proper set up e-learning model of education also develops the students’ information literacy. Teaching Commodity science in the form of e-learning aims to improve the teaching of this subject by allowing students to communicate information and knowledge, which is less costly than in the traditional form of teaching. Also, this form of education mediated by students forms new concepts and knowledge that they learn to develop pre-determined competencies. PowerPoint presentations, videos, audio files, photos and more can be used as motivation or interpretation of the curriculum.

To achieve our goal, students will be provided with basic theoretical knowledge. These can be presented as a text file or in the form of links to websites, books, literature and similarly. In order to study the literature of that could have an immediate resolution of question, students must have the possibility of using the environment of the course of direct communication with the teacher. Thus all students and teachers currently connected to the system can ask questions and seek answers to them.

Using e-learning model in commodity science education we expect great educational benefits and increase the effectiveness of teaching commodity science in food and nonfood products. We also expect to improve quality of learning process in interaction between teacher and student in secondary schools, improve computer skills working with modern software and information systems that are a prerequisite for further work of students, as we mentioned in the previous part of this paper. In the end we can say the e-learning model currently under construction can be used in the educational process on national scale.

5 Conclusions

E-learning is increasingly used in educational process and sometimes it replaces traditional educational process. Improving efficiency and success of e-learning is difficult task. Implementation of e-learning system in relation with different learning styles of students may improve overall learning results. Based on Kolb’s learning styles, theorists (Assimilators) learn from facts that lead to concept conclusions. They learn best through lectures, papers, analogies. Theorists are skilled in creation of models, organizing, analyzing, understand relationships, internal linkages, identifying parts of a whole, make priorities, classifying and comparing. Theorists need to have opportunity for posing questions and methodological research, testing propositions and relations between ideas and reality. Reflectors are primarily interested in personal reason why. Teacher’s role is more motivating and creating sense with simulation and discussion as a method. Their skills are observation, questioning – exploring, visualization, listening, speaking, brainstorming, and interaction. They need time for reasoning, preparation, reaching solutions without time pressure. Pragmatists are primarily interested in how things work. Role of the teacher as a coach is let them try it and provide help. Skills and experience that are used by this type are exploring, problem solving, experimenting, understanding, and making solutions functional. They like feedback from the coach, respected expert and they need to see the relation between explored subject and opportunity at work. Activists are primarily interested in discovering and exploring different opportunities on their own. Teacher has to create space for them so they can learn by themselves and teach others. Teacher’s role is evaluation. Their skills are integrating, explaining, summarizing and synthesizing. Activists need lot of demanding activities – as role games and competitive tasks where they can excel.
Learning styles are very important mainly from perspective of online learning. Research results of N. Manochehr’s study on influence of learning styles on learners in e-learning environments tested on sample of university students, uncovers that the best results in e-learning form were received by two types, theorist and pragmatist (Manochehr, 2000). That means, those, who like to learn by thinking and observing could achieve better results by e-learning than by using traditional method. We would like to test the results of above mentioned research in educational environment of Slovakia in e-learning form of education. From perspective of long-term lack of financial resources in education it is important to look for solutions, that are not demanding form perspective of funding, and that may lead to improved efficiency of educational process and improved computer skills. European Union initiated eLearning program No. 2318/2003/ES and devoted 44 mil. EUR funding. Major goal of the program is effective incorporation of ICT into education in Europe as the base for life-long learning. Primary role of Slovak universities and educational institutions should be effective education. Major problem that we see today is lack of other possibilities for students in distant learning. That is why we see the space for reform in education and starting implementation of new forms and methods in education as e-learning.

Acknowledgement

This paper is part of a scientific project granted by Ministry of Education in Slovak Republic VEGA No. 1/0529/12 Increasing competitiveness through design innovation management.

References


McCarthy, B (1987), The 4MAT system. IL: Excel Inc.


Author description

Ľubica Knošková, PhD., is a university teacher at Department of Commodity Science and Product Quality, Faculty of Commerce at the University of Economics in Bratislava, Slovakia, where she received her PhD in 2010. Her research interests are in product and design innovation, product strategies and management. Currently she is involved in research project on design management for increasing competitiveness as project leader and in projects on e-learning, product safety and management competences for competitiveness as a team member.

Lujza Jurkovičová, PhD., is a university teacher at Department of Commodity Science and Product Quality, Faculty of Commerce at the University of Economics in Bratislava, Slovakia, where she received her PhD in 2006. Her research fields are Quality management and trends in oil industry and e-learning in Commodity science. Currently she leads the project on e-learning support of commodity science education at secondary schools and participates as a team member other projects related to quality management, product safety and merchandising.