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EXAMINATION OF THE EFFECTIVENESS OF ELECTRONIC LEARNING ENVIRONMENTS

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Importance of impact assessment report on e-learning / e-teaching

The e-learning tools play a major role in supporting the individual learning processes and its efficiency (Green et al., 2010). However, the concept of these environments has a broad spectrum, it encompasses a variety of online platforms, applications, and virtual spaces. Nowadays educational science research focuses on the efficiency of e-learning and on the appropriateness of its methods. In a significant part of the domestic and international researches the researchers (Palfrey & Gasser, 2008; Prensky, 2005; Tapscott, 2009) analyse the adequacy of the electronic methodological device (content and format of the curriculum). In other parts, examining the connections of the different forms of course organization (e-learning, blended-learning, classic-learning, virtual-learning) and the students' characteristics (age, lifestyle, learning patterns, technological knowledge) the researchers are trying to prove or disprove the adequacy of the e-learning environments for the students. (Ollé & Csekő, 2004; Benson, 2005; Rønning, 2007; Cygman, 2010)

In the Hungarian higher education e-learning/e-teaching environments are typically realized in online learning management systems. In my research I proceed from the model and research toolkit of the *man-machine-environment* ergonomic system, and I use student and learning characteristics and concepts of learning environment used in the educational science (Kálmán, 2009). The objective of the research is to identify the characteristics that affect the efficiency of learning in e-learning/e-teaching environments.

This research explores learning management methods in online learning environments that are most frequently used in the national higher education and analyses the students' different learning specialties, customs and efficiency. Analysing the differences of the environments and the students based on these characteristics I make an attempt to create a model determining the efficiency of e-learning environments.

Concept of the research

The basic idea of the research is given by the *added pedagogical value model* expressing the efficiency of traditional school environments (Balázsi & Zempléni, 2004). I assumed that after a proper adaptation the model can also be used to evaluate e-learning environments. Therefore I developed a new model based on Kálmán's (2009) model which I expanded with the characteristics of e-learning environments and with the students' characteristics related to

online learning (Figure 1). The analysis of the relationships between elements of the model is competent to determine which students' and learning characteristics or which learning environment characteristics influence the result of learning. Former research results suggested that the learning characteristics used in traditional learning environments need to be completed with elements of online learning attitude in electronic environments to define the online learning pattern.

To characterize the various e-learning management environments I created a system of evaluation criteria that also considers the standards of designing the e-learning platforms beyond the recommendations of the above mentioned researches. Based on the ergonomic principles of ISO 10075-1 (2001) standard related to mental workload, on the characteristics of ISO/IEC 9126 (2001) standard and the new version of it, ISO 25010 (2011) standard defining the software quality as well as on the ISO 9241-11 (1998) standard defining the usability aspects of e-learning courses I summarized the system of quality and usability aspects concerning the user platform of learning environments. To compare the functional characteristics of learning environments I primarily considered the learning management concepts of Komenczi (2009) and the aspects of Allen (2011) to design the learning platform. I identified the result of learning with the concept of performance achieved by students in e-learning management environments which made it possible to compare the results achieved in different environments in a normalized form (using performance points in percentage). I used the model on the Figure 1 for course-level assessment, and the components are also suitable for course-level characterizations.

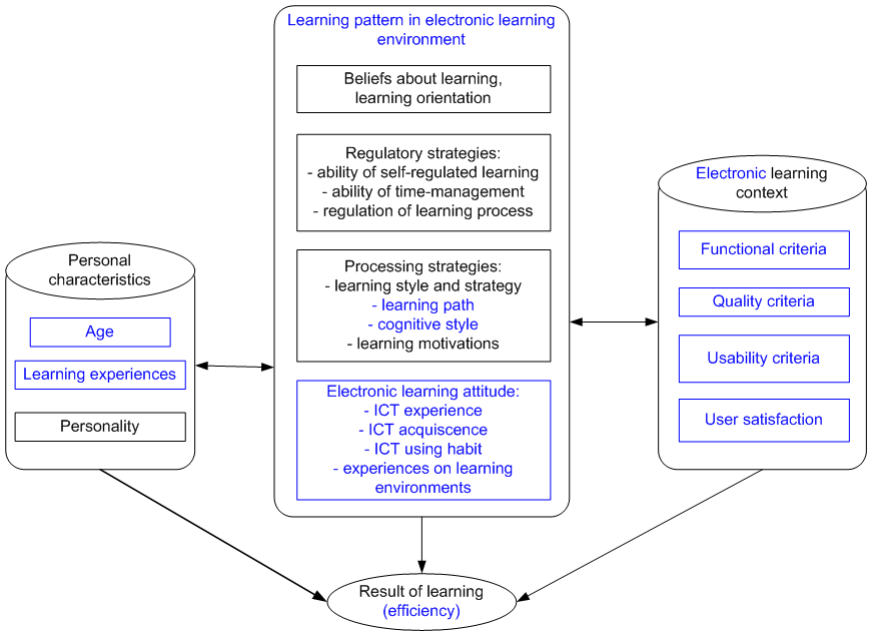

Figure 1. Elements of the online added value model (based on Kálmán (2009), my own figure)

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Main questions and hypotheses of the research

1. I assume that in courses based on different learning management principles different levels of performance can be measured; in courses with higher activities and with guided learning process the students' performances are higher. The hypothesis is based on that statement according to that the learning management principles of the content-driven and action-oriented subjects are different, the required learning activity is accordingly different (Komenczi, 2009). The degree of directionality can be also different in each course, and according to studies of Ollé and Csekő (2004), these two characteristics have an effect on the students' efficiency. In my study I intend to identify the types of sample courses and to compare these types of courses with the efficiency of the students. (H1)
2. I assume that from the learning characteristics the student's ICT experience and his attitude related to online learning primarily affect the student's efficiency in an e-learning environment; i.e. those students who have more ICT-experience and positive ICT-attitude or their efficiency is not affected by the design of the learning environment are more efficient. In former researches was shown that student's *brought* learning characteristics (personality traits, attitudes and patterns of learning), their ICT-experience and the learning efficiency are related characteristics. (Benson, 2005) (H2)
3. In a given learning environment the expected success of the students can be predicted if the students' online learning characteristics and performance data are known; so based on the available amount of data the students' expected performance can be reliably estimated from their learning characteristics. Therefore I assume that in the e-learning environment the students' expected performance can be predicted based on their online learning characteristics (their so-called *online brought value*). (H3)

Methods, tools, process and participants of the research

I used data of log files about 35 courses and their participants from 5 Hungarian higher education institutions. Based on the students' list of these courses I could analyse the online learning activities of 3147 participants in the database files. The courses were implemented in Learning Content Management Systems (LCMS), in Moodle. By collecting students' data I used online questionnaire and I could work with raw data in a form of course information and activity data of log files; by assessing the data I used statistical and data mining methods. During the evaluation of the results, the analysis of the hypotheses I worked with SPSS Statistics 19.0 and SPSS Modeler 15.0.

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Based on the evaluation criteria system described before I compared the platforms. Courses could be classified into four categories of the degree of the directionality of learning, the quantity and variety of required activities such as the major clustering features. In each course category I defined the typical learning patterns by analysing the data of the log files.

To identify the students' learning characteristics I used online questionnaire which first I tried out on a sample that included 106 students of 5 courses from 3 educational institutions and validated the issue groups. The questionnaire was finally completed by totally 826 students of 23 courses from 5 educational institutions (769 of which were completely filled out). With help of the questionnaire I created online student type categories, first just to identify the attitude and the motivations related to online learning; and later I expanded this category feature with students' characteristics that is supposed to be suitable to determine the „online brought value".

Hypotheses in the light of the results

The analysed sample did not proved that the highly required activity and the strongly guided learning process can lead to high performance. On the analysed sample the students' highest performances were measured in the partially guided and moderately active courses (requiring not regular but more than one online activity) and I experienced the students' lowest performances in the guided courses requiring a regular online activity. (H1 is rejected).

I also reject the hypothesis H2 because no significant difference can be demonstrated between the performances of the groups based on the students' online learning attitudes on the analysed sample. However, knowing the results of the attitude groups measured in different learning environments I assume relationships between the types of learning environments and the learning characteristics to determine the students' online learning attitude; further analyses are needed to prove this. Further research results show that students with a negative attitude have better grades, but their online learning management competency is weak. Students with a neutral and positive attitude have less good grades, but they were motivated and their learning management competency was efficient, according to the answers of the questionnaire they filled in. According to these results I conclude that the *positive* attitude really means online learning and in those environments these students are successful where the online learning activity actually gets place. Students with a *neutral* attitude can accept both forms of learning, the virtual and personal presence and they accomplish the theoretical and practical subjects equally well.

In hypothesis H3 I tried to adapt the pedagogical added value model for traditional learning environment into online one. To determine the relationship of online learning characteristics and learning efficiency I used factor analysis with 14 different variables of the online learning characteristics in order to create a feature (online brought value index) compacting online learning characteristics which can be suitable to predict their performance on the level of individuals. Due to their number and their low explanatory power the factors were not competent for expressing the students' online brought value index with help of the factor

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points identified by the factor analysis, i.e. I could not generate generalizable index values from them. Therefore I ignored to determine the index value but I tried to find answers to that which students' characteristics have what kind of impact on the efficiency of learning in the analysed sample. Therefore additional factor analyses were carried out on different sub-samples (grouping categories: learning environment experience, online learning attitude, performance, student type, age, gender). The identified 4-5 factors were the following:

- The 1st and 2nd factors compacted the student characteristics favouring the radical and superficial learning method that were dominant features of the student type categories (*willingness to accomplish* and *willingness to know*).
- In the 3rd and 4th factors the personality traits and the cognitive style notes appeared in general. In the sample the students with introverted and field-dependent characteristics proved themselves to be more efficient in the analysed e-learning environments which result were demonstrated in the researches of other researchers (Palloff & Pratt, 2002).
- In the weakest factors (4th and 5th) the learning management, the self-management and the time management competencies appeared. If these are positive and efficient the students typically achieved a better performance.

I could not prove the hypothesis H3 based on the analysed sample that knowing the properly selected online learning characteristics the students' performance can be predicted. From the factors developed to the online version of the traditional model to define the online brought value index was failed due to the normality problems of the analysed sample.

Conclusions, practical use of the results

The objective of my research was to develop a model suitable to measure the efficiency of e-learning environments. Based on the analysed sample I could not prove the general applicability of my *online added value model*. The hypotheses assumed relationships between certain components of my extended model. During the analyses I could prove only partial results due to deficits of the sample and I could create further analysis criteria.

But, as a result of the research I could conclude characteristics of learning environments that positively influence the students' efficiency:

- If the learning process is only partially guided (there is a recommended learning path and schedule but the students may differ from this) and
- among the required learning activities the number of compulsory tasks is low and their accomplishment is not bound to regular periodic deadlines.

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Regarding the analysed sample I could identify three personal factors that influence the efficiency of learning:

- learning orientation and the related learning strategies,
- personality traits and the related information processing strategies,
- learning management and time management competencies.

I think that based on the experiences of this research the typical adequacy of the online brought value becomes controllable on a sample with at least similar number of elements or bigger and fitted to the normality criterion and the identifyability of the index number of the online brought value can be re-examined.

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