Differences between the Answers of Questionnaire Investigation and Real Behavior of the Students in the E-Course for Healthcare

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ABSTRACT

In the paper we describe the applicability of different types of resources and activity modules in the e-learning courses and the worthiness of their usage. The presented ideas are supported by the outcomes of the questionnaire research realized within the e-learning study as well as the usage analysis of particular e-course "Role of a nurse in community care" which was one of the outcomes of the international project E-learning in Community Care supported by Leonardo da Vinci. We will also compare the outcomes of data analyses mentioned before and try to find the reasons of these differences. All presented information was implemented and verified in the combined forms of education. The authors present a detailed analysis of the user log-on data, on which we can better understand the behavior of the student in an electronic learning environment. Comparing the answers and outcomes of usage analysis we are able to find out the real process of the participants' study and eventually interpret the differences.

KEYWORDS

E-learning, Life Long Learning, E-course, Questionnaire, Usage Analysis, Log file.

1 INTRODUCTION

The increasing economical demands on providing the health care in highly developed countries brought about the changes of health care focus and goals. Several governments enforce the development of community health care aiming to health support and sustainability as well as the prevention of diseases. All these factors require the modernization of education, especially education in the field of nursing. New facts are discovered daily, the amount of knowledge constantly grows and they must be reflected in the curricula, e.g. the study programs must be regularly innovated [1]. However, not only the content needs to be modernized but also the form has to be adapted to actual trends and needs of the society. Internet usage for education substantially increasing, and many institutions are using it for distance-learning programs and connecting their academic staff to improve teaching and research [2]. The Internet dramatically changed the dissemination and sharing of information. As a result the technological advancements changed the way in which information is acquired, read, interpreted, and used [3].

The above mentioned points result in the necessity of cooperation between the universities and companies in the field of e-learning methodology [4][5][6]. The educational system supported by e-learning offers modern form of study which is highly flexible from the point

of view of time requirements and material resources. It represents very good accessibility and easy and direct communication with the tutor [4]. Internet learning environments are considered as individual and learner-centered learning environments as they contain multiple and rich resources and have an autonomous character which offers a flexible learning environment [7]. In general, e-learning is the delivery of education and training courses over the Internet and/or Intranet. It can be defined as a mixture of content (on-line courses or courseware) and communication (reaching online, emails, discussion forums) [8].

According to of Custers [9] learning from heatlcare on-line sources is often quite poor. Amount of knowledge retention gained via on-line form of study are low and average [3], which should flag an alert for educators when rely on the Internet for their students' knowledge acquisition and retention. On the other hand, remembering rate compared to traditional face-to-face course is approximately [10]. Students are motivated to engage in e-learning if it percieved to their learning [11].

Advanced Internet technology in health care learning – including e-learning, web-based learning, online computer-based educational training, Internet-based learning, and distance learning – has been widely adopted in many developed countries [12]. Having entered the European Union the new member countries gained the opportunities for international cooperation. Czech Republic, Slovakia and Poland joined to create the study program for post-gradual specialization study and life-long learning of nurses aimed at community care. These countries were given the opportunity

thanks to the international Leonardo da Vinci project named E-learning in Community Care supported by European Commission in Brussels (CZ/07/LLP-LdV/TOI/134001).

1.1 Lifelong Learning program

Due to the project, the supranational partnership of 5 institutions in the V4 countries and France was established.
The coordinator of the project: National Centre of Nursing and Other Health Professions in Brno, Czech Republic (www.nconzo.cz).
Partner organizations:
- *Czech Republic*
  MF & PARTNERS CONSULTING (www.mfpartnersconsulting.com)
- *Slovakia*
  Department of Nursing
  Faculty of Social Sciences and Health Care, Constantine the Philosopher University in Nitra (www.ko.fsvaz.ukf.sk)
  Department of Informatics
  Faculty of Natural Sciences, Constantine the Philosopher University in Nitra (www.ki.fpv.ukf.sk)
- *Poland*
  Medical University of Silesia. Katowice (www.sum.edu.pl)

The aim of this two-year project was to create new specialized module-based educational program for distance form of study and to prepare the modules for e-learning study so that the nurses-to-be could learn effectively. Web-based learning provides them with a new environment that allows them to develop professional skills and knowledge in self-initiated learning [13]. Students experienced a range of e-learning applications mainly as a support to

existing face-to-face delivery [11]. Analysis of community care was carried out by the participants of the project already in 2005. It showed that the Czech Republic, Slovakia and Poland were, more or less, at the same level. The educational programs which would effectively prepare employees in this area for their future tasks did not exist in these countries at that time. However, this sphere of health care has already been well known in the developed countries for many years and a serious attention has been paid to it thanks to its high social importance. [14]

2 STRUCTURE OF STUDY PROGRAM AND THE METHODS OF EDUCATIONAL ORGANIZATION AND MANAGEMENT

Study program contains the basic specialistic module that is compulsory for all students separately for midwives and for nurses. Furthermore, there are four selective modules for nurses as well as for midwives (Figure 1.).

Nurses
Role of the Nurse Specialist in Comunnity Care
Specific Activity of Community Nurse in Care of Family
Care Of The Elderly
Home Care
Prevention of Occupational Hazards
Midwives
Role of the Midwife Specialist in Comunnity Care
Breastfeeding counselling
Specific activities of a midwife in prevention of occupational hazards
Specific Activity of a Midwife in a Care of a Family
Ultrasound diagnosis in the work of a midwife

Figure 1. List of the courses of international study program

Since the most of the content authors were not digitally skilled enough, it was necessary to find a partner who would be responsible for the technical part of the courses. This role was undertaken by the Department of Informatics, Faculty of Natural Sciences, Constantine the Philosopher University in Nitra. Their task was not only to create the resources and activities in the e-course and fill them in with the materials but also to find quick and easy way of collecting the materials and other important information necessary for the course creation from the authors. The usage of structured MS Word template was proved as an applicable and also very convenient solution. The document contained all the information necessary for the course design, i.e. the study materials, glossary entries, quiz questions, written assignments, etc. - all of them in a logical and comprehensible structure. Text of the study materials was written linearly according to the agreed conventions. Some of the materials were very complex, the greatest of them would have about 620 pages in printed version.

For all the modules national and also international versions were created. They were implemented in the LMS Moodle environment. The e-learning portal communicates with LDAP server, which is interconnected with academic information system (students' profiles) and SAP/SOFIA (employees' profiles). Thanks to this interconnection, when users are students at our university, it is not necessary to register them manually [15].

The structure of online course needs to be, easy to follow, relevant, and learner-centered [16]. The elaborated e-courses have a unified structure which was approved in advance by the representatives of each partner organization [18]. We use the same structure also in our Department template and we try to divide each course into introductory information, lessons and the final part [17]. The main

study materials (a text-book) are complemented by automatically interconnected vocabularies of terms, or video recordings (Figure 2.).
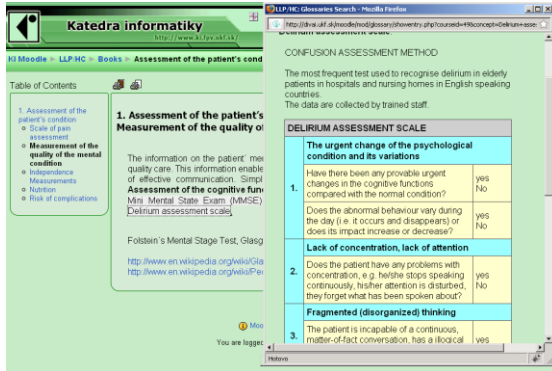

Figure 2. Preview dictionary links to study materials in the course Home Care

Figure 3. Sample of one module of e-course

The dictionary was set-up in the mode of so-called automated switching of key words in all study materials (except for the closing quiz, where this switching was turned off [18]. From the point of view of the courses the following were used: web page – study material, label and glossary – help. There were also used an activity modules, such as forum,

assignment – upload a single file and quiz (Figure 3.).

3 RESEARCH OUTPUTS

In the final phase of the project, the chosen courses were tested on a selected group of participants. In Slovakia, it was the course „The Role of a Nurse in the Community Care", which was tested by 30 students of external form of study at the Department of Nursing. The main objectives of the research were to get relevant feedback on the quality of chosen module from the created study programme, especially the information on the suitability of study material structure, quiz structure and content as well as the quantity information about the frequency of usage of particular e-course modules. The tests used in the course served only as the feedback on the quality of theoretical knowledge before the state exams. Furthermore, the outcome of the course was not expressed as a mark but in the form of credits that were practically included in the professional development of the participants. The only requirement was submitting the obligatory assignments. Therefore, we could not evaluate the successfulness according to the final mark. That was the main reason why we decided to use different research methods, specifically questionnaire and log file analysis.

3.1 Methodology of research

Our aim was to evaluate the course quality using various approaches. We used the following research methods.

Entrance questionnaire

It served to get the non-anonymous information about the statistical sample from the point of view of age, employment and practice.

Final (output) questionnaire

It provided the feedback about the quality of content, tests, used means, process of study, method and effectiveness of study as well as the attitude of the participants toward e-learning.

The outputs of non-anonymous questionnaire investigation usually tend to be very subjective, which was the reason why we decided to rely not only on the participants' responses but to find also some other, more objective point of view at the course modules. We were interested in how the users studied in the course, what was their navigation (the transition between the modules), which materials they accessed (eventually the number of accesses) etc. We needed to create the model of user's behaviour in the particular course.

Usage analysis

Usage analysis (focusing on end-user behaviour) provides an influential second source of information. Very interesting and useful course usage information were gained also from the log-on file analysis.

A log file is an electronic file generated by a software package. A logfile consists of the registered actions of end users in a predefined format. The minimum requirements for logfile analysis consist of who, when, what and how. [19]. So i tis a sequence of behavioral data (in our case recorded during the participants' study), stored on a permanent medium [20].

Log file analysis is the systematic approach to examining and interpreting the content of behavioral data. Its goal is to assist in finding patterns in the behavior of people as they interact with a computer. [20] Analysis of log file served to formulate the association rules of participants' behaviour in the e-course as well as the sequence and frequency of electronic sources accesses. Logfile analysis is an important instrument to make the behavior of these end users transparent [19].

That can help us better understand the behaviour of the student in the e-learning environment. During the data preparation we took into account recommendations resulting from series of experiments examining the impact of individual steps of data preprocessing on quantity and quality of extracted rules [21][22][23]. Analysis of log-on files is method of data mining. Data mining is a process that is used to identify hider, unexpected pattern or relationships in large quantities of data. Data mining predicts future trends and behaviors [24]. Data mining scours databases for hidden patterns, finding predictive information that experts might overlook because it falls outside their expectations. In our case, the log-on file is created by LMS Moodle automatically and contains information of everything that happens in the e-course. In order to analyze the data we have to prepare them in advance – e.g. delete invalid data, convert system time, create categories of actions, etc. After the necessary data preparation we are able to find the model of user's behavior in particular e-course - we can follow his navigation through the course, see what materials were visited and/or the time spent in the course. However, we cannot know if the opened material

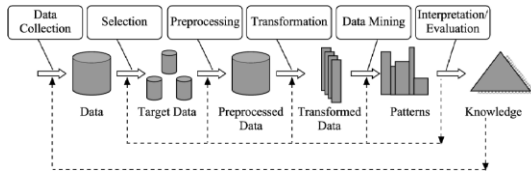was really read and understood [25], [26].

Figure 4. An overview of the data mining process [24].

Our research question was formulated as follows: Is there a difference between the responses in questionnaire investigation and the real logs in the e-course? This question was stated after the first differences were found out. Comparing the responses and result from data mining, we can reconstruct and analyse the real process of study of the participants. Furthermore, we can try to interpret the difference between the responses and their real behaviour.

3.2 Basic characteristics of the research participants

All participants of the tested course had finished bachelors degree, some of them have also specialisation. Table 1. illustrates the age categories of the participants. As we can see, most of them were from 31 to 45 years old.

Table 1. Age categories of participants.

< 30 year-old	31 - 45 year-old	46 – 60 year-old
26 %	62 %	12 %

All participants were experienced people from the practice, mainly employed in a hospital, mainly as department/ambulance clinical nurse or as head nurse of department. More than 10 years of practice was stated by 79% of participants (Table 2) [26].

Table 2. Number of years of practice

< 5	6 - 10	11 - 20	> 20
15 %	6 %	32 %	47 %

3.3 Description of behaviour of the users in the e-course

The data gained by the analysis of log file were visualised in Figure 2 and Figure 4 [14]. The interaction plot (Fig. 5) visualises the frequency of accesses to the basic system modules (assignment, upload, mainpage, quiz, etc.) according to the phase of study, Category x Term.

The graph shows that in the first phase the students most often accessed the quizzes. They completed 9 self-tests (altogether 720 attempts) and one closing test. The second most common activity was submitting the assignments (there was more than 287 assignments uploaded into the course).

In the second phase, the number of accesses to both type of activities decreased rapidly (Figure 5.). However, they still belong among the most visited course modules (either the resources or activities). Similar outcomes would be found out if we analysed the particular chapters of the course separately [14]. Integrated tests were motivating for their learning [4]. The results may be significantly different if the online program is perceived as relevant and applicable to the employee's professional role in the organization [16]. Also the fact that the self-test questions were issued from the oral state exam syllabus was also great inhibitor of the students' activities.
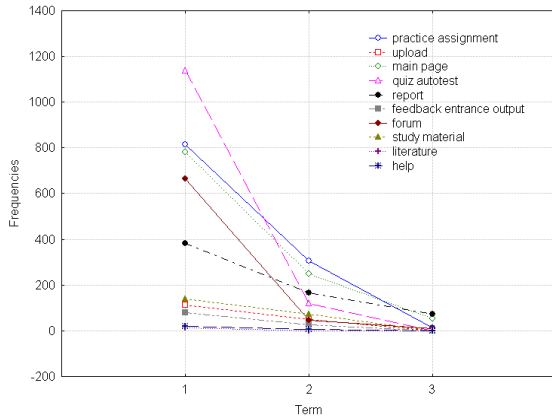
Figure 5. Interaction Plot - Category x Term (Source: own research)

There is a medium dependency between the number of accesses into individual categories of parts of the course and time periods of study [14], i.e. the number of accesses to individual parts of the course (Category) depends on the period of study (Term) [26].
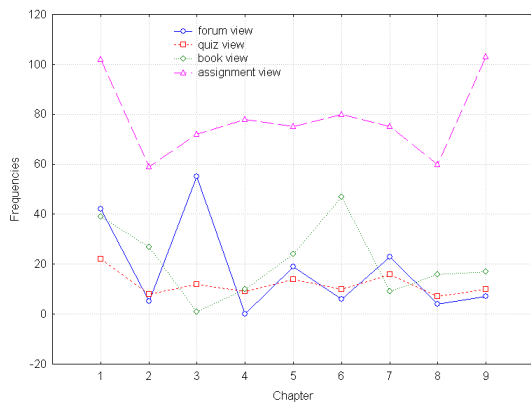

Figure 6. Interaction Plot - Chapter x Action (Source: own research)

The graph (Figure 6.) visualizes interaction frequencies Chapter x Action. The graph represents categorized polygon, where individual chapters of the course are shown on axis x, and the observed frequencies are shown on axis y, while for each level of the variable Action one polygon is drawn. Curves in this case are not copied, they have

different course – which only proves the results of the analysis. Other course is observed mainly for the actions/activities *assignment view and book view*.

The graph (Figure 6.) visualizes frequencies of activities - Frequencies of access x Month, during 13 months. There are periods of study (Month) on the x axis and observed frequencies on the y axis, while one polygon is drawn for each role (student, teacher and creator of the course).
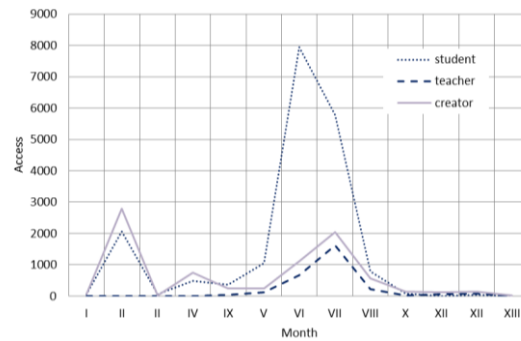

Figure 7. Frequencies of Access for student, teacher and creator role (Source: own research)

In the graph, we can see the great difference in the amount of access logs of the students in comparison with those of the tutors and the course creators (in the course there were several tutors as well as creators). In the first months after enrolling into the course there was almost no or only very low activity of the tutors. On the other hand, the course creators did the last modifications and settings in the courses (their activity was much higher in the preceding period). The greatest activity of the students can be seen short before the deadlines of particular activities and the tutors were very active at that time, too [26].
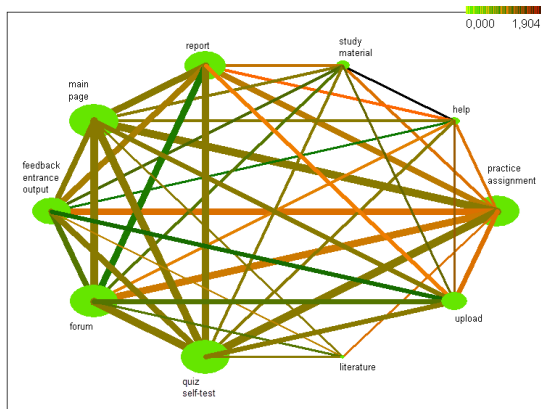
Figure 8. Web graph – visualization of found rules (Source: own research)

In the following part we are going to describe the results of association rules analysis (Figure 8.), which represents a non-sequential attitude to the data being analysed. We shall not analyse sequences, but transactions, i.e. we shall not include the time variable into the analysis. In our case transaction represents a variety of visited categories of the course by one user. Regarding our data, we shall consider one transaction to be the categories of parts of the course visited by one user for an observed period of time. The size of the node in the web graph represents the support of an element (frequency of category accesses), the line-width - the support of the rule (frequency of a pair of consecutively accessed categories) and the brightness of the line - the lift of the rule (specifies how many times more frequently the visited categories occurred jointly than in case if they were statistically independent) [14].

The web graph (Figure 8.) visualizes the found association rules, particularly the size of the node represents the support of an element, the line-width - the support of the rule and the brightness of the line - the lift of the rule. We can see from the previous graph, that among the most frequently visited categories of the parts of the course belong: main page, quiz selftest, forum, practice assignment, report a feedback entrance output (support), similarly as combinations of pairs of these categories (support) or, for example, that the categories of parts of the course - study material and help – occur more frequently jointly in the sets of visited categories of parts of the course by individual users than separately (lift). The same applies to the categories - upload and help (lift). In these cases the highest rate of interestingness was found (lift), which specifies how many times more frequently the visited categories occurred jointly than in case if they were statistically independent. In case, the selected couples occur more frequently jointly than separately in the set of visited categories of web sections by individual users [14].

The most visited categories of the course components were: main page, quiz (self-test), forum, practice assignment, report and feedback entrance output as well as the combination of pairs of these categories [14]. The least visited, on the other hand, were: study material, help and literature.

The different outcomes also came out when we analysed the questionnaires dealing with the communication in the forums. According to the questionnaire responses we can assume that only small amount of students participated in the discussions, they say that only one third of the students were active in the forums (Figure 9.), the rest only occasionally. But this opposes the association rules in the web graph (Figure 8.).
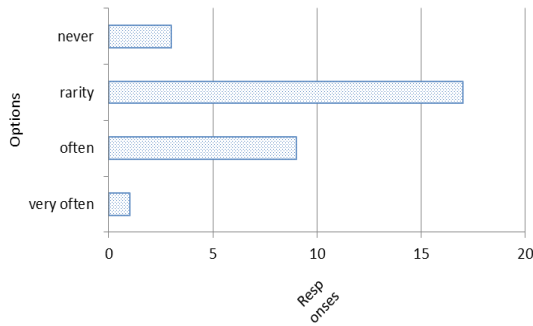
Figure 9. Questionnaire responses on the activity in the discussions in the forums (Source: own research)

According to the final questionnaire, almost 37% of the students printed the electronic materials, 7% printed only some topics, and the rest studied the materials directly from the computer screen. However, the log file analysis proved that study materials were one of three least visited types of resources and/or activities.

As many as 90% of the students stated that the opportunity to study at home was very comfortable for them – this was confirmed also by the analysis of the log file where the most of the course access logs were from the computers outside the university.

Each chapter contained also the list of additional resources. The outcomes of the questionnaires showed that 73% of the students used them during their study. The web graph, on the other hand, shows that literature was the least visited category. We can suppose that additional resources were seen by the great amount of the students but most of them visited them only once.

3.4 E-learning

The next part of the questionnaire was focused on the forms of distance learning. E-learning as the form of education interested quite a lot of participants (Table 3.). The responses also showed that only 13 per cent participants had previous experience with an e-learning method of instruction.

Table 3. The preferred type of distance learning

E-learning via internet	Traditional, printed material, CD	Blended learning
63 %	23 %	14 %

The pictures and videos as the form of study materials were preferred in comparison to text, animation and audio (Figure 10.) [26].
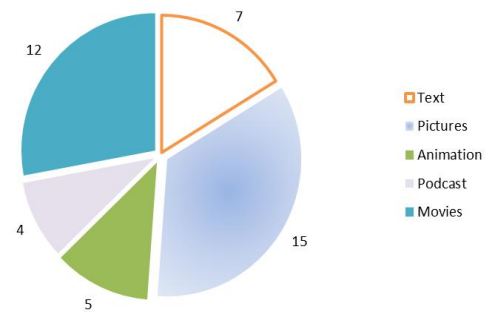

Figure 10. The preferred type of study material (Source: own research)

In the questionnaire, there were two questions asked using Lickert scale for the answers:

Q1: What was your study supported by e-learning like?
Q2: How much have you learnt during the study?

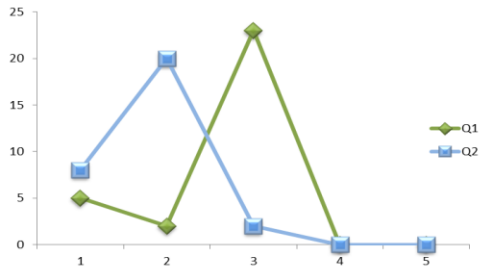The chart (Figure 11.) shows the number of responses to the questions.

Figure 11. Responses on question Q1 and Q2. Q1 Answer: Very easy (1) … Very difficult (5); Q2 Answer: Very much (1) … Very little (5) (Source: own research)

Only 3 % of participants presented that such form of study did not suit them, on the contrary, as many as 80 % stated that they would like to participate in a course like that again.

Since the participants were at the same time students of Constantine the Philosopher University in Nitra, we were interested in how they perceive the opportunity to study externally and learn via electronic means. In table 4 we present the questionnaire responses to the question on recommended type of study in which e-learning would be used. The outcomes say that they recommend this method mainly in life-long learning.

Table 4. Recommended type of study for e-learning method

Specialisational	Qualificational	Life-long	Do not recommend
27 %	13 %	60 %	0

E-learning form of study is available and accessible 24 hours a day. Each student has his/her own routines and is used to study in different time periods according to individual needs. The participants' responses regarding the time of a day most suitable for e-learning are presented in Table 5. We can see that evening and night study was most preferred.

Table 5. Time of studying via e-learning

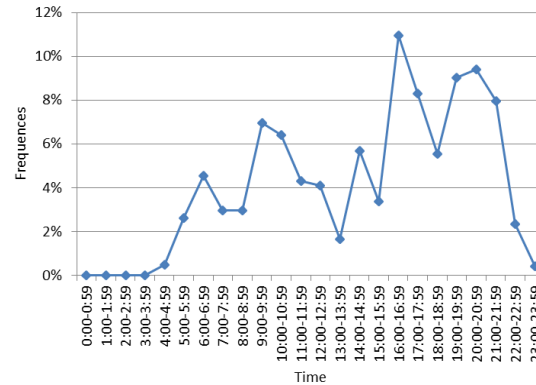| morning	afternoon	evening	Overnight	any time
7 %	17 %	50 %	20 %	7 %

Fig. 12. Log on entries categorized by the time (Source: own research)

On the other hand, if we take a look at the log file outcome, we see that the greatest amount of accesses was in the afternoon. The analysis showed that the most access entries were between 4 pm and 5 pm. Except of three hours at night, the activity of the students was distributed among the whole day (Figure 12). However, the evening activity was still much higher in comparison with the activity during the day.

Finally, we would like to present some quotes from the participants of the course:

... I am honestly very glad, that new possibility of study like these and gaining information are developing. It will bring huge positive to the students in the future – so they will have all information clearly completed, they can have easy access to the materials for studding quickly and whenever they want to, they can discuss between themselves and also with teacher, it is great that monolingual dictionary and links of literature are included in the

194

course, too, simply everything what is given to the student is easy to get.

... I was interested in self testing. It was great that we could test, we quickly got the valuations, we knew what mistakes we made, it pressed us to improve us all the time, to obtain the best results, very good, really.

... I did not take part in the discussion, because there was nothing to discuss about. The group mostly talked about the topic of final examination. There were few remarks to the course. I think that if the course is provided by a group which will want to do e-learning, the discussion will be much more full-valued.

... I have also seen another e-learning course from other schools and (this) yours is really great, nicely clear, the orientation is easy, very thing works well from the technical point of view.

4 DISCUSSION

The obtained data, both from the questionnaire and mainly from the adjusted log files of e-courses, were used for finding out certain rules of behaviour of course participants, using usage analysis. It has been shown that the course was considered too textual and the students missed pictures, animations and other multimedia applications, which was also proved by the analysis of the visit rate of categories of parts of the course [14].

The course was mainly used for the communication among the participants as well as the tool for the assignment distribution and collecting, Students were motivated for active studying also by the allotment of 20 credits for successful passing of this course necessary for their career advancement (the assignments were compulsory for the students to obtain this credits necessary for their carrier advancement). Among the most frequent moves from the main page we can name displaying the list of assignments (Assignment view all), displaying the list of users (User view all) and displaying of the list of test (Quiz view all).

Study materials were used much less than we expected. However, that does not mean that the students would not read them. On the other hand, students used tests quite a lot as they seem to be a good preparation for the state exams (77 % of them stated that self-tests were most helpful activity). The quiz reports show that a lot of students repeated the quiz attempts several times till they gained 100%. The outcomes of self-tests were displayed for some time for all the students so they could compare the results which increased the competition among them.

Summary: We found four significant differences between questionnaire survey and log-on file analysis.

A) Using on-line study material – according to data mining results, study materials were one of three least visited types of resources and/or activities. According to the final questionnaire, almost 60 % of students studied the materials directly from the computer screen. Does student print the material or save the material at their first display?

B) Using additional electronic resources - according to data mining results, literature was the least visited category. According to the final questionnaire more like 70% of students used them. Were materials visited by students only once?

C) Using discussions (forum) - according to data mining results, the course was mainly used for the communication among the participants.

According to the final questionnaire only one third of the students were active in the forums.

D) Study time - according to data mining results, most access were in the afternoon (between 4 pm and 5 pm). According to the final questionnaire students studied mainly in the evenings. Is there a different meaning about when evening an afternoon starts?

5 CONCLUSION

In the beginning we stated the question if there is a difference between the responses of questionnaire investigation and the real log entries in the e-course. Thanks to the gained data we were able to formulate several association rules of the users behaviour in the course that were described in this paper, especially in the discussion. In some cases, the differences were found in how students responded in the questionnaire and what the analysis of log file proved. The possible reason for this may be that they knew the questionnaire was not anonymous while in case of the study itself they felt more independently. We can assume that the questionnaire method is not relevant for gaining the information about the process of study in the e-course because the user can embellish the responses or sometimes he/she is not even able to say how often he/she accessed the other parts of the course. One reason for this can be that some processes can become trivial and the user does not see them as important. Via analysis like the one described above we will be able to make the e-courses more effective and attractive for the students to perform better effectiveness of e-learning study. Analysis of users' behaviour via the method of usage analysis seems to be one of more relevant possibilities how to describe and visualize real behaviour of the user in the e-course. On one hand, this method is quite complicated for interpretation – it requires a professional in the field of statistics and web data mining. On the other hand, data collecting is automated and is not influenced by any personal factors.

It would be interesting to compare the questionnaire responses and the usage analysis separately for particular participants – that may be the objective of another research.

The dissemination of the outcomes was carried in MF&Partners Consulting in Lyon [27] which is the expert for supranational management and also took part in the valorization of the project. All the outcomes of the project were presented there, i.e. the e-courses, books, and proceedings, and the coordinators of the project as well as the partners expressed high satisfaction with all presented materials. In spite of the fact that the project finished, the cooperation among the Slovak partners continues in another project, this time at the level of faculties. The project Virtual Faculty – Distance Learning at the Faculty of Social Sciences and Nursing of Constantine the Philosopher University in Nitra started in 2010. Its aim is to create virtual faculty that would be based on e-learning courses available for the students 24 hours a day, 7 days a week. Its effectiveness requires the involvement of pedagogues trained for e-learning education and able not only to manage the education but also to prepare appropriate materials and activities for this type of education. The processes and outcomes defined and verified at the level of one faculty can be, in case of successful realization, applied also to the

other faculties that are at the moment functioning rather individually.

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