Qualitative Analysis: Identification of the Factors Influencing e-Learning System Acceptance

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***Abstract* — This paper demonstrates the results of our research activities, which investigated the positive and negative aspects of an e-learning system called Moodle. The research involved 235 students, providing us with unstructured answers about their opinions on what features are most important when using an e-learning system. The research focused on what students felt was missing and what they thought were the most important and beneficial features for an e-learning system used for on-line learning. Based on their answers, we conducted a qualitative analysis and identified the main factors that influenced the acceptance of e-learning systems. Based on the results of the qualitative analysis, we have proposed a theoretical acceptance model that could be used to measure the acceptance and use of an e-learning system.**

Keywords- e-learning system; Moodle; acceptance

I. INTRODUCTION

The basic goal of our qualitative research, conducted at the University of Maribor's Faculty of Electrical Engineering and Computer Science in Slovenia, was to identify the main factors that influence a user's decision, to use a certain e-service -- in our case, a specific e-learning service called Moodle. By analyzing the quality of the data, we wanted to provide an answer to the question: what are the factors that significantly influence the acceptance and use of an e-learning system and how do we measure them? The research was done step by step, as defined by the quality process execution of empirical research.

Perceived usefulness is the most important factor that predicts the acceptance and use of e-learning system. This causal relationship was confirmed by Yi and Hwang [1], Ong et al. [2], Liaw et al. [3], Zhang et al. [4], Ngai et al. [5], Lee [6], Vanraaij and Shepers [7]. However, Brown [8] showed that in the developing country, the perceived usefulness is not the main predictor of usage of an e-learning system. In his research, the perceived ease of use was found to be the most important factor. E-learning system acceptance studies found in the literature are usually based on existing acceptance theories and models, where researchers try to confirm causal relationships proposed by the theoretical model on which the study is grounded. The main objective of this study was to find additional factors, which are not included in existing acceptance theories that may have significant influence on user's perceptions when using an e-learning system.

This paper is presented in the following manner. The second section presents the facts about the research: the planning, data collection and data analysis, and how we created data codes from the results. The third section presents the implementation and results of the qualitative analysis method and the fourth section discusses the results. The fifth section describes the limitations we had to take into consideration. The sixth section concludes the main knowledge gained over the course of our research.

II. RESEARCH METHODOLOGY

This research was focused on the factors that influence the user's decision to use a specific e-service in the future. We chose a qualitative research approach to gain data. Based on this, we developed a theoretical model composed of the most important factors that influence the user's decision. We did this because we wanted to gain as much information as possible, and not restrict our research to only our ideas, as would have been the case if we conducted a structured question survey type of research. In our research, we defined a specific area of e-services that we would research in more detail, the e-learning system Moodle, a rather popular open source e-learning system that was also used at the Faculty of Electrical Engineering and Computer Science in Maribor.

A. Research Questions

The main objectives of this research were 1) to identify the factors that influence the acceptance of an e-learning system, and 2) to compare the identified factors with the factors of existing empirically tested acceptance models together with factors from existing quality models.

Since the research focused on a specific system, the targeted participants in the research were all users of the Moodle system. Therefore, the ideal population in our case is represented by all users of Moodle. Because Moodle is an open source system, it is very difficult to determine the number of users currently using the system. Each month the number of registered users increases by approximately 1,300. Based on a statistical report from September 2010 [9], there were 49,481 registered and approved Web Moodle installations in 211 different countries. At the time of this paper, the number of registered users reached nearly 37 million.

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The method, chosen as appropriate for collecting qualitative data, was an online survey with open unstructured questions. An online survey was chosen so that the respondents were not limited by time while participating. The study participants were entirely free to decide on their level of participation. To compare the factors affecting the use of Moodle we asked the following research questions: 1) What features and/or characteristics are most important for the use of the online course management system, Moodle, and 2) What features and/or characteristics are missing when using the online course management system Moodle?

B. Data Collection

The answers to previously defined questions were provided by the users of different Moodle systems that had been installed in Slovenia. The invitation to participate in an online survey was sent to every student that had registered for Moodle at the Faculty of Electrical Engineering and Computer Science in Maribor at the time of the survey. We also sent a request for participation to a number of contact addresses at various higher education and other education institutions in Slovenia.

III. Data Analysis

In answer to the first question ("what is most important") we received 232 replies. For the second question ("what is missing") we received 227 responses. In the following sections we will present the method behind the qualitative data analysis and the results of the analysis.

A. Analysis method

The answers given by the respondent's online survey were provided in a qualitative form. The qualitative data was not numerical; therefore it was necessary to choose a method for qualitative analysis, whose basic purpose is to work with raw qualitative data and formulate it into new concepts or improve already existing concepts.

To define the concepts from qualitative raw data we performed coding, which is one of the most common techniques for qualitative analysis. While coding qualitative data, the raw data was arranged into conceptual categories and, in this way, new topics or concepts were created. The coding was carried out in order to reduce the amount of data and to effectively manage information units. The process of coding, which was managed based on the two research questions, consisted of two concurrent activities: data reduction and the analytical categorization of data. The general coding technique was then supplemented by a method of successive approximation, whose aim was the improvement of theories or concepts that were acquired in the coding method. The basis of the successive approximation method was represented by basic theoretical models and concepts, as defined in the coding method.

B. Results of Data Coding

For the purpose of qualitative data analysis, we used a test version of a tool called QDA Miner [10]. QDA Miner is a tool devoted to analyzing qualitative data that provides features for: 1) text management with support for various file formats such as Excel, Word, SPSS, etc., 2) text retrieval tools for searching for specific simple and complex text patterns in documents, 3) text coding tools for creation and edition of hierarchical codebooks, code merging, splitting, etc., and 4) qualitative analysis tools for obtaining a list of all codes along with different statistics such as their frequency, the number of cases in which they are found, etc.

Table 1 summarizes the list of codes that were identified in the process of coding during the qualitative analysis of answers to the first question ("what are the most important features"). The list of codes is arranged in descending order of frequency codes. For each code, we also determined the percentage of code opposed to the full list of codes. The most frequently identified code was the accessibility of the material as well as the availability of the learning material.

TABLE I. Identified Codes and Code Classification in Concepts

Code	***N***	***%***	***Concept***
Learning material availability	86	18.70	Usability
Electronic task submission	55	11.90	Usability
Evaluation supervision and records of grades, assessments	29	6.30	Usability
Transparency	23	5.00	Quality of UI
Calendar and Information notifications	22	4.80	Usability
Quizzes	21	4.60	Usability
Security and data privacy	19	4.10	Security
Simplicity	17	3.70	Ease of Use
Communication	16	3.50	Communication
Smooth operation	15	3.30	Stability
System reliability	15	3.30	Reliability
Fast transfer	14	3.00	Responsiveness
Forum	13	2.80	Usability
Logging in anytime and anywhere and SSO	12	2.60	Availability, SSO
Up-to-date information	11	2.40	Content quality
Material quality	11	2.40	Content quality
Simple and clear interface	10	2.20	Quality of UI
Explanation of exercises and solved examples	9	2.00	Content quality
Exact description of to-do tasks	7	1.50	Content quality
Unity, Moodle unification	5	1.10	Facilitating conditions
All information in one place	5	1.10	Usability
Modern design and technology	4	0.90	Quality of UI
Stability	4	0.90	Stability
Connectivity with other systems	3	0.70	Interoperability
Live communication	2	0.40	Communication
Archiving, version control	2	0.40	Maintenance capability
Efficiency	2	0.40	Efficiency
Search tool	2	0.40	Usability
Contentment with the system	2	0.40	Contentment
Personification	2	0.40	Personalization
Multimedia content, animations, video	2	0.40	Content quality
RSS news	2	0.40	Web 2.0
Minimization	1	0.20	Quality of UI
The window flexibility	1	0.20	Adaptability of UI
Task verification	1	0.20	Functionality
Appropriate indexing	1	0.20	Functionality
Guidance for further acquisition of knowledge	1	0.20	Content quality
Organization between objects and groups	1	0.20	Organization of UI

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Code	*N*	*%*	*Concept*
Availability of content after schooling completion	1	0.20	Availability
Insight of registered in the subject	1	0.20	Functionality
Multiple browser support	1	0.20	Portability
Single sign on - SSO	1	0.20	Availability, SSO
Multilingualism	1	0.20	Quality of UI
Sophistication	1	0.20	Accuracy
Games and fun	1	0.20	Playfulness
Consistency	1	0.20	Consistency
Functionality	1	0.20	Functionality
Interactivity	1	0.20	Interaction
FAQ for each subject	1	0.20	Usability
Codes together	**459**	**100**	

Figure 1 shows built share codes, depending on their frequencies. In the chart, we can see that 40% of codes occurred more than five times, however, 34% appeared only once.

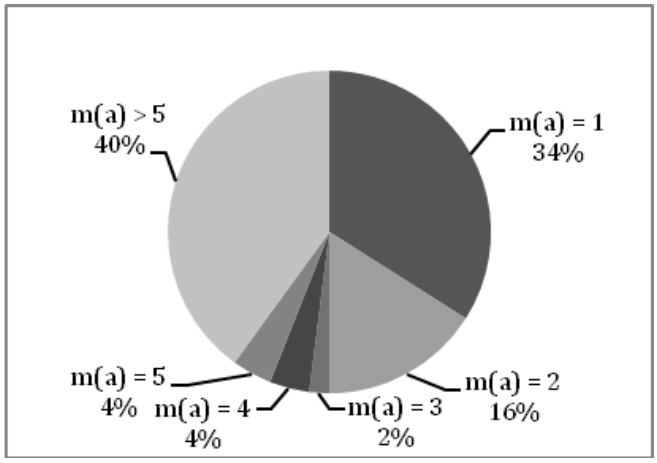

Figure 1. Share of equal codes depending on their frequency (1. question)

TABLE II. IDENTIFIED CODES AND CODE CLASSIFICATION IN CONCEPTS

Code	*N*	*%*	*Concept*
Satisfaction	46	16.5	Quality of service
Unity, Moodle unification	25	9.00	Facilitating conditions
Modern design and technology	18	6.50	Quality of UI
Calendar and Information	14	5.00	Usability
Other forms of communication - chat	14	5.00	Communication
Transparency	12	4.30	Quality of UI
Up-to-date information	9	3.20	Content quality
Evaluation supervision and records of grades, assessments	9	3.20	Usability
Simple and clear interface	7	2.50	Quality of UI
Multimedia content, animations, video	7	2.50	Content quality
Notifications	6	2.20	Usability
Access via mobile devices	6	2.20	Availability
Material availability	6	2.20	Usability
Organization of objects and groups	6	2.20	Quality of UI
Communication	6	2.20	Communication
Quizzes	5	1.80	Usability
Connectivity with other systems	5	1.80	Interoperability
Security in data privacy	5	1.80	Security
Possibility of self-verification	5	1.80	Usability
Material quality	5	1.80	Content quality
Support for other browsers	4	1.40	Portability
All information in one place	4	1.40	Usability
Simplicity	4	1.40	Ease of Use
Forum	3	1.10	Communication
Logging in anywhere, anytime and SSO	3	1.10	Availability, SSO
Search tool	3	1.10	Functionality
Live communication	3	1.10	Communication
Exact time	3	1.10	Functionality, Reliability
Publication of old content and exams	3	1.10	Availability
The flexibility window	2	0.70	Adaptability of UI
Archiving, version control	2	0.70	Maintenance capability
FAQ for each subject	2	0.70	Functionality
Explanation of exercises and solved examples	2	0.70	Content quality
Games and playfulness	2	0.70	Playfulness
Fast transfer	2	0.70	Responsiveness
personification	2	0.70	Personalization
Additional content	2	0.70	Content quality
Simply upload files	1	0.40	Ease of Use
Consistency	1	0.40	Consistency
Possibility for remote learning	1	0.40	Availability
The possibility of re-submissions	1	0.40	Functionality
Support for research work	1	0.40	Usability
Subscription to an oral exam	1	0.40	Functionality
Diversity	1	0.40	Adaptability
Direct access to profiles	1	0.40	Functionality
Minimalism	1	0.40	Quality of UI
Exact description of tasks	1	0.40	Content quality
Teamwork	1	0.40	Functionality
Stability	1	0.40	Stability
Smooth operation	1	0.40	Stability
Electronic task submission	1	0.40	Usability
Free entry	1	0.40	Availability
Enough space on the server	1	0.40	Efficiency
RSS news	1	0.40	Web 2.0
Codes together	**279**	**100**	

Table 2 summarizes the list of codes that were identified in the process of coding during the qualitative analysis of responses to the second question ("what features are missing"). The list of codes is arranged in the descending order of frequency codes. For each code, we also determined the percentage of codes depending on the full list of codes. From the list of codes, it is evident that individual codes were identified several times. The code "Satisfaction" had the highest frequency.

Figure 2 presents code shares, depending on their frequency. The chart shows that 31% of codes appeared more than five times, while 25% of codes appeared only once.

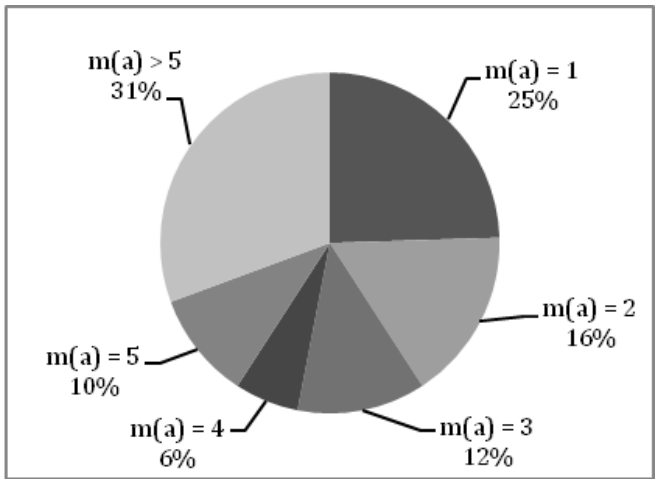

Figure 2. Share of equal codes depending on their frequency (2. Question)

IV. IMPLEMENTATION AND RESULTS OF A SUCCESSIVE APROXIMATION

Entrance to the process of successive approximation was presented by a list of identified codes and an initial list of concepts. This was formulated on the basis of characteristics and sub-characteristics ISO/IEC 9126-1 [11], factors in the design of e-service quality (SERVQUAL [12], Dromey [13], McCall [14]) and concepts in technology acceptance models (TAM [15], UTAUT [16], TTF [17]). We tried to sort each code to a list of initial concepts based on the following semantic relationships (R):

- The code is equal to, or synonymous with, the concept, or
- The code is a hyponym of the concept.

If the code could not be inserted into the list of concepts, a new concept was defined; namely the term hypernym, which was then added to the list of concepts.

Table 3 shows the final list of concepts, arranged based on the relevance of each concept, which were discovered in the set of all concepts in the encoding phase. From the list, it is evident that Moodle users found 'Usability' to be the most important aspect of e-learning. This result is consistent with the results given by a previous meta-analysis of data identified in the systematic review of existing literature. Following this, the most important concepts that affect the use of e-learning are: the quality of the user interface, the quality of the learning content, satisfaction, the quality of e-service, facilitating conditions, availability, uniform appearance and use of the system in various subjects; security, ease of use and stability.

TABLE III. LIST OF IDENTIFIED CONCEPTS, ORDERED BY RELEVANCE

Concept	Model	%
Usability	TAM	41.03
UI Quality	ISO	10.62
Content Quality	ISO	8.18
Satisfaction	/	5.86
E-Service Quality	Quality of e-service	5.49
Facilitating Conditions	UTAUT	4.40
Availability	SERVQUAL	3.05
Uniform Appearance	/	3.05
Security	ISO	2.93
Ease of Use	TAM	2.81
Stability	ISO	2.56
Responsiveness	/	1.95
Functionality	ISO	1.95
Reliability	ISO	1.83
Interoperability	ISO	0.98
Maintainability	ISO	0.49
Personalization	/	0.49
UI Adaptability	ISO	0.49
Efficiency	ISO	0.37
Web 2.0	/	0.37
Perceived Playfulness	/	0.37
Consistency	/	0.37
Understandability	ISO	0.12
Accuracy	ISO	0.12
Interactivity	/	0.12

V. DISCUSSION

The objective of implementing web survey was to answer the questions that were presented in this paper. The study was limited to a specific e-learning system. The study involved 534 users, who used Moodle for educational purposes at various institutions. Based on the 232 responses to the question RQ_1 "What functionality and/or characteristics are most important for the use of Moodle," we identified 459 codes, of which the most common was perceived usability of the system.

Based on the 227 responses to the question RQ_2 "What Functionality and/or features do you miss when using Moodle," we identified 279 codes, in which the most common concept proved to be satisfaction. Students find that an e-learning system should provide a modern and unified user interface for all on-line courses. E-learning system must also provide mechanisms for communication with the professor/teacher and other students.

We performed a successive approximation, and a common qualitative data analysis, over a set of codes that we acquired in the encoding data phase. Using the illustrative method, we tried to connect the identified codes with concepts from existing theories. The basis for the method of successive approximation were the relations "is synonymous with" and "is a hypernym term". Finally, we performed an illustrative method.

As the final result of the qualitative analysis, 25 concepts were identified. Among them, the following concepts/factors have proven to be most relevant and we have included them in the theoretical (causal) model, which is illustrated in Figure 3. We applied the model in the UTAUT model, where we changed the variables from a TAM model with similar variables as a UTAUT model, namely:

- Perceived Usability (TAM) → Performance Expectancy (UTAUT) and
- Perceived Ease of Use (TAM) → Effort Expectancy (UTAUT)

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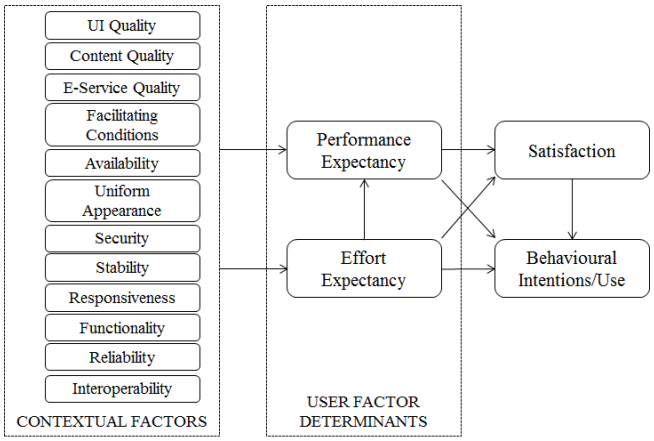

Figure 3. Theoretical model of acceptance of the Moodle system

VI. LIMITATIONS

When interpreting the results we had to take into consideration the following restrictions:

- *Restrictions on the methods of research* – the surveys were conducted through an online survey system, where each respondent expressed their opinion in one answer. The online poll did not allow the development of discussions, so the answers reflect the respondent's current feelings. Still, the survey contained two clearly defined and focused questions, which contributed to the relatively large number of responses and answers.
- *Limitations of the study frame* - the sampling frame of our study was purpose oriented and undetermined. Users responded to the survey based on their own motivations. For this reason, the results are difficult to generalize for the population of all Moodle users. The results do, however, give a general picture, since the sample was relatively large and contained a large variety of respondents coming from various educational institutions. In this study, only learners participated. In order to get the whole picture, the opinion of the instructors should also be included. Users that participated in this study, come from different institutions that may have different Moodle implementations.
- *Restrictions on analytical techniques* - an analysis of qualitative data was conducted in a systematic way, where we tried to nullify subjective influences. In the process of data coding, we identified codes directly from the qualitative data. The results of the qualitative data were obtained analytically by using semantic relationships between codes and concepts.
- *Research repeatability* - it is likely that in the event of performing a re-analysis by using other concepts from existing models of quality and acceptance, we would receive a final list of concepts, where individual concepts and their structure would be significantly different.

VII. CONCLUSION

In this paper, we presented quality research, identifying the factors that influence e-learning system acceptance. We conducted a survey, asking respondents two main questions: what features are important in an e-learning system and what do they miss in the e-learning system that they currently use. With their answers, we defined the main factors. In the case of importance, learning material availability was considered the most important factor that respondents expressed. In the case of missing features, "satisfaction with the system" was the main issue. E-learning system developers and professors/teachers/instructors should therefore search for features that could improve user's degree of satisfaction when using an e-learning system for learning purposes. There are many factors that may have influence on user's overall satisfaction with the system. E-learning system developers must consider how to integrate the e-learning environment with new services and technologies. New technologies with social openness will lead into a social revolution, where learners will actively participate in the learning content creation and learning process. E-learning system developers should therefore consider about how to integrate e-learning system with Web 2.0 technologies and services (Wiki, blogging systems, RSS, Twitter, Youtube, Flickr, Slideshare, Facebook, etc.).

The factors that we identified with a qualitative analysis were used to develop a theoretical model of Moodle system acceptance. In the developed acceptance model, the quality of the user interface and learning materials, functionality, availability, security, facilitating conditions and stability showed an influence on the learner's performance expectancy and effort expectancy, which are both predictors of a user's behavioral intentions in using a specific e-learning system. In our future research work we will conduct a quantitative study in which we will evaluate the research model and try to confirm/reject the proposed causal relationships.

VIII. REFERENCES

[1] M. Yi and Y. Hwang, "Predicting the use of web-based information systems: self-efficacy, enjoyment, learning goal orientation, and the technology acceptance model," *International Journal of Human-Computer Studies*, vol. 59, 2003, pp. 431-449.

[2] C. Ong, J. Lai, and Y. Wang, "Factors affecting engineers' acceptance of asynchronous e-learning systems in high-tech companies," *Information & Management*, vol. 41, 2004, pp. 795-804.

[3] S. Liaw, H. Huang, and G. Chen, "Surveying instructor and learner attitudes toward e-learning," *Computers & Education*, vol. 49, 2007, pp. 1066-1080.

[4] S. Zhang, J. Zhao, and W. Tan, "Extending TAM for Online Learning Systems: An Intrinsic Motivation Perspective," *Tsinghua Science & Technology*, vol. 13, 2008, pp. 312-317.

[5] E. Ngai, J. Poon, and Y. Chan, "Empirical examination of the adoption of WebCT using TAM," *Computers & Education*, vol. 48, 2007, pp. 250-267.

[6] Y. Lee, "The role of perceived resources in online learning adoption," *Computers & Education*, vol. 50, 2008, pp. 1423-1438.

[7] E. Vanraaij and J. Schepers, "The acceptance and use of a virtual learning environment in China," *Computers & Education*, vol. 50, 2008, pp. 838-852.

[8] I.T. Brown, "Individual and Technological Factors Affecting

 ISBN: 978-1-61208-120-5

Perceived Ease of Use of Web-based Learning Technologies in a Developing Country," *The Electronic Journal of Information Systems in Developing Countries*, vol. 9, 2002, pp. 1-15.

[9] "Moodle.org: open-source community-based tools for learning," *http://moodle.org/*.

[10] "QDAMiner." [Online]. Available at: http://www.provalisresearch.com/QDAMiner/QDAMinerDesc.html [Accessed: 21-Oct-2010].

[11] ISO/IEC 9126-1:2001.

[12] A. Parasuraman, V.A. Zeithaml, and L.L. Berry, "SERVQUAL: A Multiple-Item Scale for Measuring Consumer Perceptions of Service Quality," *Journal of Retailing*, vol. 64, 1988, pp. 13-37.

[13] R.G. Dromey, "A Model for Software Product Quality," *IEEE Transactions on Software Engineering*, vol. 21, Feb. 1995, pp. 146-162.

[14] J.A. McCall, P.K. Richards, and G.F. Walters, "Factors in Software Quality. Volume I. Concepts and Definitions of Software Quality," Jul. 1977.

[15] F.D. Davis, "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly*, vol. 13, Sep. 1989, pp. 319-340.

[16] V. Venkatesh, M.G. Morris, Gordon B. Davis, and F.D. Davis, "User Acceptance of Information Technology: Toward a Unified View," *MIS Quarterly*, vol. 27, Sep. 2003, pp. 425-478.

[17] D.L. Goodhue and R.L. Thompson, "Task-Technology Fit and Individual Performance," *MIS Quarterly*, vol. 19, Jun. 1995, pp. 213-236.

 ISBN: 978-1-61208-120-5