Learner–content interaction in distance learning models: students' experience while using learning management systems

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Abstract: Distance education or distance learning is a process that provides access to learning when the source of information and the learners are separated by time and distance. It is a field of education that focuses on the involvement of technology and the social aspect, while delivering knowledge and training to students over distance. This study focuses on the social aspect regarding learner–content interaction in distance learning models, evaluates several learning managements systems while investigating the relations among different variables which impact the degree of students' learning experiences. A survey among students in different universities was conducted, Structural Equation Model (SEM) was created and analysed with Confirmatory Factor Analysis (CFA), for better understanding of the factors which predicts student satisfaction from such learning environments. Research findings illustrate the relationship among usability, adaptability of the system and students' experience. Limitations to the research and recommendations for future research are also being discussed.

Keywords: distance education; learner–content interaction; students' experience; survey; SEM; structural equation model; learning management systems.

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1 Introduction

The education in wider sense represents action or perceived knowledge that has a purpose to shape person's mind, character or physical capabilities of an individual. As the way of life becomes more complex, education has to develop and change its forms and models for better integration with the modern society. There are different research approaches, publications and best practises which focus on the components of education, their interaction and implications on the development of the whole process. For thousands of years, learning and teaching always took place in close proximity, and this has become classical model for education. Distance education or distance learning has emerged as a process that provides access to learning when the source of information and the learners are separated by time and distance. It was initiated by the need to deliver education in remote and distant places, which followed in development and different research activities in this area. There are different chronologies that list certain activities and events that influenced the development of this field of education. Isaac Pitman (Leedham and Downton, 1987; Nagabhushan and Murali, 2003), generally recognised to be the first modern distance educator, reduced the main principles of his shorthand system to fit into postcards. He sent the postcards to students, who were instructed to transcribe passages of the Bible into shorthand and send the transcription back to him for correction. This was just an attempt to provide guidance, instructions and education to students over a large geographical distance.

Distance education is often connected with the technology and its development, practical implementation and new solutions. The new communication media, videoconferencing, tele-presence solutions, web-enhanced instructions and web-based resources, have brought a new dimension to education, providing quality enhancement to distance education.

Still, the distance education process should not be always identified with the latest and the most advanced technological solutions. The common opinion which states that this type of education is just adding technology to the traditional way of education is wrong and completely out of the concept. In essence, distance education encompasses open possibilities and difference levelling, global approach to learning and education, different organisation of resources, which change the balance between the institutions

and the individuals, in order to create more effective process at the end. With such approach, this form of education delivers more efficient and cost benefit investment of the institutions' funds invested in education and training.

Any educational process tries to reach a level of perceived students' knowledge according to their potential. The goal is to reach productive balance between learner's personal factors, such as affective and cognitive variables, motivation and capabilities for learning; the instructional factors, like the professor and the context; and different social factors like learner interaction, environmental expectations, etc. Less than maximum achievement is not always due to low cognitive abilities or due to factors over which the learners exercise control. To reach this objective, utilisation of the latest technological solutions is not enough, so the influence of user's perception of quality and level of positive experience should be evaluated. Furthermore, the literature has boomed over the last few years, specifying Quality of Experience (QoE) (Muntean, 2008; Zhang et al., 2011) as a full-scale evaluation of systems' performance in terms of end-user expectation.

Therefore, this study focuses on one of the aspects of distance education, while evaluating different factors for increased students' experience from the learning process. Through the research period of few years, we have evaluated course and content delivery learning systems in several universities in Macedonia. The possibility of these systems to store, index and deliver information with computer-aided instructions, exercises, simulations and collaboration have changed the structure of students' interaction with the content and learning materials. The identification of relevant variables of such learning process could provide the means to increase the likelihood of positive students' experiences. Through the evaluation of these systems, we have investigated the relations among several variables which may impact the degree of students' learning experiences and perceived quality. In this paper, structural model is presented that encompasses several aspects of the student interaction with the content while using these learning systems and information how different variables are related to each other.

2 Related work

Several researchers considered social component and the interaction as essential element for student learning and for the overall success and effectiveness of distance education. Moore (1972) started his research, which later produced the "Theory of transactional distance" (Moore, 1997), that defined three components of distance education. These components should work together to minimise the distance during the educational process, which lead to development of three-part model of interaction. This is regarded as the first theorem that systematically defined interaction in distance education, which consists of three types of interactions: learner–content interaction, learner–instructor interaction and learner–learner interaction. Of course, none of these three methods of interaction functions independently in practice, and the overall success can be realised through correct positioning of each one of them.

Different research approaches have been made while exploring the mentioned interaction in order to deliver better QoE for the end-users. Rourke et al.'s (2001) 'community of inquiry' model of online learning presents how all three work together, while hypothesising for the relationship between social presence, cognitive presence and teaching presence. According to Garrison et al. (2001), cognitive presence is defined as

the extent to which the participants are able to construct and confirm meaning most often associated with critical thinking. The social presence model is defined as "the ability of learners to project themselves socially and emotionally in a community of inquiry" (Rourke et al., 2001). Teaching presence is defined "as the design, facilitation, and direction of cognitive and social processes for the purpose of realising personally meaningful and educationally worthwhile learning outcomes" (Anderson et al., 2001).

Learner–instructor interaction is a part of different research analysis, which try to systematically observe and categorise types of learner–instructor interactions (Richarson and Swan, 2001; Kuo et al., 2009). It has been shown that the asynchronous media which does not support active and regular effective contact produces weaker results in students' perceived knowledge than the synchronous media that provides better social interaction. Furthermore, the use of technology may allow an instructor to meet that goal in a greater variety of ways and tailor different teaching methods to individual students.

Learner–learner interaction (Nijholt, 2002; Sunny, 2008) provides exchange of opinions, discussion, global information sharing, distributed thinking, collaboration, which creates stronger results in students' perceived knowledge.

The interaction between the learner and the content plays also an important part within the distance learning process. It is generally accepted that during this basic form of interactivity in distance education, the learner gains and constructs knowledge by working directly with the subject materials. Therefore, different researches have proposed strategies for supporting deep and meaningful student interaction with the content (Tuovinen, 2000; Dunlap et al., 2007) or even evaluate usability of the learning object repositories (Balatsoukas et al., 2008; Sicilia et al., 2010). Some propose heuristic evaluation (Nielsen and Molich, 1990) as a method of usability analysis of the user interface design, so that they can be corrected as part of an iterative design process.

In this paper, we focus on different aspect while exploring the social behaviour of learner–content interaction. We believe that this type of interaction is less researched than the others, especially from the users' point of view. We try to produce results that will shape and give guidelines for better positioning and improvement of this type of interaction, produce positive and motivating experience to the end-users in distance education.

Furthermore, we believe that is very important to provide relevant information for the relations among several variables and test hypotheses that may impact the degree of positive experience of the students involved in the distance learning process and ideally provide technology independent guidelines.

3 Research methodology

Learner–content interaction is a form of interaction in distance education process, encompasses different means and approaches in which the students are introduced to the material, which may be in a form of text, audio, video, computer simulation/application, etc. In essence, the students are aware of the open possibilities for information which is widely available, but the information itself does not mean perceived knowledge. That is why the learner–content interaction is important for the complete educational process. The technology has provided wide opportunities for material storage, indexing and distribution, while computer simulation, instructional tools and distance laboratories have changed the behaviour and structure in learner–content interaction. Therefore, research

approaches that incorporate technical acceptance and learners' positive experience provide qualitative input for proper learner–content interaction.

The research presented in this paper is performed over a period of several years, as a part of an undergoing project for extending and maintaining learner opportunities for students in universities in Macedonia, through development of distance learning educational systems. The project involved state universities in Macedonia located in different cities: 'Ss Cyril and Methodius' in Skopje (UKIM), 'St Kliment Ohridski' in Bitola (UKLO), and 'Goce Delcev' in Stip (UGD) and their learning management systems that include learner–content interaction. During these years, these systems were evaluated through different aspects and this paper presents an approach which explores the relations among different variables which impact the degree of students' learning experiences. The involved universities have slight difference in the technical implementation, but they can represent any national higher education institution which utilises learning management systems, so the research finding can be globally accepted.

FEIT learning environment (FEITle) is an online learning system that provides collaboration environment, exchange of materials and courses information at Faculty of Electrical Engineering and Information Technologies at UKIM. This system has 4000 users among students, teaching professors and assistants. Between March 2008 and March 2011, FEITle was visited 643,948 times, with an average of 587 visits per day. The statistical data have shown that the highest number of visits was recorded during the final exam period, moderate visit during the academic year and lowest number of visits during the summer period. This data corresponds to the learning trends in the Faculty and therefore we can conclude that the students actively used the system to enhance their learning process according to their everyday needs. During the mentioned period, 41.65% of the students access the site directly, 53.85% from referent sites (mostly Faculty's sites) and only 4.50% access the site using search engines.

UKLO utilises standard web-oriented application as a learning portal that houses all the necessary information about the Faculties at this University and interactive modules for web-enhanced learning environment. This system is at early stages of development and has 220 users. The research information regarding this university was included in the study, in order to have diverse maturity level of the evaluated learning management systems.

UGD have deployed Moodle-based learning management system with different learning activities (forums, glossaries, wikis, assignments, etc.) and globally available resources. This system is used in the everyday learning process by the students and the professors in these universities with a total number of 10,000 users. Therefore, this was the highest utilised system during the research study. For example, between October 2009 and October 2010, this system had 3,100,907 visits by the students only, with the highest number of 533,966 visits in March 2010. Again, this high number of students' visits gave us assurance that the provided research results are based on actual usage and real students' experience during the learning process.

This research study presented in this paper is a social research and it does not analyse the architecture, technical behaviour and the performance of these systems. It follows user's oriented approach by focusing on positive students' experience in such learning process, a key driver of technology acceptance, adoption and usage behaviour.

The purpose of the study is to explore opportunities and possibilities that these systems for distance learning provide to the students. Furthermore, we try to produce relevant measurements that can illustrate the level of students' acceptance of these

systems, students' experience and adaptability to this technology, which provides information for the improvement of the learning process in general.

To evaluate students' experience, a survey was developed and made available to a target audience in the mentioned universities. The survey was administered online and sent to different level of graduate and post-graduate students. The survey allowed students to reflect on their online-learning experience regarding the comfort and ease of usage of the learning system, its adaptability and the possibility to improve the learning process.

The survey had two different parts: the first questionnaire asked for background information, such as age and gender, as well as information regarding the students' levels of prior knowledge for the learning managements system in their universities. The second questionnaire asked the students about their perceptions of the learning managements system and their opinion on different aspects regarding usage, interface organisation, positive influence of the system in the learning process, etc. These questions were chosen carefully so students' adaptability to this technology can be evaluated in a form of students' experience through different hypotheses.

The number of evaluated students was 236: 40 from UGD, 150 from UKIM and 46 from UKLO. The sampling method covers the general students' population in the universities and these numbers include 63% male and 37% female students, 84% graduate and 14% post-graduate students with satisfactory computer skills and knowledge. 89 % of the evaluated students were between 20 and 30 years of age. Furthermore, the involved students were interested to participate in the study and they were using the system to perform everyday activities, so their responses and insight are considered relevant and accurate.

After filling the demographics information, these students were asked to specify if they have used the learning management system present at their universities. High numbers of 196 students (83% of the total) have filled in that they have used these systems during the learning process, which provided us with positive input that evaluation results can be used in deeper analyses. These students continued to answer the second part, where their opinion and experience on different aspects from using these learning systems was evaluated. They were able to grade different questions on a scale from 1 to 5, where 1 is strongly disagree and 5 is strongly agree on each question.

From the answers of different questions, we were able to identify relevant factors which may influence the students' experience. This quantitative numbers were used in further analyses while identifying input variables for the structural model that can define inner-correlation and test different hypothesises (Section 4).

Through this research study, we have tested the following hypotheses:

H1: Proper instructions and simplified usage of the learning management systems highly influence the level of positive experience when these systems are introduced in the learning environment.

H2: The usability of the system and it's adaptability to users' needs are closely related to each other.

H3: The students' experience is depended on easy usage of the system and the adaptability of the user interface.

3.1 Information and data collection

The evaluation surveys were performed through web-oriented application, which improves effectiveness and evaluates positive impact of the learning process. Unlike standard reporting and dashboard features included in most learning and talent management software, this survey application combines data from multiple learning systems with information collected through evaluations and assessments to paint a complete picture of learning performance. It has options for professor and course management, evaluation retrieval, reporting and statistics quantitative analysis. Survey application database component houses all the data sets as well as some pre-defined educational logic. All reporting and analysis data is derived from this database component. The researchers in this paper were given access to this knowledge base application and its online database.

Students' personal data and privacy was protected at all time, and the professors were not influencing students' decision and evaluation criteria.

3.2 Information and data analysis

In the last phase of the research, reporting and analysis on the evaluations' data was performed so research findings can be proposed for better understanding of the factors that predict student satisfaction within similar learning environments. Even more, these quantitative measures could provide information for the purpose of continuously improving learning management systems and showcasing the value of the learner–content interaction in distance learning oriented system.

The gathered information was used in creating a structural model which was analysed with Confirmatory Factor Analysis (CFA) and Structural Equation Model (SEM). When building the correct model with SEM (Kaplan, 2000; Kline, 2010), two different kinds of variables, exogenous and endogenous, can be used. Student's evaluation data on different aspects (as exogenous or observed variables) was used in the regression analysis and modelling to generate information about unobserved (endogenous) variables which can predict student satisfaction from the explored learning environments.

These statistical analyses were conducted using statistical package for social sciences and Analysis of Moment Structures (AMOS) software. The results and the research findings are presented in this paper.

4 Research findings

By examining the surveys' application database which houses all the data sets from the students surveys, preliminary conclusions were made which showed the extend of students' positive experience, reflected on different aspects in learner–content interaction. These students' responses were used when defining the indicators as input variables in the proposed model for statistical analyses.

We believe that presented results in this paper could help stakeholders of the education institutions, which should take into consideration the recommendations that may contribute to a better understanding of the factors that affect student success and positive experience, while utilising learning management systems in distance environment.

By carefully evaluating students' responses on different questions, we have chosen the following list of input variables, which were part of the questionnaire (Table 1):

Table 1 Input variables

Variable name	*Description*
Easy1	The usage of the learning management system is simple and easy
Easy2	The materials in the system are easily searchable and available
Easy3	The provided instructions and guideless are sufficient for system's successful usage
Easy4	Course information can be easily found within the system
Adap1	The system is adaptable for student interaction and group activities
Adap2	The system interface is well organised and can be customised to users' needs
Exp1	The students are comfortable in using web-oriented application for course preparation
Exp2	The learning management system is useful and enhances students' learning process
Exp3	The system provides sufficient information about a selected course during the whole academic year

The actual data for these nine exogenous variables was retrieved from the students' grades in the surveys' responses. To examine the normality of the data, we have summarised the results and tested in the standardised manner. Therefore, Table 2 illustrates the surveys' response data regarding mentioned variables represented as mean, standard deviation, skew and kurtosis.

Table 2 Statistical information regarding input variables

Variable name	*Mean*	*Standard deviation*	*Skew*	*Kurtosis*
Easy1	4.60	1.290	–2.268	4.900
Easy2	4.43	1.358	–2.206	5.122
Easy3	4.70	1.178	–1.790	2.337
Easy4	4.70	1.292	–2.060	2.263
Adap1	4.10	1.573	–1.142	0.253
Adap2	4.50	1.515	–2.678	7.548
Exp1	4.80	1.182	–2.359	5.141
Exp2	4.83	1.267	–2.669	6.869
Exp3	4.70	1.264	–2.052	2.466

According to the guidelines based on computer simulation studies of estimation methods used by SEM computer programs (e.g., Curran et al., 1997), variables with absolute values of skew > 3.0 are described as 'extremely' skewed and kurtosis absolute values > 8.0–20 suggest a problem, and absolute values of kurtosis > 20.0 indicate a more serious one. We can conclude that the information presented in Table 2 illustrates the normality of the surveys' data used as input variables.

In the effort to predict different aspects, we have constructed three endogenous variables in the research model: usability of the learning management system (Easy), adaptability of the system (Adap) and students' experience while utilising the learning management system (Exp). Therefore, these not directly observed variables are forming hypothesised relationship with the observed variables.

4.1 Measurement model

The measurement model specifies how the observed variables (exogenous) depend on the unobserved (endogenous) or latent variables. It represents a CFA model which is constructed from the previously mentioned nine exogenous and three endogenous variables, with included errors of measurement (e1–e9). As mentioned, the data set for the exogenous variables was used from the grades in the students' responses on the regarding questions. The measurement scale of each unobserved variable was established arbitrarily by setting its regression weight to a constant, such as 1 (Holzinger and Swineford, 1939).Therefore, in the proposed measurement model, 11 regression weights are fixed at 1, which is one fixed regression weight for each unobserved variable, and the rest for each error of measurement. These constraints were sufficient to make the model identified.

Figure 1 illustrates the measurement model which was tested for construct validity and proper model fit.

Figure 1 Measurement model (see online version for colours)

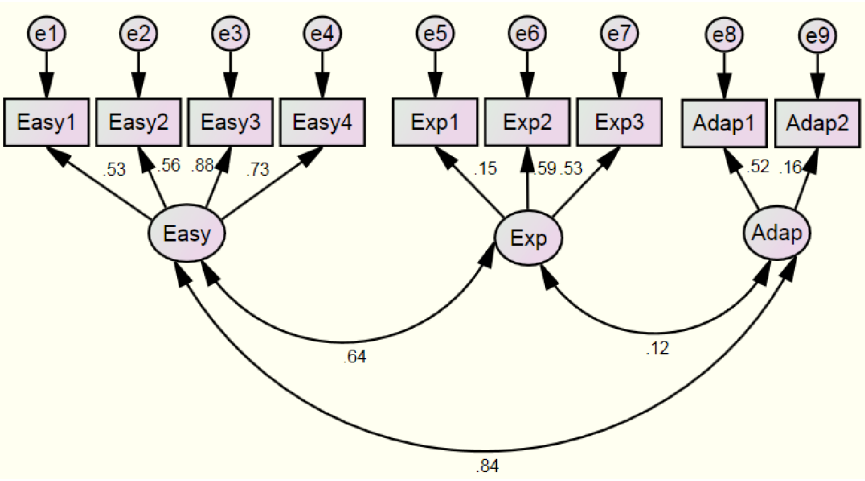


Figure 1 lists the factor loadings of the observed variables when constructing the latent variables. The highest value is the loading from the indicator Easy3 on Easy, while Adap2 on Adap and Exp1 on Exp are significantly lower than the others. We can see that Easy and Exp have higher value for correlation among each other than Adap and Exp.

The model gives us information about possible factors that could influence students' positive experience in the researched learner–content environments. As expected, Adap and Easy are closely related among each other with high correlation value.

Further exploration of the measurement model is made by observing the standardised residual covariances and modification indices. We have notice that Easy2 and e2 have higher values for modification indices with some of the other factors, and therefore we have explored the option to remove the Easy2 from further analysis. Still to justify this approach, we have compared the behaviour while building a structural model with and without Easy2 variable and test the models for higher values of model fit on different aspects.

4.2 Structural model for learner–content interaction

In the second phase of our research, we have constructed a structural model which specifies how the latent variables are related to each other. The purpose of the model is to evaluate social aspects of the learner–content interaction and possibly give actual quantitative information for the correlation of different variables, which can provide guideless for further improvement. During the study, model fit measures were obtained to assess how well the proposed model captures the covariance between all the items or measures in the model.

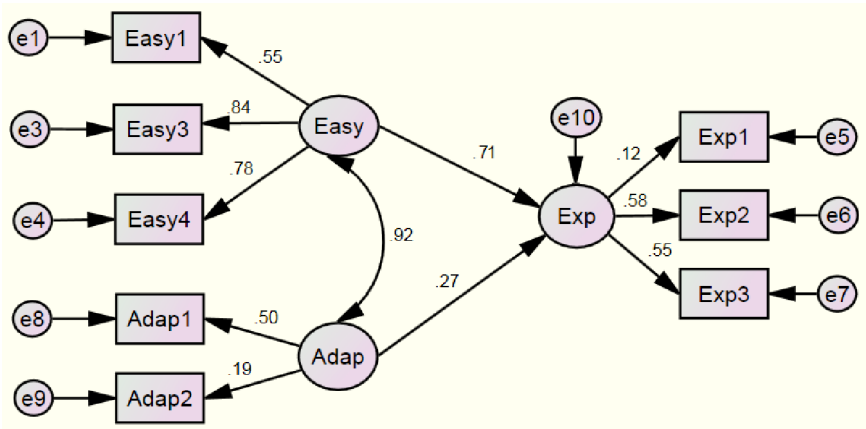
As previously mentioned, we have reviewed the results from two alternative models (with and without Easy2) for the same set of data, so we can determine which model fits the data better.

Table 3 gives information about model fit data from the two observed models and Figure 2 shows the final form of the structural model (without Easy2) with standardised regression weights.

Table 3 Model fit summary regarding two observed models

Model fit parameter	*Model with Easy2*	*Model without Easy2*
CMIN/DF	1.649	1.110
CFI	0.758	0.954
GFI	0.844	0.910
RMSEA	0.109	0.049

Figure 2 Structural model for learner–content interaction (see online version for colours)



Relative chi-square CMIN/DF, which suggests that the model has been reduced by dropping too many paths if exceeds 2 or 3 (Wheaton et al., 1977), indicates a reasonable fit in both models. Still, Comparative Fit Index (CFI) (Bentler, 1990), where values close to 1 indicate a very good fit, reports that the final structural model (without Easy2) is better than the alternative model. Furthermore, Goodness of Fit (GFI) (Joreskog and Sorbom, 1989) which ranges between 0 and 1 and 0.90 is a suggested acceptable value and Root Mean Square Error Approximation (RMSEA) (Steiger and Lind, 1980) where value of 0.05 or less indicates a close fit to the data, justifies overall model fit for the final structural model presented in Figure 2.

The information provided in the fit summary data shows that the proposed structural model and its standardised regression weights support our three hypotheses (Section 3), especially H1 and H2, since the regression weights are positive, as is the correlation between Easy and Adap.

5 Discussion and future work

Stakeholders of the education institutions are constantly interested in the factors that may contribute to student success in learning and perceived knowledge. These institutions constantly involve different pedagogical and methodical approaches to reach a level of perceived student knowledge according to their potential.

Distance learning methodologies introduce technology and new social aspects that increase efficiency, improve decision making, and provide new insights in educational process. Learner–content interaction in the distance learning models is very important for successful learning process. Different research shows that individual distance learning activities with properly structured and well-organised learning systems are not inferior to interactive learning without the proper structured material and content. Even more, some of them emphasise the importance of students' activation where learning takes place while solving complex tasks based on the students' interest (Birkenkrahe and Mundt, 2009).

The study presented in the paper evaluates students' experience while using learning management systems during the learning process. It focuses on the social element and different factors that influence higher level positive of students' experience. The survey results presented in this paper, measurement and structural model have shown that distance can be introduced between the learners and the content, while positive experience is retained. The observed variables in the study provided information about other general aspects defined as unobserved variables, which can help us understand their behaviour and correlation. The students' comfort in using web-oriented interface (Exp1) did not regress highly on the overall students' experience from the learning systems (Exp), since students had adequate computer knowledge and web usages comes natural to them. Still they were able to recognise the enhancement that these systems could offer in everyday learning process (Exp2), which influenced the level of their positive experience (Exp).

The research results have shown that proper instructions (Easy3) simplify the usage of the learning management systems (Easy), which directly influence high level of positive experience (Exp). When Easy goes up by 1 standard deviation according to the model's results, Exp goes up by 0.71 standard deviations. The regression weights in the structural model provide quantitative information about different aspects that define easy

usage of the system. The high value of the correlation between Adap and Easy in the structural model positively shows that the usability of the system and its adaptability to users' needs are closely related to each other. The connection between positive students' experience (Exp) and the easy system's usage (Easy) was stronger than between the experience (Exp) and the adaptability of the system (Adap). It shows that the students were used to the environment as it was provided by the administrators and expressed higher level of positive experience as long it was easy to interact with the system.

This study focuses on the learner–content interaction in distance learning environment only. Further results and information can be gathered if distance is introduced between the learners and the instructor, while course and content management are still conducted in virtual learning environment. We believe that quality synchronous media, video conferencing (Hanor and Hayden, 2008; Taylor, 2009) and interaction could bridge the instructor–learner distance, while the students' positive experience would not be significantly diminished. In Malinovski et al. (2011), we propose QoE measurement methods in e-learning systems based on videoconferencing platform as a form of instructor–learner interaction.

Future work will include the results presented in this paper and the results of mentioned QoE measurement methods, so larger structural models can be formed that can provide information about complex distance learning environment regarding instructor–learner and learner–content interaction, and even their interconnection. For example, properly placed instructions and information within the learning management system could influence higher level of students' QoE from a referred videoconferencing learning sessions. On the other hand, recorded sessions could be used as content in the system that will enhance the students' learning process. Such structural model with larger amount of input variables could provide deeper insight that could benefit educational institutions which utilise distance learning methods.

5.1 Limitations to the study

The research presented in the paper could have some limitations to this study that may limit its generalisation to other research settings. The findings of this study do not focus on the technology used for distance learning environments, but only on concepts and expectation that should be fulfilled for positive students' experience. We have explored learning management systems in different universities, which follow necessary standards and deliver high quality of service. These systems have appropriate technical support, so the level of students' experience results from the learning process, while the technology was performing appropriately. Some of these systems are using proprietary software solutions and some open source solutions. Still, most of the educational processes supported by similar learning management systems could benefit from this study.

6 Conclusion

Learning management systems as a form of learning–content interaction have brought new dimension in the distance educational field. Course and content management, student self-service, collaboration, globally available materials are some of the advantages that improved educational and administrative requirements. Lots of modern education institutions are already utilising some form of a learning management system,

which increases students' engagement with the learning process, simplifies the communication among the involved parties, increases effectiveness while reducing educational costs.

In our study, we have researched several learning management systems which are used in everyday activities by more than 10,000 students attending different Faculties. User-oriented approach was taken while these systems were evaluated for students' perception of quality and experience.

A survey among students in three universities in Macedonia was conducted and a structural equation modelling approach was used to gain important insights into the factors which influence higher level of positive students' experience in such learning environments. The presented model specifies regression weights and correlation among usability of the learning management system, adaptability of the system and the social aspect in a form of students' experience. These measures can help in setting up educational strategy, can create guideless for implementation of the technology and improvement in the learning management systems. This paper presents utilisation of technology in education, which is expected to play an even greater role in the field in the future.

To confirm the validity of the model, it could be subjected to further analyses using data from similar learning environments. Additional input variables may be included in the model to improve our understanding of students' perceptions and perceived experience and ideally provide technology independent guidelines for successful distance learning environment.

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