# Critical Success Factors for the of Acceptance and Use of an LMS
## *The Case of e-CLASS*

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Keywords: e-Learning, Critical Success Factors, Instructor, Student, Technology, Support.

Abstract: Nowadays, as e-learning is increasingly used in education, it is useful to know what are the critical factors for its successful implementation in higher education institutes. This research has two main objectives. The initial objective is to clarify and categorize the Critical Success Factors (CSF) of education with the use of a Learning Management System (LMS) from the perspective of students and then to investigate the relationships among these factors, suggesting a new causal model. To achieve the above objectives, an extensive, detailed and systematic study of available literature sources was held. Then, the critical success factors were separated in four (4) broad categories: instructors' characteristics, students' characteristics, information and communications technology used and technical support provided by the technical staff. Each factor contains a number of deterministic variables which were adopted mainly by previous studies. Also, for the collection of data for analysis, a questionnaire was distributed to students who use the LMS. Technical multivariate analysis was used to examine the relevance of each variable determinant factor, while for the evaluation of the causal model, structural equation systems were used.

## 1 INTRODUCTION

The use of Internet in education has created a new context known as *e-learning* or web-based education process, in which large amounts of information about teaching–learning interaction are endlessly generated and ubiquitously available. e-Learning is one of the tools emerged from information technology and it has been integrated in many university programs. e-Learning describes the ability to electronically transfer, manage, support, and supervise learning and learning materials (Normark, and Cetindamar, 2005). In its broadest sense e-Learning can be defined as instruction delivered via all electronic media including the Internet, intranets, extranets, satellite broadcasts, audio/videotape, interactive TV and CD-Rom (Urdanand Weggen, 2000).

e-Learning has been viewed as synonymous with web-based learning (WBL), Internet-based training (IBT), advanced distributed learning (ADL), web-based instruction (WBI), online learning (OL) and open/flexible learning (OFL) (Khan, 2001). e-Learning is the effective learning process created by combining digitally delivered content with learning support services (Hara & Kling, 1999). Above are the varied definitions and meanings that can be ascribed to the modern pedagogy known as e-learning. The categories of eLearning are depicted in figure 1 (Siemens, 2004). e-Learning for the purposes of this article refers to teaching and learning that is web-enabled (Govindasamy, 2002).

The growth of e-learning led to the appearance of *Learning Management Systems (LMSs)*, which provide a variety of features and operations including the development, management, distribution, diffusion and presentation of the educational material as well as tools for the management of users and courses. Some of the most well-known commercial LMS are Blackboard,



Valsamidis, S., Kazanidis, I., Aggelidis, V., Kontogiannis, S. and Karakos, A.
Critical Success Factors for the of Acceptance and Use of an LMS - The Case of e-CLASS.
In *Proceedings of the 8th International Conference on Computer Supported Education (CSEDU 2016) - Volume 2*, pages 331-338
ISBN: 978-989-758-179-3

WebCT and TopClass while Moodle, Claroline and aTutor are free distributed (Romero et al., 2008). In Greece, the Greek University Network (GUNet) uses Open eClass platform (GUNet, 2015), which is an evolution of Claroline (Claroline, 2009). This system is an asynchronous distant education platform and is open source under a General Public Licence (GPL).

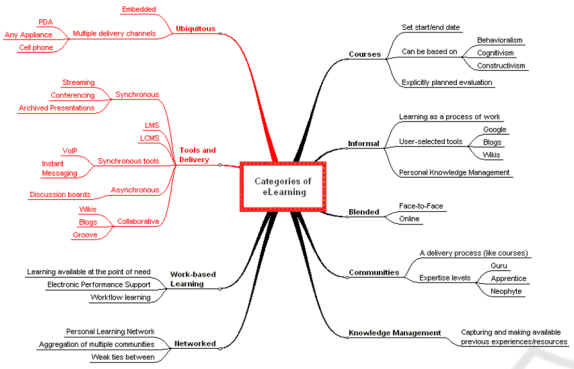


Figure 1: Categories of eLearning.

Ingramet et al., (2000) argue that the term *Critical success factor (CSF)* was coined in the 1980s. The fact that some organizations seemed to be more successful than others caused the investigation for this. Some factors appeared to be critical for this success and characterized as critical. A factor that is critical to the success of the project is intuitively referred to as a Critical Success factor (CSF). Therefore, critical success factors (CSFs) are variables that are fundamental to the success of the implementation, and an organization must handle these CSFs well in order to have a successful implementation (Frimpon, 2011). CSFs are "those things that must be done if an organization is to be successful" (Freund, 1988).

A complex technological initiative like an e-learning deployment is an undertaking involving a multiplicity of factors that impact the implementation to varying degrees. In literature for e-learning there is not much work for critical success factors.

Drennan et al., (2005) derived measures of perceptions of technology from research on the Technology Acceptance Model and used locus of control and innovative attitude as indicators of an autonomous and innovative learning mode.

Sela and Sivan (2009) proposed nine success factors for enterprise-wide e-learning. These factors are divided into two categories: "must-have" factors and "nice-to-have" factors. The must-have factors include: useful and easy to use e-learning tools, marketing, management support, the right organizational culture, and the existence of a real need for the organization. The "nice to have" factors include: time to learn, support, mandatory learning, and incentives.

Researchers have identified different CSFs in e-learning. Volery and Lord (2000) identified technology, instructor and previous use of technology from a student's perspective as the CSFs in e-learning. More specifically define technology as the factor that has relation with navigation and easy of access as well as the interface of the LMS. Regarding authors they measure attitudes towards students and classroom interaction. Similarly Soong, Chan, Chua, and Loh (2001)identified as e-learning CSFs the human factors, technical competency of participants, e-learning mindset, collaboration between participants, and perceived information technology infrastructure.At the same direction other studiespropose as CSFs the technology, instructor characteristics, and student characteristics (Leidner and Jarvenpaa 1993; Guawardena, 1995).

According to Selim (2007), four CSFs were identified and measured, namely instructor characteristics, student characteristics, technology infrastructure, and university support. Similar is the approach by Frimpon (2001). Seventeen critical success factors (CSFs) were obtained through an exhaustive search, and were partitioned into 4 natural roles of Student, Instructor, Technology, and Institution. The latter two papers inspired us for this study.

In this paper, two main objectives have been set. First, to clarify and categorize the Critical Success Factors (CSFs) in an LMS from the perspective of students and then, to investigate the relationships between these factors, suggesting a new causal model. 400 students from two departments of the school of Business and Economy of TEI of East Macedonia and Thrace were involved. They use the LMS e-class taking advantage of most of its features. E-class is installed and functions for almost two decades in TEI of East Macedonia and Thrace (former TEI of Kavala).The techniques of simple descriptive statistics and multivariate analysis techniques were used.

For the exploratory factor analysis and descriptive statistics, correlations and reliability validation, the statistical package SPSS 19 was used. For the confirmatory factor analysis the structural equation systems (Structural Equation Modeling - SEM) with the AMOS software packagewas used.

# 2 APPROACH

## 2.1 The Proposed Model

Four variables were defined as critical factors in the proposed model; *Instructors' characteristics (Instructor), Students' characteristics (Student), Information and Communications Technology (Technology) and the Support by the school (Support).* Finally to measure the intention of students to use the e-class, a fifth deterministic variable (Intention to Use) is used.

A questionnaire that is consisting of 56 questions was completed by students. The deterministic variables are the questions of our questionnaire. After a thorough analysis, the questionnaire responses show us if the deterministic variables are suitable to measure the hidden variables and how they affect the formation of the students' intention in the adoption and use of an LMS. The analysis of our model, is focused on the four hidden variables (factors), each determined by some deterministic variables.

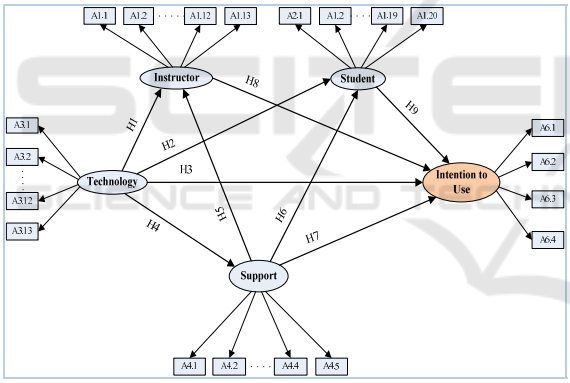


Figure 2: The Research Model and its Assumptions.

The proposed model, for the acceptance of online education by students is depicted in Figure 2. The five variables are: (A1.) Instructors' characteristics, (A2.) Students' characteristics, (A3.) Information and Communications Technology, (A4.) The information technology used by the school (Support), (A6.) Intention of use of the LMS (e-class).

In our research, the factor *Instructors'* characteristics includes thirteen (13) deterministic variables (A1.1-A1.13), in order to explore these characteristics. The deterministic variables A1.1-A1.7 were adopted by Selim (2007) and were previously used by Volery and Lord (2000), to examine the teaching styles. The deterministic variables A1.8 and A1.9 were adopted by Lim et al. (2008) to measure the availability of the instructor. The deterministic variables A1.10-A1.11 were adopted by the Selim (2007) and were previously used by Volery and Lord (2000). The deterministic variables A1.12-A1.13 were adopted by the Selim (2007) and were previously used by Soong et al. (2001). The deterministic variables A1.10-A1.13 will be used to verify the relationship of teacher education through the LMS (e-class).

In order to determine the factor Students' characteristics, twenty (20) deterministic variables (A2.1-A2.20) were included. The deterministic variables A2.1 and A2.2 measure the student's motivation for use of education through the Internet. The deterministic variables A2.3-A2.7 measured the technical ability of the student. The deterministic variables A2.8 - A2.14 measure the effectiveness of the content of the course through the Internet as well as the structure and design as perceived by students. The deterministic variables A2.15-A2.20 are used, to measure attitudes and behaviors of students toward education through Internet. The first fourteen (14) deterministic variables adopted by Selim (2007) and the rest of the Lim et al. (2008). The deterministic variables A2.1-A2.7 had been also previously used by Soong et al. (2001).

The factor Information and Communications Technology includes thirteen (13) deterministic variables (A3.1-A3.13). These will be used to measure the reliability, richness, consistency and effectiveness of technology in the school.

The factor Support from the educational institution was covered by five (5) deterministic variables (A4.1-A4.5), which were adopted by Selim (2007) and were used to investigate the effectiveness and efficiency of technical support by the school, library services, and the reliability of computer laboratories.

For the factor Intention to use the e-class, five (5) deterministic variables (A6.1 - A6.5) were used, which has also been adopted by Selim (2007), in order to m1easure the intention of the students to use e-class. In other words, we want to measure how willing are the students to follow that kind of learning that was unknown to them.

## 2.2 Hypotheses

According to the research model (depicted in Figure 2), the instructors' characteristics, the students' characteristics, the support and the technology aresufficient to describe the acceptance of online education from students' point of view and their

intention to use it as well. Therefore, we suggest the following assumptions:

H1: The technology will positively affect instructors' characteristics.

H2: The technology will positively affect students' characteristics.

H3: The technology would have an immediate positive effect on the intention to use.

H4: The technology will positively influence the support.

H5: The support will positively affect the instructors' characteristics.

H6: The support will positively affect students' characteristics.

H7: The support will have a direct positive effect on intention to use.

H8: The instructors' characteristics will have a direct positive effect on intention to use.

H9: The students' characteristics will have a direct positive effect on intention to use.

### 2.3 Test of the Research Hypotheses

For the test of research hypotheses, we estimate the structural part of the research model, which evaluates the causal relationships among factors that make up the model. Consequently, the structural part answers the research hypotheses of the research. The assessment's purpose of the overall adaptation of a model is the degree of determination in the model that is compatible with the empirical data.

For the implementation of this test, a confirmatory factor analysis will be performed in a model, which shows the averages of the variables that define the conceptual factors. According to Grapentine (1997, 2000), by using the above model, allows better management of side effects resulting from the multicollinearity of the variables that determine the factors and focus more attention on the concerned factors and the relationships between them, despite the deterministic variables that are used only to measure these factors.

The results of this analysis answer to the research hypotheses and evaluate accordingly with regard: (a) the accepted limits of adaptability coefficients, (b) the recommendations of the modification indices and (c) the statistical significance of the causal links (paths of the model).

Based on the updated indices, some variables were removed so as to maximize the adjustment of the model. The decision to remove a variable or relationship or the addition of a relationship, based on revisions and corrections, reflects the substance. So, for the redefinition of the model, only the statistical significance of the relationship must be taken into account, as well as the recommendations of modification coefficients that should have such values that the adaptability indices are within acceptable limits of the adopted methodology (Bollen, 1989; Green et al., 1999). In this way, variables or relationship are deleted, when it is no longer necessary to maintain the adjustment of the model.

## 3 RESULTS

The results of *confirmatory factor analysis*, as depicted in Figure 3, according to the statistical significance of the relationship with the values of adaptability coefficients suggest removing two causal relationships of the model and the simultaneous rejection of corresponding research hypotheses (H1: technology affects directly and positively to the formation of instructors' characteristics, H6: Support directly and positively affects the students' characteristics).

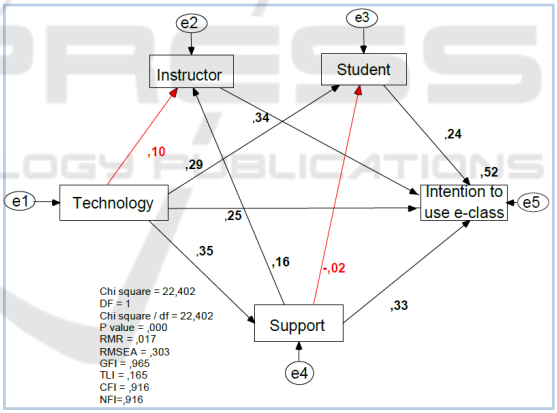


Figure 3: Schematic confirmatory factor analysis of the research model (first step).

After removing the two relationships, a confirmatory factor analysis again is performed. The results show all the remaining causal relationships, which are statistically significant (Figure 4).

But according to the modification indices, to increase the reliability, validity and adaptability of the model, a new relationship between the factor instructors' characteristics and the factor students' characteristics is necessary to insert, as depicted in Figure 5.

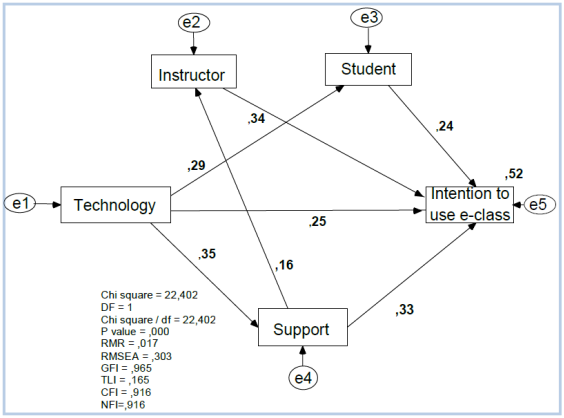


Figure 4: Schematic confirmatory factor analysis of the research model (second step).

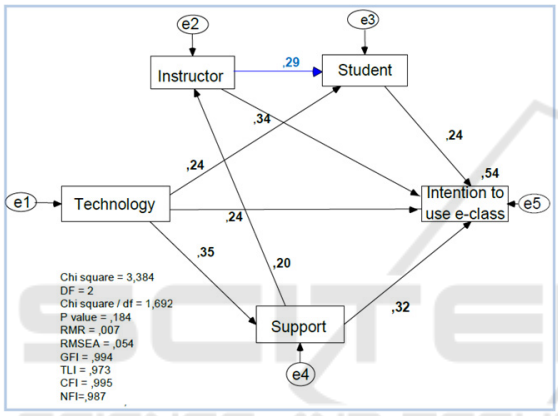


Figure 5: Schematic confirmatory factor analysis of the research model (third step).

After the insertion of the new causal relationship, taking into account the acceptable margins of the adaptability coefficients, a generally very good fit of the data with the concerned model is observed. In particular, the indices CFI, GFI, RMR and NFI get value greater than 0.9, which is considered the threshold of reliability, validity and adaptability to the data. The value of the index $x^2$ for the degrees of freedom to be with less than 3 and the value of RMSEA index is less than 0.1; these values were adopted as the upper limit of a fitness model. So, according to the values of adaptability coefficients, the model is proved as a valid and reliable model for analysis of the results and draw conclusions. Figure 5depicts the final proposed model for acceptance and use of the LMS. It includes also the capacity of causal relationships between factors that compose it, and the explained rate fluctuates as well.

Table 1 contains the research hypotheses, as these were determined during the creation of the hypothetical research model, as well as a new research hypothesis which has been added according to the modification indexes. It also contains the statistical analysis values, as those were resulted from the confirmatory factor analysis

Table 1: The research hypotheses of acceptance and use model of the LMS.

| Research Hypotheses | | | | Estimate | S.E. | C.R | P |
|---|---|---|---|---|---|---|---|
| H1 | Instructors' characteristics | ← | Technology characteristics | 0,133 | 0,088 | 1,508 | 0,132 |
| H2 | Students' characteristics | ← | Technology characteristics | 0,224 | 0,057 | 3,918 | *** |
| H3 | Intention of use of e-class | ← | Technology characteristics | 0,242 | 0,049 | 4,929 | *** |
| H4 | Support Characteristics | ← | Technology characteristics | 0,523 | 0,093 | 5,638 | *** |
| H5 | Instructors' characteristics | ← | Support Characteristics | 0,169 | 0,055 | 3,078 | 0,002 |
| H6 | Students' characteristics | ← | Support Characteristics | 0,013 | 0,042 | -0,302 | 0,762 |
| H7 | Intention of use of e-class | ← | Support Characteristics | 0,212 | 0,032 | 6,656 | *** |
| H8 | Intention of use of e-class | ← | Instructors' characteristics | 0,259 | 0,037 | 7,018 | *** |
| H9 | Intention of use of e-class | ← | Instructors' characteristics | 0,252 | 0,052 | 4,863 | *** |
| H10 | Students' characteristics | ← | Instructors' characteristics | 0,208 | 0,044 | 4,731 | *** |

Table 2: Direct, indirect and total normalized effects between the factors that make up the proposed model of acceptance and use of LMS (D = Direct, I=Indirect, T = Total Effect).

| | | Technology characteristics | Support Characteristics | Instructors' characteristics | Students' characteristics |
|---|---|---|---|---|---|
| **Support Characteristics** | **D** | 0,346 | | | |
| | **I** | | | | |
| | **T** | 0,346 | | | |
| **Instructors' characteristics** | **D** | | 0,198 | | |
| | **I** | 0,068 | | | |
| | **T** | 0,068 | 0,198 | | |
| **Students' characteristics** | **D** | 0,239 | | 0,289 | |
| | **I** | 0,020 | 0,057 | | |
| | **T** | 0,259 | 0,057 | 0,289 | |
| **Intention of use** | D | 0,243 | 0,321 | 0,336 | 0,236 |
| | I | 0,195 | 0,080 | 0,068 | |
| | T | 0,438 | 0,401 | 0,404 | 0,236 |

In conclusion, table 2 presents the determinant of direct, indirect and total normalized (in unit) effects among the factors that comprise the proposed model for the acceptance and use of the LMS by the students. The coefficients of the paths can be used to

decompose the correlations between the factors, which form the model of direct and indirect effects, corresponding to the direct and indirect paths shown by the arrows of causality model. The indirect effect of a variable i to variable j, according to the rules of linear systems, is calculated from the summary of the coefficients multiplications of all the indirect paths from i to j.

# 4 DISCUSSION AND CONCLUSIONS

As the results from the descriptive and statistical analysis reported and interpreted above, here we will report and explain the results from the test of the hypotheses.

A) The model was initiated, having set these hypotheses for the relationships between the factors to be considered together and the intended use of students on the e-class. However, other cases were confirmed and others were rejected. Especially, after the analysis, a new relationship between two factors derived. More specifically, the relationship between Technology and Instructors' Characteristics and the relationship between the Support and Students' characteristics were rejected. On the other hand, a new relationship between Instructors' Characteristics and Students' characteristics arose.

These findings are reasonable, as the technical background of the instructor is not affected by the Institute's technology but also the characteristics of students are not affected by the quality and quantity of technical support. On the other hand, the characteristics of students are affected and shaped by the characteristics of instructors. Every instructor should be the coach and the advisor of the student. Generally, the characteristics and the progress of each student are dependent, to some extent, on the interactions s/he had with his/her instructors.

B) It is worth noting that the strongest relationship in our final model, is that between technology and the support from the school. The weakest is observed between the support of the educational institute and instructor's characteristics. This makes sense because a school as good technical support has, the better it will be or at least seems to be the technology to students. And vice-versa, as finer technology has, the better it will be or at least seems to students, the technical support. On the other hand, the only relationship between instructor and support is when the instructor assumes such responsibility, i.e. to fix something or help a student to something relevant.

C) The order of significancy among the five factors, based on the average of the coefficients are: students' characteristics, the intention of use, the technology, the instructors' characteristics and the support from the school. This result does not agree with the corresponding conclusion of Lim et al. (2008), who had found as the most significant factor the technical support from the school. It agrees, with Poon et al., (2004), who had also found students' characteristics, as the most important category.

D) Table 2 can give us enough results worth interpret. Initially, we observe that the instructor's characteristics have the strongest direct relationship with the intention to use. This probably indicates that the attitude and the knowledge of the instructor play an important role in the student's intention of use the LMS. On the other hand, the student's characteristics are weakest directly related to the intention of use. His/her own characteristics i.e., no shape his/her intention as strongly as other external factors.

Interests are the results of the overall relationships, namely computing and indirect from direct. The strongest relationship longer observed between technology and the intention to use. While the direct relationship between them was particularly weak, the indirect was particularly strong with the result as a whole to have the strongest correlation model. The so strong indirect relationship, probably due to the fact that technology is related to all the factors which affect. We have not to forget that education through Internet is a methodology that uses advanced technology. It is worth noting that the difference of total relationship among factors and intention of use is small. In particular, the relationships of intention to use with technology, students' characteristics, instructors' characteristics and support are in the same range. It is striking that the student's characteristics have a significantly weaker relationship with the intention to use. The same occurred with the direct relationship. The most likely explanation in this case is that the student is more influenced by external factors than by its own characteristics.

E) In general, we see that the education through LMS is still at an early investigation stage in Greece. Nevertheless, students seem willing to walk the new paths that appear in front of them and adopt the e-class and other relevant LMSs. The factors affecting the intent of students are many. Some of them are definitely the student's and instructor's characteristics, information technology and technical

support from the university. This has also been noticed by previous studies (Selim, 2007; Volery and Lord, 2000; Friesen, 2005; Soong et al., 2001) and now it was confirmed. The relationships between the factors are influenced by other factors affecting the students' intention to use.

F) All the above tables, figures and analysis show us that the constructed model can be considered reliable and can fulfil its mission successfully.

It should be noted that the above results related to the test of hypotheses, largely agree with most previous studies (Selim, 2006; Volery and Lord, 2000; Al-Fadhli, 2009; Abbad et al., 2009).

Concluding, we point out with some general remarks. The presented causal model explains 54% of education acceptance criteria through an LMS. The strongest relationship in our final model is between Information Technology and Technical Support from the school. The weaker relationship is observed between the Technical Support and Instructors' Characteristics.The study revealed the following order of significancy of the five factors used, according to the average of the responses of the students; the most significant factors in descending order are: Students' characteristics, Intention of use, Technology, Instructors' characteristics and Technical Support.

However the limitations of the study are the sample size, the questionnaire size, the objectivity of the respondents, the level of education through LMS in Greece, the associative nature of the research and the adaptability indices of confirmatory factor analysis.

Suggestions for further research are the repeat of study with new larger sample, to be applied in other Universities to confirm the findings of the study. Since this causal model covers only the 54% of all the possible factors, there are more factors that have to be discovered. A twofold evaluation with research to other entities apart of the students (i.e. proper questionnaires for teachers, executives of school, companies of advanced technology) would be useful.

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