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# E-Learning Critical Success Factors: An Exploratory Investigation of Student Perceptions

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## ABSTRACT

Information technology and intense competition are reshaping universities worldwide. Universities have to utilize and integrate information technology in teaching and learning in order to meet the instructors' and students' needs. E-learning, one of the tools emerged from information technology, has been integrated in many university programs. There are several factors that need to be considered while developing or implementing university curriculums that offer E-learning based courses. Since e-learning is relatively new learning technology, this paper is intended to identify and measure its critical success factors (CSFs) from student perceptions. In line with the literature, four CSFs were identified and measured, namely instructor characteristics, student characteristics, technology infrastructure, and university support. A sample of 37 class sections with 538 responses was used to validate the proposed e-learning CSFs. The results revealed that students perceived instructor characteristics as the most critical factor in e-learning success and adoption followed by information technology infrastructure and university support. The student characteristics factor was perceived as the least critical factor to the success of e-learning.

## INTRODUCTION

The new global economy, advances in information technology, and job market pose complex challenges to university students, requiring computer literacy, critical thinking, information analysis, and synthesizing skills. Advances in information technology are perceived by universities as the solution to the quality and costs problems. This has created a need to transform how university students learn by using more modern, efficient, and effective alternative such as e-learning. E-learning concept has been around for decades and is one of the most significant recent developments in the information systems industry (Wang, 2003). E-learning is the delivery of course content via electronic media, such as Internet, Intranets, Extranets, satellite broadcast, audio/video tape, interactive TV, and CD-ROM (Urdan & Weggen, 2000). E-learning is one of the new learning trends that challenge the traditional "bucket theory" or the banking concept of education (Freire, 1994). The banking concept of education assumes that the instructor owns the knowledge and deposits it into the passive students who attend the class (Freire, 1994). (Khan, 2001) sees e-learning 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). Recently, e-learning has evolved into a learning approach widely adopted in academic institutions.

In the past two decades, a substantial number of articles have been published addressing e-learning. According to (Milliken & Barnes, 2002), throughout the 1980s much of the research and development designed to improve learning in higher education focused on teaching and the ways learning is structured by instructors (Brown, Bakhter, & Youngman, 1982; Dunken, 1983). In the early 1990s the research included the relationship between teaching and learning (Ramsden, 1992). Recently, effective student learning became the central theme and organizing principle of higher education (Helmi, 2002; Katz, 2002; Lu, Yu, & Liu, 2002; Milliken & Barnes, 2002; Oliver & Omari, 2001; Selim, 2003). Many studies examined the design and structure of e-learning based courses (Chuang, 1999; Human & Kilboume, 1999; Kaynama & Keesling, 2000; Leon & Par, 2000; Selim, 2003). Several studies compared students' learning experiences in e-learning based courses (Ernest & Federico, 2000; Hiltz, Coppola, Rotter, & Turoff, 2000; Lee, Hong, & Ling, 2002; Oliver & Omari, 2001; Selim, 2003; Sole & Lindquist, 2001; Tuckman, 2002; Watters, 2000; Wegner, Holloway, & Garton, 1999). An analysis of more than 600 feedback questionnaires at one UK university revealed that some 50% of students surveyed identified a need for more effective teaching delivery (Pennington, 1994). Several researchers showed that students who are exposed to e-learning, compared to those exposed to conventional learning, generally achieved improved learning effectiveness (Baker, Hale, & Gifford, 1997; Beyth-Marom, Chajut, Roccas, & Sagiv, 2003; Lockyer, Patterson, & Harper, 2001; Tuckman, 2002). (Le Grew, 1995) constructed a "paradigm shift" table to show the transformation necessary in higher education institutions in order to keep up with the changes in communications and information technology. The shifts are: industrial society to information society, technology peripheral to multimedia central, and institutional focus to learner focus.

Effective E-Learning environments require some form of interaction and collaboration among students, several researchers recognized the importance of student interaction to improve performance and satisfaction (Driver, 2002; Fulford & Zhang, 1993; Ritchie & Newby, 1989; Vrasidas, 1999). (Moore & Kearsley, 1996) identified three types of interactions that allow students to learn effectively in e-learning environments. The first is learner-content interaction that refers to the student's interaction with the course materials. This type of interaction is fostered through an effective and efficient design of electronic or web-based materials and activities (Freberg, 2000; Selim, 2003). The second is the learner-instructor interaction that refers to the student's interaction with the instructor, which is an essential component of e-learning (Fulford & Zhang, 1993). The third is the learner-learner interaction through student collaboration (Hayes, 1990). New information technologies enable instructors to develop interaction and collaboration among students into the courses. Most studies indicate that learner-learner interaction is a critical success factor when measuring student satisfaction with e-learning based courses (Graham & Scarbrough, 1999; Phillips & Peters, 1999).

The target of improving university students' learning efficiency and effectiveness triggers the question of the extent to which e-learning aids this process and the factors leading to its acceptance by students. It is generally acknowledged that very little has been researched on the CSFs of e-learning acceptance from student perception (Lee et al., 2002). This paper reports on an exploratory study aims to identify and measure the e-learning acceptance CSFs as perceived by a sample of undergraduate students in the college of Business and Economics at the United Arab Emirates University (UAEU). UAEU is a large university with 19,000

students enrolled in several undergraduate degrees offered by 9 colleges. UAEU has started offering e-learning based courses since 1998 and started implementing a university-wide laptop project at the beginning of 2002 in order to facilitate the e-learning adoption by both students and instructors. The pilot laptop project included more than 1000 students in three colleges. The AACSB accredited College of Business and Economics has most of the 100 level courses offered using different e-learning tools and all students enrolled in these courses must have laptop computers as an e-learning facilitating tool. In the next section, the literature related to e-learning CSFs is reviewed and several e-learning CSFs categories are identified which form the core of this study.

## E-LEARNING CRITICAL SUCCESS FACTORS

Critical success factor (CSF) term appeared in the literature in the 80s when there was a concern about why some organizations seemed to be more successful than others, and research was carried out to investigate the success components (Ingram, Biermann, Cannon, Neil, & Waddle, 2000). CSFs are *"those things that must be done if a company is to be successful"* (Freund, 1988). CSFs should be few in number, measurable and controllable. Although there is a large number of research articles on e-learning, few of them address the most important issue of e-learning critical success factors. (Papp, 2000) explored distance learning from a macro perspective and suggested some critical success factors that can assist faculty and universities in e-leaning environment development. Papp's e-learning CSFs included intellectual property, suitability of the course for e-learning environment, building the e-learning course, e-learning course content, e-learning course maintenance, e-learning platform, and measuring the success of an e-learning course. Papp (2000) suggested studying each one of these CSFs in isolation and also as a composite to determine which factor(s) influence and impact e-learning success. (Benigno & Trentin, 2000) suggested a framework for the evaluation of e-leaning based courses, focusing on two aspects: the first is evaluating the learning, and the second is evaluating the students' performance. They considered factors such as student characteristics, student-student interaction, effective support, learning materials, learning environment, and information technology.

(Volery & Lord, 2000) drew upon the results of a survey conducted amongst 47 students enrolled in an e-learning based management course at an Australian university. They identified three CSFs in e-learning: *technology* (ease of access and navigation, interface design and level of interaction); *instructor* (attitudes towards students, instructor technical competence and classroom interaction); and *previous use of technology* from a student's perspective. (Soong, Chan, Chua, & Loh, 2001), using a multiple case study, verified that the e-learning CSFs are: human factors, technical competency of both instructor and student, e-learning mindset of both instructor and student, level of collaboration, and perceived information technology infrastructure. They recommended that all these factors should be considered in a holistic fashion by e-learning adopters. According to studies conducted by (Dillon & Guawardena, 1995) and (Leidner & Jarvenpaa, 1993), three main variables affect the effectiveness of e-learning environments: technology, instructor characteristics, and student characteristics. Using a survey on the perception of e-learning among postgraduates enrolled at Curtin Business School, (Helmi, 2002) concluded that the three driving forces to e-learning are information technology, market demands, and education brokers such as universities.

In an attempt to provide a pedagogical foundation as a prerequisite for successful e-learning implementation, (Govindasamy, 2002) discussed seven e-learning quality benchmarks namely, institutional support, course development, teaching and learning, course structure, student support, faculty support, and evaluation and assessment. Based on a comprehensive study by (Baylor & Ritchie, 2002), the impact of seven independent factors related to educational technology (planning, leadership, curriculum alignment, professional development, technology use, instructor openness to change, and instructor computer use outside school) on five dependent measures (instructor's technology competency, instructor's technology integration, instructor morale, impact on student content acquisition, and higher order thinking skills acquisition) were studied using stepwise regression. The study resulted in models explaining each of the five dependent measures.

The purpose of e-learning, like any other learning approach, is to achieve the learning objectives. The objectives attainment measures can be environmental, technological, student related, and instructor related. In e-learning some of the crucial CSFs are technological, such as bandwidth, hardware reliability, and network security and accessibility. Another e-learning CSF is student engagement in learning models. E-learning models are synchronous (real time), asynchronous (anytime and anywhere), or a mix of the two. There are numerous tools that instructors can use to adopt an e-learning model: mini-lectures, electronic/conventional discussion, active/cooperative learning and many others. The third e-learning CSF is student related. Students must be motivated and committed. In e-learning based courses, students take the responsibility of their learning pace.

According to the studies reviewed in this section, e-learning CSFs within a university environment can be grouped into four categories: (1) information technology; (2) Instructor; (3) Student; and (4) university support.

Information technology (IT) explosion resulted in changes in education. E-learning integration into university courses is a component of the IT explosion; as a matter of fact IT is the engine that drives the e-learning revolution. The efficient and effective use of IT in delivering e-learning based components of a course is of critical importance to the success and student acceptance of e-learning. So ensuring that the university IT infrastructure is rich, reliable and capable of providing the courses with the necessary tools to make the delivery process as smooth as possible is critical to the success of e-learning. IT tools include network bandwidth, network security, network accessibility, audio and video plug-ins, courseware authoring applications, Internet availability, instructional multimedia services, videoconferencing, course management systems, and user interface.

Instructor plays a central role in the effectiveness and success of e-learning based courses. (Willis, 1994) and (Collis, 1995) believed that it is not the information technology but the instructional implementation of the IT that determines the effectiveness of e-learning. (Webster & Hackley, 1997) proposed three instructor characteristics that affect e-learning success: (1) IT competency; (2) teaching style; and (3) attitude and mindset. (Volery & Lord, 2000) suggested that instructors provide various forms of office hours and contact methods with students. Instructors should adopt interactive teaching style, encourage student-student interaction. It is so important that instructors have good control over IT and is capable of performing basic troubleshooting tasks.

University students are becoming more diverse and demand for e-learning based courses is increasing. Students need to have time management, discipline, and computer skills in order to be successful in the e-learning era. Student prior IT experience such as having a computer at home and attitude towards e-learning is critical to e-learning success. As stated before, research concludes that e-learning based courses compare favorably with traditional learning and e-learning students perform as well or better than traditional learning students (Beyth-Marom et al., 2003). This shows that students like to use e-learning if it facilitates their learning and allows them to learn any time any where in their own way (Papp, 2000).

E-learning projects that were not successful in achieving their goals did not have access to technical advice and support (Aldexander, McKemzie, & Geissinger, 1998; Soong et al., 2001). If the technical support is lacking, the e-learning will not succeed. University administration support to e-learning is essential for its success. This study limited the e-learning CSF categories to those that were supported in the literature while including newly used items within each CSF category. The research question that this study attempts to answer is "What are the critical success factors that higher education institutions should take into consideration when adopting e-learning tools and philosophies in order to satisfy students' needs and expectations?"

## METHOD

The courses selected for the study combine both e-learning and traditional learning tools and all of them are laptop-based courses and use active and student centered learning methods. Traditional learning tools used in the selected courses are required attendance, regular textbook, and presence of instructor during the scheduled class time. E-learning tools used are electronic student-student and student-instructor communication, asynchronous course material delivered through a Blackboard (adopted course management information system) course web, in-class active and collaborating learning activities, and student self-pacing pattern. Data were collected through an anonymous survey instrument administered to 900 undergraduate university students during the Fall semester of 2003.

### Subjects

Respondents for this study consisted of 538 (334 females and 204 males) undergraduate students enrolled in five 100-level mandatory laptop-based courses distributed over 37 class sections. All the selected courses were offered by the AACSB accredited college of Business and Economics at the United Arab Emirates University (UAEU). UAEU has 5 campuses located in 4 different geographical sites. One of the campuses is dedicated to female students and includes all the university colleges and the other 4 campuses contain different male colleges. Table 1 summarizes the demographic profile and descriptive statistics of the respondents. Student ages ranged from 17 to 28 years, with a mean age of 19.98 years (S.D. =1.256). Students came from 18 different countries. They have an average GPA of 2.6 with a standard deviation of 0.54. Participants had 8 majors, namely accounting, economics, finance and banking, general business, management, management information systems, marketing, and statistics. The exposure to e-learning technologies of the participating students varied from 1 to 3 years, 38.7% had 1 year exposure, 36.6% had 2 years, and 24.7% had 3 years of exposure. All students participated voluntarily in the study.

### Instrument

The literature review suggested that the e-learning CSF categories are student characteristics, instructor characteristics, and information technology. This study proposed support as a fourth e-learning CSF category. University support at different levels is perceived to be critical for the e-learning success. Each CSF category was represented by a latent construct that was observed via a group of indicators. Numerous instruments have been developed to measure e-learning satisfaction. Therefore, various potential indicators exist to measure each CSF category. A survey instrument was developed that consisted of 6 sections, one for each e-learning CSF category and an additional category for the e-learning acceptance in addition to a demographic characteristics section.

The instructor characteristics construct section included 13 indicators (INS1-INS13) which assessed the characteristics of instructors (see Appendix for the indicator details). Indicators INS1 to INS11 were adopted from Volery and Lord (2000) to capture instructor's attitude towards the technology, teaching style, and control of the technology. The last two items INS12 and INS13 were adopted from Soong et al. (2001) to complete measuring the instructor's teaching style.

Twenty three indicators were used in assessing the students' characteristics construct (STUD1-STUD23). The first two indicators measured the student motivation to use e-learning. Indicators STUD3-STUD7 measured the student technical competency. Items STUD8-STUD10 measured student's mindset about e-learning. Items STUD11-STUD16 measured student interactive collaboration. The first 16 indicators were adopted from Soong et al. (2001). Seven additional indicators were developed to measure the effectiveness of e-learning course content, structure, and design from student perception (see Appendix for details).

Thirteen indicators were developed to measure the technology reliability, richness, consistency, and effectiveness which represented the information technology construct. The first eight indicators (TECH1-TECH8) were adopted from Volery and Lord (2000). The 8 indicators measured the on-campus ease of Internet access and browsing, browsing speed, course websites ease of use, user interface efficiency, student-student communication reliability, and student-instructor communication. The last five items (TECH9-TECH13) were developed to capture the effectiveness of the IT infrastructure and services available at UAEU. They measured consistency of computers access using the same authentication, computer network reliability, and student information system efficiency.

The university support section consisted of 5 items (SUP1-SUP5) and all of them were developed to capture the effectiveness and efficiency of the university technical support, library services and computer labs reliability. The last section was dedicated to capturing the perceived acceptance of e-learning by students via 4 indicators (ELU1-ELU4).

Some of the items were negatively worded. All items used a five-point Likert-type scale of potential responses: strongly agree, agree, neutral, disagree, and strongly disagree. The instrument was pre-tested by a random sample of 70 students. Minor changes to the order and wording of the items resulted from the pre-testers opinions. The survey instruments were distributed during laptop-based lectures and were left to the students to be filled and returned later. Around 900 instruments were distributed, 538 usable responses were used giving a 60% response rate. The students were informed that all data were anonymous and were to be used in assessing the acceptance of e-learning technology at the university instruction environment. Table 2 shows the mean and variance of each item in the e-learning assessment instrument.

Students were asked to rank the four CSFs. The rating for each factor was placed between 1 and 4. Table 3 shows the rank of the four e-learning CSFs as perceived by students. The instructor characteristics factor was given the first rank, according to 54% of the surveyed students, as the most critical success factor for e-learning success. This result came in line with Collis (1995) remark that the instructor plays a centric role in the effectiveness of distance learning and it is not the technology but the instructional implementation of the technology that determines the effects on learning. Student characteristics factor came fourth as the least critical factor for the success of e-learning courses as perceived by 47% of the surveyed students. The university support factor was ranked third in the criticality level with 31% of the surveyed students. The second rank was given to the technology factor.

*Table 1. Demographic Profile and Descriptive Statistics of Surveyed Students*

| Item | | Frequency | Percentage |
|---|---|---|---|
| Gender | Male | 204 | 37.9 |
| | Female | 334 | 62.1 |
| Age | 17-19 | 210 | 39.0 |
| | 20-22 | 313 | 58.2 |
| | 23-25 | 12 | 02.2 |
| | 26-28 | 3 | 00.6 |
| Years at UAEU | 1-2 | 381 | 70.82 |
| | 3-4 | 153 | 28.44 |
| | 5-6 | 4 | 00.74 |
| Years of e-learning | 1 | 208 | 38.7 |
| | 2 | 197 | 36.6 |
| | 3 | 133 | 24.7 |
| PC ownership | Yes | 474 | 88.1 |
| | No | 64 | 11.9 |

## EXPLORATORY FACTOR ANALYSIS

Exploratory factor analysis was conducted to identify the underlying critical indicators in each of the e-learning CSF categories (instructor characteristics, student characteristics, technology, and university support). The same factor analysis was used to validate the e-learning CSF categories. LISREL version 8.52 was used to develop the polychoric correlation and asymptotic covariance matrices used in generating the factor loadings because all the items were represented by ordinal variables. Table 4 shows the output results for the Promax-rotated factor loadings. Items intended to measure the same e-learning CSF must demonstrate a factor loading of >0.50.

*Table 2. Descriptive Statistics of E-Learning CSF Indicators*

| Item | Mean | S.D. |
|---|---|---|
| INS1 | 3.82 | 1.01 |
| INS2 | 3.68 | 1.07 |
| INS3 | 4.00 | 1.02 |
| INS4 | 3.99 | 1.00 |
| INS5 | 4.00 | 0.99 |
| INS6 | 3.92 | 0.97 |
| INS7 | 3.94 | 1.00 |
| INS8 | 3.86 | 1.02 |
| INS9 | 3.89 | 0.98 |
| INS10 | 3.91 | 1.02 |
| INS11 | 3.86 | 1.03 |
| INS12 | 3.73 | 1.03 |
| INS13 | 3.87 | 1.01 |
| | | |
| TECH1 | 4.18 | 0.99 |
| TECH2 | 3.82 | 1.13 |
| TECH3 | 3.88 | 0.98 |
| TECH4 | 4.05 | 0.90 |
| TECH5 | 3.99 | 0.88 |
| TECH6 | 3.75 | 0.95 |
| TECH7 | 3.96 | 1.01 |
| TECH8 | 4.01 | 0.96 |
| TECH9 | 3.99 | 1.05 |
| TECH10 | 3.95 | 0.97 |
| TECH11 | 3.91 | 1.04 |
| TECH12 | 4.13 | 0.91 |
| TECH13 | 3.88 | 0.98 |
| | | |
| ELU1 | 3.86 | 1.15 |
| ELU2 | 3.67 | 1.19 |
| ELU3 | 3.81 | 1.09 |
| ELU4 | 3.88 | 1.14 |

| Item | Mean | S.D. |
|---|---|---|
| STUD1 | 3.87 | 1.04 |
| STUD2 | 3.58 | 1.06 |
| STUD3 | 4.05 | 1.06 |
| STUD4 | 4.00 | 1.00 |
| STUD5 | 3.82 | 1.01 |
| STUD6 | 3.96 | 1.04 |
| STUD7 | 4.01 | 1.05 |
| STUD8 | 3.59 | 1.013 |
| STUD9 | 3.73 | 0.99 |
| STUD10 | 3.54 | 1.07 |
| STUD11 | Dropped | |
| STUD12 | 3.22 | 1.07 |
| STUD13 | 3.30 | 1.11 |
| STUD14 | 3.59 | 1.01 |
| STUD15 | 3.10 | 1.04 |
| STUD16 | 3.57 | 1.03 |
| STUD17 | 3.68 | 1.00 |
| STUD18 | 3.61 | 1.05 |
| STUD19 | 3.68 | 1.04 |
| STUD20 | 3.91 | 0.96 |
| STUD21 | 3.73 | 1.00 |
| STUD22 | 3.84 | 0.98 |
| STUD23 | 3.81 | 0.94 |
| | | |
| SUP1 | 4.04 | 0.96 |
| SUP2 | 3.86 | 0.94 |
| SUP3 | 3.85 | 0.93 |
| SUP4 | 3.69 | 1.00 |
| SUP5 | 3.73 | 0.97 |

*Table 3. E-Leaning CSF Ranking*

| | 1 | 2 | 3 | 4 | Average |
|---|---|---|---|---|---|
| INS | 54% (270) | 23% (113) | 18% (91) | 5% (26) | 1.74 |
| STD | 10% (48) | 22% (112) | 21% (107) | 47% (233) | 3.05 |
| TECH | 27% (137) | 25% (123) | 30% (148) | 18% (92) | 2.39 |
| SUP | 9% (45) | 30% (152) | 31% (154) | 30% (149) | 2.82 |

The 13 items (INS1-INS13) proposed to measure the instructor characteristics construct as a critical factor of e-learning success were highly correlated with it, as indicated by the factor loading values of >0.70 in Table 4. This testifies to the validity of the indicators used to capture the instructor characteristics factor. The items comprised in this factor were related to the instructor's attitude towards students, e-learning skills literacy, and ability to encourage students to interact and ask questions. The following recommendations have emerged from the instructor characteristics exploratory factor analysis:

- Instructors should be enthusiastic about teaching e-learning based courses in order to motivate the students.
- Instructors should be able to handle the technology used in e-learning based courses such as e-mail, e-discussion, and Web site maintenance.
- Instructors should show genuine interest level in the students by replying their e-mails promptly and allow them to actively contribute to the course content.
- Instructors should rely on e-learning tools such as online exams, posting e-announcements, and attract the students to rely on e-learning tools embedded in the course.

Exploratory factor analysis results and students' perception about ranking the instructor characteristics factor as the most critical factor for the success of e-learning based courses should encourage higher education institutions to carefully plan short and long term plans for faculty development. This simply indicates that the instructor is the main key to successful e-learning based courses in higher education institutions.

Three factors emerged from the exploratory factor analysis applied to the 23 indicators used in measuring student characteristics construct. All items correlation values (loadings) with the identified factors were

*Table 4. Factor Loadings*

| | INS | ST-COMP | ST-COLL | ST-CONT | TECH | SUP | ELU |
|---|---|---|---|---|---|---|---|
| **INS1** | ***0.67*** | 0.07 | 0.07 | -0.06 | 0.10 | -0.03 | 0.04 |
| **INS2** | ***0.82*** | 0.00 | -0.03 | -0.03 | -0.01 | -0.07 | 0.10 |
| **INS3** | ***0.79*** | 0.06 | -0.05 | -0.04 | 0.02 | 0.08 | -0.06 |
| **INS4** | ***0.84*** | -0.04 | -0.05 | -0.02 | 0.07 | 0.06 | -0.01 |
| **INS5** | ***0.85*** | 0.03 | -0.08 | -0.02 | 0.02 | 0.05 | -0.04 |
| **INS6** | ***0.84*** | 0.01 | 0.04 | 0.01 | -0.02 | 0.01 | -0.07 |
| **INS7** | ***0.73*** | 0.06 | 0.01 | 0.13 | -0.04 | 0.02 | -0.06 |
| **INS8** | ***0.74*** | -0.01 | 0.02 | 0.14 | 0.00 | -0.01 | -0.02 |
| **INS9** | ***0.71*** | 0.00 | 0.04 | 0.12 | 0.09 | -0.03 | -0.06 |
| **INS10** | ***0.87*** | -0.08 | 0.05 | -0.04 | 0.01 | 0.00 | 0.04 |
| **INS11** | ***0.87*** | 0.02 | 0.08 | -0.13 | -0.02 | 0.00 | 0.05 |
| **INS12** | ***0.89*** | -0.02 | 0.00 | 0.03 | -0.03 | -0.04 | 0.06 |
| **INS13** | ***0.85*** | 0.02 | -0.02 | 0.01 | 0.02 | -0.05 | 0.05 |
| | | | | | | | |
| **STD1** | -0.03 | ***0.87*** | 0.08 | -0.01 | -0.04 | 0.01 | 0.01 |
| **STD2** | 0.08 | ***0.73*** | 0.10 | 0.01 | -0.04 | 0.03 | 0.02 |
| **STD3** | 0.02 | ***0.85*** | -0.04 | 0.07 | 0.01 | -0.08 | 0.03 |
| **STD4** | -0.01 | ***0.74*** | 0.00 | 0.07 | 0.11 | 0.00 | 0.01 |
| **STD5** | 0.00 | ***0.95*** | 0.01 | -0.05 | 0.04 | -0.05 | -0.13 |
| **STD6** | -0.01 | ***0.89*** | -0.02 | 0.06 | 0.06 | 0.01 | -0.14 |
| **STD7** | 0.01 | ***0.77*** | -0.02 | 0.03 | 0.03 | -0.05 | 0.10 |
| **STD8** | 0.03 | ***0.77*** | -0.06 | -0.06 | 0.02 | 0.01 | 0.08 |
| **STD9** | -0.01 | ***0.64*** | -0.01 | 0.08 | 0.00 | -0.02 | 0.21 |
| **STD10** | 0.00 | ***0.62*** | 0.04 | 0.03 | -0.08 | 0.10 | 0.11 |
| | | | | | | | |
| **STD12** | -0.07 | 0.04 | ***0.83*** | -0.04 | 0.04 | -0.07 | -0.06 |
| **STD13** | -0.04 | 0.05 | ***0.85*** | -0.01 | -0.05 | -0.01 | 0.04 |
| **STD14** | 0.15 | -0.03 | ***0.75*** | 0.00 | -0.03 | 0.02 | -0.03 |
| **STD15** | -0.06 | 0.03 | ***0.75*** | -0.02 | 0.01 | 0.01 | 0.01 |
| **STD16** | 0.16 | -0.07 | ***0.69*** | 0.12 | -0.04 | 0.06 | -0.02 |
| | | | | | | | |
| **STD17** | 0.06 | 0.01 | 0.12 | ***0.66*** | -0.02 | 0.05 | 0.05 |
| **STD18** | 0.02 | 0.07 | 0.05 | ***0.66*** | 0.06 | -0.01 | -0.01 |
| **STD19** | -0.04 | 0.09 | 0.09 | ***0.70*** | 0.03 | -0.02 | -0.07 |
| **STD20** | 0.02 | 0.01 | -0.05 | ***0.76*** | 0.08 | -0.01 | 0.03 |
| **STD21** | -0.03 | 0.04 | -0.04 | ***0.73*** | 0.08 | 0.03 | -0.01 |
| **STD22** | 0.07 | 0.00 | -0.04 | ***0.74*** | 0.03 | 0.11 | -0.11 |
| **STD23** | 0.00 | 0.08 | -0.04 | ***0.73*** | 0.04 | 0.03 | 0.09 |
| | | | | | | | |
| **TEC1** | 0.01 | 0.05 | -0.06 | -0.07 | ***0.82*** | 0.07 | -0.02 |
| **TEC2** | 0.02 | 0.07 | -0.07 | -0.03 | ***0.77*** | 0.05 | -0.09 |
| **TEC3** | 0.01 | -0.05 | -0.05 | -0.03 | ***0.86*** | -0.02 | -0.08 |
| **TEC4** | 0.05 | 0.01 | -0.05 | 0.24 | ***0.75*** | -0.09 | -0.02 |
| **TEC5** | 0.07 | -0.09 | -0.09 | 0.37 | ***0.67*** | -0.09 | 0.06 |
| **TEC6** | 0.11 | -0.12 | 0.13 | 0.17 | ***0.57*** | -0.02 | 0.02 |
| **TEC7** | -0.07 | 0.04 | 0.12 | -0.01 | ***0.61*** | -0.07 | 0.13 |
| **TEC8** | -0.02 | -0.07 | 0.09 | 0.10 | ***0.60*** | -0.03 | 0.16 |
| **TEC9** | -0.01 | 0.01 | 0.09 | 0.00 | ***0.61*** | 0.03 | -0.01 |
| **TEC10** | 0.06 | 0.06 | 0.00 | -0.07 | ***0.67*** | 0.03 | -0.01 |
| **TEC11** | 0.00 | 0.07 | -0.04 | -0.14 | ***0.78*** | 0.13 | -0.06 |
| **TEC12** | -0.07 | 0.06 | 0.03 | -0.01 | ***0.65*** | 0.03 | 0.09 |
| **TEC13** | 0.06 | 0.04 | 0.07 | 0.00 | ***0.55*** | 0.22 | -0.01 |
| | | | | | | | |
| **SUP1** | -0.02 | 0.04 | 0.00 | 0.02 | 0.14 | ***0.71*** | 0.01 |
| **SUP2** | 0.06 | -0.06 | 0.02 | 0.08 | 0.09 | ***0.72*** | -0.02 |
| **SUP3** | -0.05 | 0.09 | 0.10 | 0.00 | 0.19 | ***0.65*** | 0.03 |
| **SUP4** | -0.03 | -0.06 | -0.06 | 0.07 | 0.17 | ***0.75*** | -0.03 |
| **SUP5** | 0.03 | -0.03 | -0.04 | 0.01 | 0.10 | ***0.71*** | 0.10 |
| | | | | | | | |
| **ELU1** | -0.02 | 0.26 | 0.06 | 0.02 | 0.05 | 0.02 | ***0.65*** |
| **ELU2** | 0.02 | 0.27 | -0.07 | 0.04 | 0.02 | 0.01 | ***0.64*** |
| **ELU3** | 0.04 | 0.25 | -0.04 | 0.02 | -0.03 | 0.07 | ***0.74*** |
| **ELU4** | 0.02 | 0.26 | 0.02 | -0.04 | 0.03 | 0.00 | ***0.78*** |

>0.60. The first student factor (ST-COMP) comprised the first 10 indicators of student characteristics (STD1-STD10). All 10 items were related to students' computer competency and their ability to use and promote computing technology as it is applied to learning (see Table 4). This factor included student's motive to use e-learning and the approach that best suits him/her such as learning by construction or absorption. The second student factor (ST-COLL) comprised 5 items (STD12-STD16), all the 5 indicators were related to the different types of interactive collaborations which include student-student and student-instructor collaborations. Item STUD11 was dropped from any further analysis because it did not load on any e-learning CSF. All factor loadings of the ST-COLL factor were >0.65 which indicated high validity of the factor structure. This factor indicated that the more interactions the students get exposed to, the more opportunities they have to learn. The e-learning resources such as on-line discussion forums can play a mediating role for collaboration among students. The third factor (ST-CONT) comprised the last 7 indicators (STD17-STD23). All the 7 indicators were related to e-learning course content and design. All factor loadings were >0.65. This factor captured students' perception about interactivity, efficiency and effectiveness of Blackboard as a

course management system used by the university as an e-learning resources management tool. Course management systems made it possible to hold online discussions among student group members, virtual classrooms, and many other e-learning resources. The availability and timeliness of course materials and e-learning course components were tested by this factor. In general the student characteristics as a factor contributing to the success of e-learning initiatives at the university was split into three factors capturing the students' perceptions about computing literacy, interactive collaboration, and e-learning based course content. The recommendations concluded from student characteristics exploratory factor analysis can be summarized as follows:

- Students should gain a high level of computing competency. They should master applications such as e-mail, presentation and communication, creative thinking, all the software applications needed to enhance the e-learning process.
- Students should be aware of the differences between learning by construction and learning by absorption in order to value the e-learning tools.
- Students should rely on e-tools embedded in e-learning course such as e-mail, e-discussion, virtual classroom, collaboration, and active role in class.
- Students like to attend class. This should motivate the higher education institutions to promote synchronous e-learning components.
- Most of the student responses to the factor items were positive indicating a satisfaction with e-learning based course content, structure, and design.
- Most of the students had exposed before to computing skills and e-learning experiences (see demographic data in Table 1).

The technology factor of e-learning success was measured by 13 indicators, all of them loaded with correlations of values >0.50. The indicators used in the technology factor were related to the ease of technology access and navigation, visual technology interface, and the information technology infrastructure reliability and effectiveness. Most of the student responses to the 13 technology items were positive. The students were mostly satisfied with the on-campus Internet access, course websites available via Blackboard, and online course registration. The technology factor analysis revealed the following recommendations, higher education institutions should:

- Provide students with easy on-campus access to the Web.
- Install enough bandwidth in order to have fast enough Web browsing.
- Install a campus wide single student authentication in order to have access to his/her data from anywhere in the campus.
- Develop an effective information technology infrastructure that should consist of highly reliable networking facilities, course management system, student information system, and medium richness.

The university support factor is the second wing of the technology factor and was measured using 5 indicators; all of them had factor loadings of ≥0.65. All the items were related to university support to e-learning initiatives available. The support included library services, help desk, computer labs and facilities. Students were satisfied with university support. The last factor was related to the student usage of e-learning courses as an indicator of their acceptance of this technology at the university. The e-learning usage (ELU) factor was measured by 4 indicators, all of them had high factor loading values of ≥0.75. The ELU factor included the intention of registering in future e-learning based courses and the students' perception about e-learning in general. Students indicated positively that they will register in e-learning based courses in the future which indicated a positive attitude toward accepting the e-learning technology. Finally, it can be concluded that the indicators used in e-learning CSF assessment instrument truly represented the concepts of interest.

E-learning CSF assessment instrument's reliability was measured using Cronbach alpha. Table 5 shows Cronbach alpha values for the 7 e-learning CSFs emerged from the factor analysis given in Table 4. The suggested accepted value of Cronbach alpha is ≥0.70 (Hair, Anderson, Tatham, & Black, 1998). All factors exhibited a high degree of internal consistency as the alpha values were ≥0.87. It was concluded that the indicators could be used to measure the factors with acceptable reliability. The average variance extracted, which reflects the overall amount of variance in the items accounted for by the factor. The average variance extracted is more conservative than Cronbach alpha as a composite reliability measure and its accepted value is 0.5 or above (Fornell & Larcker, 1981). As shown in Table 5, all the average extracted variance values are ≥0.69. Average extracted variance can be used to evaluate the discriminant validity. The square root of the average extracted variance for each factor should be greater than the correlations between that factor and all the other factors (Fornell & Larcker, 1981). Table 6 shows the correlation matrix of the e-learning CSFs and the square root of the average extracted variance. The discriminant validity does not reveal any problems.

*Table 5. E-learning CSFs Instrument Reliability*

| CSF | Cronbach Alpha | Variance Extracted |
|---|---|---|
| INS | 0.95 | 0.81 |
| ST-COMP | 0.95 | 0.79 |
| ST-COLL | 0.87 | 0.78 |
| ST-CONT | 0.90 | 0.71 |
| TECH | 0.92 | 0.69 |
| SUP | 0.90 | 0.71 |
| ELU | 0.93 | 0.71 |

*Table 6. Correlation Matrix of E-Learning CSFs*

| Factor | INS | ST-COMP | ST-COLL | ST-CONT | TECH | SUP | ELU |
|---|---|---|---|---|---|---|---|
| INS | ***0.90**** | | | | | | |
| ST-COMP | 0.37 | ***0.89**** | | | | | |
| ST-COLL | 0.41 | 0.39 | ***0.88**** | | | | |
| ST-CONT | 0.51 | 0.50 | 0.47 | ***0.84**** | | | |
| TECH | 0.46 | 0.45 | 0.37 | 0.57 | ***0.83**** | | |
| SUP | 0.35 | 0.35 | 0.30 | 0.48 | 0.57 | ***0.84**** | |
| ELU | 0.28 | 0.53 | 0.35 | 0.45 | 0.43 | 0.38 | ***0.84**** |

** Square root of the average extracted variance*

## CONCLUSIONS AND FUTURE WORK

Information technology and intense competition are reshaping higher education institutions worldwide. E-learning has been integrated in several higher education institutions. Consequently, several adoption-related factors must be carefully evaluated before any adoption attempt is made by universities and instructors. The adoption of e-learning technology is a complex process of establishing and developing an integrated information technology system. This study, in line with the literature, identified and measured four critical factors that assist universities and instructors to adopt e-learning technologies. CSFs, which were identified and measured from student perceptions, included: instructor characteristics, student characteristics (computer competency, interactive collaboration, and course content and design), technology, and support. The four CSFs impact the decision to adopt e-learning technology in higher education institutions.

A sample of 37 class sections with 900 enrolled students was used to identify and measure the proposed e-learning CSFs. The students perceived the four factors as critical success factors in e-learning. The surveyed students indicated that instructor characteristics factor is the most critical factor followed by support and technology. The student characteristics factor was perceived as the least critical factor to the success of e-learning. The students indicated that when a higher education institution attempts to adopt e-learning based courses the following factors should be critically considered:

- Instructors should have sufficient computing skills and enthusiasm in order to motivate the students.
- Construction of faculty development plans at both the short and long term to enhance and improve their technology related skills and interactive learning different methods.
- Development of student orientation programs to introduce them to the different teaching and learning styles using e-learning.

- Enhancement of students' computing literacy and e-learning applications skills (e-mail, presentation, and creative thinking)
- Construction of an effective information technology infrastructure in order to facilitate fast Web access, email, course management system, and other e-learning services.
- Establishment of e-learning support services.

All indicators of the instructor characteristics factor were important and significant measures. Students perceived the instructor's enthusiasm, presentation style, friendliness, and interest in students as important and critical factors of e-learning success. Students perceived instructor's technical skills as significant to the e-learning success which came in line with the results of a recent study by Demetriadis, Babas, Tsoukalas, and Palaigeorgiou (2003). Student's characteristics, as perceived by the students themselves, were split into three sub-factors: student computing literacy, student interactive collaboration, and e-learning course content and design. Students showed a positive attitude towards e-learning indicating that "e-learning encouraged us to search for more facts and participate more actively in the class than traditional learning methods". This came in support to results of another recent study by Beyth-Marom et al. (2003).

In the technological dimension, reliability of the information technology infrastructure, as perceived by surveyed students, was very important to the success of e-learning. The critical indicators were Internet accessibility, user interfaces, authentication consistency, student information system, and networking. The university support to students enrolled in e-learning based courses was viewed as critical success factor. Support was not limited to technical assistance and troubleshooting but included library and information availability. Students indicated that they would register in future e-learning based courses assuring their positive attitude and support to e-learning technology and tools.

This study explored the students' perceptions in identifying and measuring e-learning critical success factors within a university environment. There is a need to explore instructors' perceptions about e-learning CSFs and contrast both instructors' and students' perceptions. Further study can expand on this research to develop a causal research model that includes all the 7 constructs (INS, ST-COMP, ST-COLL, ST-CONT, TECH, SUP, and ELU). The objective of the causal research model would be to study the effects of the first 6 factors on e-learning acceptance as indicated by ELU. The proposed research model can generate causal relationships among the 7 CSFs.

In conclusion, this study investigated the critical factors affecting e-learning technology adoption by universities from students' perspective. The factors identified and measured in this study can assist higher education institutions in increasing the efficiency and effectiveness of the adoption process.

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*Appendix: E-learning CSF Instrument*

| | |
|---|---|
| **Instructor Characteristics (INS)** | |
| **INS1** | The instructor is enthusiastic about teaching the class |
| **INS2** | The instructor's style of presentation holds me interest |
| **INS3** | The instructor is friendly towards individual students |
| **INS4** | The Instructor has a genuine interest in students |
| **INS5** | Students felt welcome in seeking advice/help |
| **INS6** | The instructor encourages student interaction |
| **INS7** | The instructor handles the E-learning units effectively |
| **INS8** | The instructor explains how to use the E-Learning components |
| **INS9** | I feel the instructor is keen that we use the E-Learning based units |
| **INS10** | We were invited to ask questions/receive answers |
| **INS11** | We were encouraged to participate in class |
| **INS12** | The instructor encourages and motivates me to use e-learning |
| **INS13** | The instructor is active in teaching me the course subjects via e-learning |
| **Student Characteristics (STUD)** | |
| **STUD1** | The E-Learning encourages me to search for more facts than the traditional methods. |
| **STUD2** | The E-Learning encourages me to participate more actively in the discussion than the traditional methods |
| **STUD3** | I enjoy using personal computers |
| **STUD4** | I use the personal computers for work and play |
| **STUD5** | I was comfortable with using the PC and software applications before I took up the E-Learning based courses |
| **STUD6** | My previous experience in using the PC and software applications helped me in the E-Learning based courses |
| **STUD7** | I am not intimidated by using the E-Learning based courses |
| **STUD8** | I learn best by absorption (sit still and absorb) |
| **STUD9** | I learn best by construction (by participation and contribution) |
| **STUD10** | I learn better by construction than absorption |
| **STUD11** | I do not read / participate in the discussion group |
| **STUD12** | I only read messages in the discussion group |
| **STUD13** | I do read as well as participate in the discussion group |
| **STUD14** | The instructor initiated most of the discussion |
| **STUD15** | The students initiated most of the discussion |
| **STUD16** | The instructor participated actively in the discussion |
| **STUD17** | I found the instructions on using the E-Learning components to be sufficiently clear |
| **STUD18** | I found the course content to be sufficient and related to the subject |
| **STUD19** | It was easy to understand the structure of the E-Learning components |
| **STUD20** | It was easy to navigate through the Blackboard/course web |
| **STUD21** | The E-Learning components was available all the time |
| **STUD22** | The course materials were placed on-line in a timely manner |
| **STUD23** | I perceive the design of the E-Learning components to be good |
| **Technology (TECH)** | |
| **TECH1** | Easy on-campus access to the Internet |
| **TECH2** | Did not experience problems while browsing |
| **TECH3** | Browsing speed was satisfactory |
| **TECH4** | Overall, the website was easy to use |
| **TECH5** | Information was well structured/presented |
| **TECH6** | I found the screen design pleasant |
| **TECH7** | I could interact with classmates through the web |
| **TECH8** | I could easily contact the instructor |
| **TECH9** | I can use any PC at the university using the same account and password |
| **TECH10** | I can use the computer labs for practicing |
| **TECH11** | I can rely on the computer network |
| **TECH12** | I can register courses on-line using Banner |
| **TECH13** | Overall, the information technology infrastructure is efficient |
| **Support (SUP)** | |
| **SUP1** | I can access the central library website and search for materials |
| **SUP2** | I can get technical support from technicians |
| **SUP3** | I think that the UAEU E-Learning support is good |
| **SUP4** | There are enough computers to use and practice |
| **SUP5** | I can print my assignments and materials easily |
| **E-learning Usage/Acceptance (ELU)** | |
| **ELU1** | I intend to register in courses that use E-Learning methods |
| **ELU2** | E-Learning is a failure and a bad idea |
| **ELU3** | E-Learning is an effective method of learning |
| **ELU4** | I like the idea of using E-Learning |