

Online Education: Lessons Learned from Teaching Undergraduate Courses

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Abstract

As a result of the 'COVID-19' pandemic, the urgent introduction of online distance education into the learning process has become an eminent change in the delivery of courses, requiring urgent decisions and effective mechanisms to implement into the educational process as well as the analysis of the current traditional teaching process. This paper presents the result of an online questionnaire survey conducted among instructors and undergraduate students of an institution in a developing country during the 'Spring 2020' and 'Fall 2020' semesters to explore their experience and feedback related to online education. Issues related to the logistics and infrastructure, interaction between instructors and students, communication problems, available policies and procedures, technical support, and other problems associated with online teaching/learning are presented. The data received from the survey respondents was analyzed and the analysis results has suggested that online education may be more effective for lecture-based courses but when studying scientific courses that requires problem solving, the priority should be given to traditional methods of teaching, particularly for courses that have lab components. Despite facing some challenges and difficulties, the responses received from students indicated that, in general, they are quite satisfied with online teaching and expressed their desire to continue offering courses using this mode of delivery even during normal times. Data analysis also showed that online teaching resulted in a slightly better-than-expected performance as compared to face-to-face lecturing and boosted student's learning experience. Course instructors and students indicated that the reason for this better performance is due to the online availability of lecture notes and other learning material, including the recordings of lectures. This is in addition to the fact that online classes allow students to attend from anywhere and conveniently access course material anytime and anywhere. Students, however, have listed some concerns associated with online learning including the inadequate time provided for online exams and the unfair evaluation and assessment of students' work. This is in addition to the technical problems frequently encountered during online classes and exams and the absence of an efficient technical support system and a clear policy related to this relatively new delivery method. The results also revealed that around 62% of the surveyed students indicated that blended learning, a combination of online learning and traditional face-to-face lecturing, can be useful and recommended using it in future course delivery. Instructors, on the other hand, indicated that, despite the several benefits of online learning, the engagement of students was minimal, and the online learning infrastructure and learning management system need to be improved. Finally, recommendations and lessons learned from the online learning experience are presented

Index Terms: Online Learning, Traditional Delivery Method, Undergraduate Courses, Student Performance

1. Introduction

Despite that fact that online teaching was imposed during the COVID-19 pandemic, it offered benefits to both course instructors and students and provided new interesting challenges and experiences. In fact, higher education is being rapidly transformed by the growth in online learning, with an increasing number of universities worldwide offering degree programs in online distance mode of study. With the digital communication advances of the 21st century, traditional teaching worldwide has transformed into online learning, with many more universities offering undergraduate and graduate degree programs that can be completed entirely online. While this can provide a significant opportunity for further widening of participation in higher education, current research indicates that much needs to be done to improve how online learning is conducted and to what extent can be implemented for the sake of improving the learnability and performance of students.

Moore et al. [1] investigated how practitioners and researchers in the literature define non-traditional learning environments. The results of the study revealed that there are different expectations and perceptions of learning environment labels: distance learning, e-learning, and online learning. As learning continues to evolve, practitioners and researchers have yet to agree on common definitions and terminologies for distance learning, e-learning, and online learning environments [2, 3]. The following subsections provide a brief overview of these learning environments as discussed in the literature.

A. Distance Learning

The main idea of distance education is to provide access to learning for those who are geographically distant. As advanced technology and computers became involved in the delivery of education, distance education can be viewed as the delivery of instruction and instructional materials using electronic media. The instructional mode includes an instructor who is physically located in a different place from the learner and, possibly, provides the instruction at different times. King et al. [4] indicated that distance learning and distance education are two different things. Distance learning is the ability of learning while distance education is an activity within the ability of learning at a distance and both are limited by the differences in time and place [3]. As new technologies and advances become available, distance learning used these advances and technologies as part of its activities and the term 'distance' is there because of the time and place constraints [5, 6]. The term then evolved to describe other forms of learning such as online learning, e-learning, technology, mediated learning, online collaborative learning, virtual learning, web-based learning, etc. [7]. As reported by Moore et al. [1], a common definition of distance learning can be drawn as the form of instruction that occurs between two parties, a learner and an instructor, and is held at different times and/or places. Moore and Kearsley [8] added the need to use new advances and technologies.

B. e-Learning

Nichols [9] defined e-learning as using instructional delivery methods and making learning material accessible via technological tools that can be web-based or web-distributed. Ellis [10]; however, believes that e-learning also includes audio, videotape, satellite broadcast, and interactive TV. Tavangarian et al. [11] believed that the technology being used was insufficient and stated that e-learning shows some transformation of a learner's experience into the learner's knowledge. Triacca et al. [12] indicated that e-learning is a type of online learning. Arbaugh [13] defined e-learning as the use of the Internet by users to learn specific content. Other researchers define e-learning as using modern Information and Communications Technology (ICT) and computers to deliver instruction, information, and learning content [14]. However, it is quite clear that there is some uncertainty as to what exactly are the characteristics of the term e-learning. However, it is clear that all forms of e-learning such as applications, programs, objects, websites, etc., can provide a learning opportunity for students or learners in general.

C. Online Learning

Online learning is described by most researchers as the access to learning experiences via the use of some technology [15, 16]. Hiltz and Turoff [17] and Benson [15] identify online learning as a more recent and improved version of distance learning which improves access to educational opportunities for learners. Other researchers discussed the accessibility of online learning and its connectivity, flexibility, and ability to promote various interactions [17, 18]. In general, many researchers believe that there is a relationship between distance education or learning, e-learning, and online learning but there is still no clear agreement on their descriptive narratives. In essence, literature provided unclear reference to distance learning, e-learning, or online learning believing that the term can be used synonymously [19, 20, 21].

D. Online Education

In addition to the traditional face-to-face course-delivery method and the three online methods (distance learning, e-learning, and online learning), blended learning [22] and flipped learning [23] have also been used by some educational institutions around the world. However, the three most commonly used learning environments are distance learning, e-learning, and online learning and the three terms are closely connected in most learner's and educator's minds. This paper, therefore, uses the term online education as a means for making learning material and experiences accessible by using technology to deliver instruction and provide access to information and learning content for students and for those who are geographically distant. It may also include providing learning audios and videos. Online education is an innovative approach to education delivery via electronic forms of information that enhance the learner's knowledge, skills, and/or performance [24]. Online learning systems provide benefits for educational institutions and for students and educators located around the world. As indicated by Bhuasiri et al. [24], advantages of e-learning for learners include an increased accessibility to information, personalized instruction, better content delivery, content standardization, on-demand availability, accountability, interactivity, self-pacing, and increased confidence and convenience. Other important benefits of online learning include reducing costs, enabling a consistent delivery of content, and improving tracking, this is in addition to other benefits for instructors. As for the cost, online education reduces classroom and facilities cost, training cost, travel cost, printed materials cost, labor cost, information overload, and other overheads [24]. However, online education requires considerable investments in technology and infrastructure improvements such as hardware costs, software licenses, learning material development, equipment maintenance, and training cost. It also presents a significant challenge to both students and educators and the transition from traditional classroom learning to online learning needs time for the users to adjust. Despite these challenges, opportunities still exist to improve the effectiveness and success of online education.

2. Literature Review

Many higher education institutions are increasingly encouraging and embracing online educations as a means of providing learning and improving students' performance. The key prerequisites for the success of online education include the availability of appropriate staff, instructors, and effective technology and infrastructure, in addition to the instructional design and course evaluation [25]. Furthermore, the success of online education depends on both its initial acceptance and its continued usage. The acceptance of new technologies and advances has been the subject of many studies in the past decades and, therefore, various theoretical models have emerged for online education. As reported by [25], the most widely used models include the technology acceptance model (TAM), the theory of planning behavior (TPB), and expectancy confirmation theory (ECT). Welsh et al. [26] concluded that online learning has huge potential and can reduce costs in comparison to a traditional classroom environment but, despite these benefits, online learning has a higher drop-out rate than traditional delivered instruction. Alshare et al. [27] reported that technology integration within education in developing countries is lagging due to cultural, political, and economic concerns.

Zou [28] investigated the feasibility, effectiveness, and viability of using e-learning in an undergraduate course and students' preference as opposed to traditional face-to-face learning. E-learning modules were developed for the course and the results showed that the majority of students' knowledge using e-learning has increased and their experience of e-learning has been positive. Besides, the majority of students indicated that they would prefer a combination of face-to-face and e-learning methods (blended learning). Lin [25] explored the factors that affect the intention to continue using online e-learning from the viewpoint of educators and learners and examined the moderating effects of e-learning experience on the relationships among these factors. The results revealed that negative incidents and attitude are the main factors that affect the intention to continue using e-learning irrespective of their level of e-learning experience. Smith et al. [29] compared student group work experiences in online versus face-to-face sections of the same graduate course over three years to determine what factors influence student group work experiences. The results of the study revealed that students in online sections were more negative about group work as compared with students in face-to-face sections. DeJong et al. [30]; Nguyen [31]; Potkonjak et al. [32] concluded that virtual classes and laboratories that employ computer simulations of real-world learning situations can be as effective as face-to-face instruction. A study by Gardner and Belland [33] and Freeman et al. [34] indicated that active learning, in particular, improves learners' educational performance outcomes. Bokor and Hadju [35] discussed the impact of using blended learning in teaching undergraduate courses at an international university. The courses were created using a combination of blended-learning and face-to-face methods. A study by Bortnik et al. [36] revealed that virtual laboratories can be used as a supporting mean to train students and improve their understanding of experiments before they conduct hands-on experiments in real labs but it does not replace doing the experiment in face-to-face real labs.

More recently, Yilmaz [37] examined the perception of students for face-to-face and distance education. The study revealed that distance education has great benefits as it allows students to get access to learning material

whenever they want at any place and as many times as they want. This is in addition to the fact that it is much more convenient for working students as it saves commuting time and effort. Shraim [38] conducted an online questionnaire survey to elicit their perceptions of the advantages of online examinations in terms of pedagogy, validity, reliability, affective factors, practicality and security. The results showed that online exams were perceived to have significant benefits over traditional, paper-based examinations, including reliability of grading and efficiency in terms of time, effort and money spent on the exam process. However, participants identified many challenges facing the successful implementation of online exams including reliability, security, validity, and fairness issues. Stone [39] conducted a study to compare students and instructors' perspectives on ways to improve the outcomes in online learning in Australian higher education. The finding of the study indicated that online education allows employees to pursue their studies while working and managing other responsibilities and businesses but this type of students tend to be academically less experienced and less confident than their face-to-face younger counterparts. Lucky et al. [40] addressed both concerns by assessing learning outcomes in two courses with both face-to-face and distance learning sections and evaluating the frequency of plagiarism occurrence. The results revealed that both sections (face-to-face and distance learning) had equivalent learning outcomes. However, academic dishonesty and plagiarism were detected in few percentage (2%) collected incidents while cheating was more in distance than in face-to-face classes. Kireev et al. [41] examined the use of blended learning (online learning and face-to-face learning) in 6 groups of students of general engineering to study their attitude toward online learning during the 2017-2018 academic year. The results of the research showed positive attitude of students and instructors toward the use of blended learning. In another interesting recent study, Muraveva [42] discussed the process of active implementation of online learning modes based on digital technologies and concluded that digital technologies diversify the classes and possess numerous tools to enhance motivation of students.

Most research efforts indicated that the traditional way of delivering lectures in classrooms proved to be inadequate and inefficient and the availability of modern technologies to help instructors and students engaged in the online education process made it possible to quickly adopt to the online learning environment. Recently, the education sector is witnessing a dramatic progress and is undergoing a major shift towards online education. This shift has been influenced largely by technological advances and pedagogical trends and the greater worldwide access to the Internet. Adopting online learning in teaching would be a positive influence to boost students' learning at the undergraduate and graduate levels. In this study, 158 students enrolled in two undergraduate courses were surveyed to investigate the effectiveness, benefits, and satisfaction of students and instructors when using online learning as a means of education and delivering course topics and exams. The survey was designed and posted using Blackboard learning platform for students and by email for instructors. Students were asked to respond to the survey via Blackboard while instructors responded by email. Surveyed students took undergraduate and graduate courses online in the 'Spring 2020' and 'Fall 2020' semesters (during the COVID-19 pandemic). The responses received from students and instructors for the selected two courses were statistically analyzed and the analysis results are presented. The performance of students in the 'Spring 2020' and 'Fall 2020' semesters was compared with that for other students who took the same course in the 'Fall 2019' semester using conventional face-to-face lecturing.

3. The Questionnaire Survey

In this study, students enrolled in the 'engineering economics' and 'construction management' courses offered by an international institution in the 'Spring 2020' and 'Fall 2020' semesters (a total of 158 students) were surveyed using Blackboard, a learning management platform used by this institution. The 'engineering economics' course is a general core course required to be taken by all engineering students while the 'construction management' course is a core course in the Civil and Environmental Engineering Department, which requires the 'engineering economics' course as a co- or pre-requisite. Also, 14 instructors from the College of Engineering, College Business and Economics, and College Science were also surveyed. The purpose of the questionnaire survey, in general, is to elicit the opinions and feedback of students and instructors related to their overall online learning/teaching experience and other issues related to the logistics and infrastructure, interaction between instructors and students, communication problems, available policies and procedures, technical support, and other problems associated with online teaching/learning. Two separate questionnaire surveys were designed to address these issues, one for students and one for course instructors. The details of the two surveys are described in the following subsections.

A. Students' Survey

Students' survey is composed of 31 questions distributed over 7 parts 1) general: includes questions related to students' specialization and familiarity with online learning; 2) online learning: addresses questions related to the availability of online course material and other learning tools and the overall effectiveness of online learning; 3) instructors' organization and experience with online learning: includes questions related to the

commitment of instructors to online sessions and office hours, effectiveness of course delivery, and availability of instructors in times other than class times and office hours; 4) exams and student evaluation process: with questions related to the fairness and effectiveness of online exams and assessment tools and methods; 5) infrastructure and logistics: addresses questions related to the effectiveness of the institution's learning management system and the availability of a reliable online learning infrastructure; 6) technical problems: includes questions related to the technical problems students face and the availability of an effective technical support when students encounter such problems during online lecture times or exams; and 7) suggestions for future improvement.

B. Instructors' Survey

The survey distributed to instructors is composed of 17 questions distributed over 6 parts 1) general: includes questions related to instructors' area of specialty and experience with online teaching; 2) online course material and teaching: addresses questions related to the effectiveness of online course delivery, the difficulties associated with interacting with students and making sure that they comprehend course concepts, and the overall interaction and communication with students during online sessions; 3) exams and students' performance assessment process: includes questions related to the effectiveness of online exams and assessment methods used to measure students' performance; 4) infrastructure and logistics: with questions related to the effectiveness of the institution's learning management system and the availability of a reliable online learning platform; 5) technical problems: includes questions related to the technical problems instructors face and the availability of an effective technical support when instructors encounter such problems during online lecture times; and 6) lessons learned and recommendations for future improvement.

4. Data Analysis and Results

The data of the responses of students and instructors were extracted from Blackboard and analyzed. Data analysis and results are presented in the following subsections.

A. Analysis of Students' Responses

Out of the 158 students surveyed, the majority are already specialized (62%) while 38% are still general engineering students. The 'COVID-19' pandemic started during the 'Spring 2020' semester, and the analysis of students' responses revealed that 81% of students did not take online classes before the 'Spring 2020' semester. On the other hand, 73% indicated that they have been taking online classes for the second consecutive semester with around the same percentage indicating that they took 7 online courses or more and that they are familiar with online learning environment. Around 72% of the surveyed students believe that instructors provided enough online course material and that the provided material and lecture recordings are easy to comprehend and understand in case they do not attend the online lectures. However, when asked whether it is easier to understand course material when lectures are conducted face-to-face as compared with online lectures, 63% of students indicated that course topics and concepts are understood better with face-to-face lectures. Around 38% of the surveyed students indicated that instructors also provide online educational videos as part of the online learning materials. When asking students about the advantages of online learning, 95% indicated that the main advantage of online learning is that they can attend classes from anywhere and view the lecture recordings anytime and anywhere. However, the majority of students (83%) believe that online learning is not suitable for conducting courses that involve problem-solving and lab sessions. Also, more than 67% of the surveyed students believe that it was hard to engage in class discussions and interact with the instructor during online session due to the high enrollment of online courses and lack of time. Interestingly, around 62% of students indicated that they prefer blended learning, a combination of online learning and traditional face-to-face lecturing.

In the third part of the students' survey, students were asked about the commitment of instructors to online sessions and office hours and the majority of students (93%) believe that instructors are committed to class times and to the assigned office hours and are available even outside class times. Around 87% of students indicated that instructors explain the course topics in an organized and clear manner. When asked about the availability of course material before lecture times, respondents seem to be quite satisfied since more than 84% of them indicated that course material is always available days before class times. Around 82% of students showed their satisfaction with the tutorial sessions and indicated that instructors provide enough tutorials including a sufficient number of examples and exercises. In general, the majority of students (93%) believe that instructors are always there when needed and that they respond to students' questions and concerns in a clear and timely manner.

Part four of the survey investigated students' satisfaction with online exams and their performance assessment process. Only 43% of students showed their satisfaction with the assessment process and believe that

instructors need to use better evaluation schemes to assess their performance. Also, more than 62% of students believe that the time allocated for online exams is not adequate. When asked about their preference of the manner by which exams should be conducting, 36% indicated that they prefer to have exams face-to-face while 23% only prefer online exams. Interestingly, 30% showed interest to have blended type of exams (face-to-face and online) while 11% prefer to have take-home exams. When asked about the way students like to see exam questions, only 4% indicated that they prefer seeing questions one at a time while the majority (62%) like to see exam questions displayed in groups where each group is related to a specific course topic. Around 27% of students prefer to see all questions at once while 7% prefer to see exam questions in a group of 3 to 4 questions.

Parts five and six of the survey focus on the effectiveness of the available infrastructure and logistics for conducting online lectures and the technical problems encountered during attending online lectures and exams. Analysis of the results revealed that 89% of the surveyed students believe that the 'Blackboard' learning management system used by the institution is effective and reliable despite that fact that 57% of the students suffered from lag-times during online lecture sessions. Also, more 61% of students indicated that they have encountered technical problems during online lecture sessions and exams. Around 46% of students are happy with the institution's technical support indicating that they address and respond to students' concerns and solve their technical problems effectively and in a timely manner. Finally, students were asked to provide suggestions and recommendations to improve the online learning process. Some of the important recommendations are summarized in the following section.

B. Analysis of Instructors' Responses

Out of the 14 instructors surveyed in this study, 11 are from the different departments of the College of Engineering, two from the College of Business and Economics, and one from the College of Science. The instructors are specialized in different areas related to engineering, business, and science disciplines. Only three instructors (around 21%) have previous experience with online teaching. Eight instructors (57%) believe that the online course delivery is quite effective for lecture-based courses while it is not advisable for lab-based course. However, around 86% highlighted the difficulties of interacting with students and getting them engaged during online sessions. While it is quite clear that online teaching is more convenient for both instructors and students since instructors can conduct lectures and students can attend from anywhere, almost all instructors (13 out of 14) showed concerns on how to make sure that students comprehend course concepts during online lecture sessions. As a matter of fact, 9 out of the 14 surveyed instructors indicated in a comment that some students attend the lecture virtually while they are actually (physically) not there. This raises the issue of how to make students more serious in terms of being more mature to realize that missing classes intentionally may affect their overall performance, despite the fact that they can view lecture recordings later. Unexpectedly, however, instructors indicated that students' performance has slightly improved with online learning as compared to face-to-face delivery of lectures.

When asked about the effectiveness of online exams and the assessment process used to measure students' performance, more than 64% of the instructors believe that online exams do not fairly assess students' performance and their actual understanding of course material, particularly for courses that require calculations and problem-solving. The majority of instructors (11 out of 14) believe that the current infrastructure needs to be improved to in order to be more effective and robust for online teaching. More than 71% of the instructors also emphasized the importance of improving the institution's current learning management system and make it more efficient and practical. Few instructors (3 out of 14) indicated that they always face technical issues during online lecturing, and this hinders course delivery in the absence of a robust and efficient technical support. Finally, instructors were asked to summarize the lessons learned from their experience with online teaching and provide suggestions and recommendations for future improvement. Some of the important lessons learned and recommendations are summarized in the following section.

5. Lessons Learned and Recommendations

The following is a summary of some lessons learned, suggestions, and recommendations provided by students and instructors to improve the online learning and teaching process and make it better in the future:

- Lecture-based courses are very good candidates for online delivery. This is because of the convenience associated with delivering courses of such nature, attending these courses from anywhere, and watching lecture recordings anytime. On the other hand, lab-based courses are recommended to be delivered face-to-face.
- The current online teaching infrastructure needs to be improved and a more efficient and robust learning management system is needed. A comprehensive study should be conducted to investigate the issues related to online learning/teaching and suggest effective solutions.

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- Instructors need powerful and efficient online teaching devices such as touch pads or touch screen laptops. Such devices are needed for effective online lecture delivery.
- A better exam proctoring management system is needed. It is also recommended that online exam proctoring be conducted by a third party.
- An effective technical support system should be available to address technical difficulties and problems faced by instructors and students, particularly during exams.
- A clear policy should be available to address online legal issues. This is particularly important when students request to have makeup exams due to experiencing technical problems during exams.
- The process of assessing students' performance for online courses should be revisited and more attention should be given to the nature of online exam questions and the way these questions are displayed during exams.
- Blended learning is recommended to be implemented in future online course delivery.

6. Conclusion

This paper presented the results of an online questionnaire survey conducted among instructors and undergraduate students of an institution in a developing country during the COVID-19 pandemic to elicit their experience and feedback related to online education. The data received from the survey respondents was analyzed and the analysis results have suggested that online education may be more effective for lecture-based subjects but when studying scientific courses that requires intensive problem-solving, the priority should be given to traditional face-to-face method of teaching, particularly for courses that have lab components. Despite the challenges associated with online learning, survey data analysis revealed that the majority of students prefer online learning due to the convenience of attending lectures from anywhere and the availability of lecture recordings that can be viewed anytime. In general, students are quite satisfied with online learning and hope to continue offering some courses online even during normal times. Data analysis also showed that online teaching resulted in slightly better-than-expected performance as compared to face-to-face lecturing and boosted student's learning experience. Students, however, listed few issues and concerns related to online learning such as the inadequate time provided for online exams and the unfair evaluation and assessment of students' work. This is in addition to the technical problems frequently encountered during online classes and exams due the absence of an effective technical support mechanism and a clear policy related to this relatively new delivery method. Some important lessons learned and interesting recommendations to improve the online learning and teaching were finally suggested by students and instructors

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