

2022

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Original Publication Citation

M. Tomovic, C. Tomovic (2022) Teaching in the times of pandemic, *ICERI2022 Proceedings*, pp. 3624-3628. <https://dx.doi.org/10.21125/iceri.2022.0884>

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Teaching in the Times of Pandemic

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Abstract

The changes in academia are typically slow but very purposeful, they are carefully reviewed and strategically implemented, that is, until unpredictable massive tectonic shifts occur in society. Historically, academia has not experienced major distress on a global scale that would require a fundamental change and adaptation to new set of circumstances, until the world faced COVID-19 pandemic of proportions which caused academia to rapidly adjust to new realities and make major changes. The time frame in which the changes needed to be done, weeks and months, were so short that academia was placed under the significant stress to which it is unaccustomed, but it did change in numerous innovative ways and delivered exceptional results. This paper presents some of the lessons learned by the authors from this global pandemic which could be added to the toolbox of measures to deal with the future tectonic changes, and yet these same lessons can also serve to improve student learning experiences in the times of normalcy.

Teaching approaches discussed in this paper are related to authors' extensive experiences in delivering courses in synchronous and asynchronous distance modalities. These experiences allowed authors to seamlessly and effortlessly transition to new conditions facing academia. In addition, the students who were exposed to similar learning experiences prior to pandemic had equally seamless and effortless transition.

The results indicate that students benefited significantly from the applied approach which included flipped classroom and asynchronous learning amongst other approaches. In addition, the "any-time" and "any-where" access to course material helped students manage numerous obligations outside the coursework during the challenging and uncertain times when they had to deal with personal and professional issues.

The pre-Covid and during-Covid analysis has been performed on the student success. The results indicate that students mastered the material at the same or even higher level of comprehension compared to traditional lecture environment. It can be concluded that methods applied to improve student learning using non-traditional methods can help students succeed in mastering material and help universities manage stress of a considerable magnitude.

Introduction

The COVID-19 pandemic, that swept the world, had profound impact on every aspect of human life. The pandemic resulted in significant loss of human life and had broad negative impact on almost every aspect of daily life. The economy was in virtual standstill for a long time, people lost their jobs, companies closed their offices, and communities saw their schools closed. All these measures were taken as a defensive mechanism to minimize the spread of the virus and to save lives.

According to UN report close to 1.2 billion learners were impacted by school closures. [1] As a result, it is expected that overall students will experience delayed graduation, and in the case of higher-ed students the loss of job or job offer, and loss of wages. In order to keep continuity of learning, educational institutions from K-12 schools to higher-ed institutions converted learning experiences from traditional classroom setting to on-line distance education. The conversion period was virtually non-existent as educational institutions had to adopt new ways of learning and course delivery as well as student engagement within weeks from the moment of the global declaration of pandemic.

The research was performed to study impact of conversion of the traditional classroom learning to on-line course delivery. [2, 3] The results indicates that both faculty and students initially struggled through transition but quickly adapted to the new style of online teaching. [4] The study indicates that number of different approaches have been applied, e.g. flipped classroom, blended learning, pre-recorded lectures, interactive Q&A sessions, quizzes for self-assessment etc. It was also found that traditional lectures were not impacted significantly, but that the major challenge for engineering courses is offering laboratory experiences. It was discovered that some of the implemented approaches included virtual labs, remote labs and digital-live labs.

Importance and positive effect of online education is undeniable but sudden conversion of face-to-face to online learning is fraught with numerous problems which can have negative effects on students and teachers alike. [5, 6] The issues that need to be addressed for improved impact of online learning include logistical, technical, learning/teaching challenges, assessment methods, and hands-on training. [7]

The problems that existed in converting face-to-face course delivery in developed world were exacerbated in the underdeveloped countries with no access to internet due to technical or financial reasons. [8]

Approach

This paper presents authors' experiences with creating, developing, and delivering courses for on-line students. The experiences have certain limitations where the main limitation is related to the fact that the courses that were developed are lecture only, i.e. they did not have laboratory components. The authors realize that laboratory-based courses carry significant level of complexity in terms of providing distance students with reasonably realistic hands-on laboratory experience. Regardless, it is hoped that authors' decade-long experiences in developing lecture

focused on-line courses will be of benefit to others who have started on the path of creating and delivering on-line courses.

Over the course of time the authors have made number of observations in terms of elements that are required for effective on-line learning experiences. Some of these observations coincide with the previously published work. [9] These elements are presented below along with analysis of practices that worked for authors and their students.

Motivation – This is probably the most important element that needs to be addressed in structuring and conducting an on-line course. Taking on-line courses, either asynchronous or synchronous, poses a great challenge to students in terms of focusing and keeping up with required pace to master the course material. The students are facing many daily demands related to job and family which diverts their attention from learning. The fact that students are not required to attend in-class lectures can result in delayed learning which puts pressure on the students to comprehend significant amount of material in a short period of time and complete course assignments with limited comprehension. The students are tempted to wait till the last minute to complete assignments which can have negative effect on mastering material. Hence, the course needs to be designed and conducted in a way that will be engaging and relevant to students which will improve their interest and motivation to continuously progress through the material. It was observed that regular contact with students, via emails, text messages, and phone calls, increases student engagement and attention to the course material. In general, the students respond well to instructor's engagement and sincere interest in their success and as a result they place increased attention to the material. They appreciate having clearly stated course objectives and deadlines. They appreciate faculty's quick response to their email messages, and respectful and accommodating attitude towards their life and work-related needs. They acknowledge and are thankful to the faculty who are accommodating their life related requirements that may take a temporary precedence over learning.

Focus on content, not on comprehension skills – The emphasis should be placed on the material that is relevant to students' professional careers. Theory should be accompanied with examples that are connecting theoretical material with real world problems. The relevant connection between the two makes students more interested in the material and more likely to invest time to understand the basic concepts and be able to apply them in the workplace. The content should provide ample number of examples to demonstrate the breadth of possible applications so that students can understand.

One method of keeping students focused on the material is to modularize material into a sequence of short presentations/topics followed by quizzes that are covering the material. This may be in the form of gamification, where students would be able to proceed to the next topic after they successfully pass the previous topic. This approach recognizes the fact that one's attention span is limited to 10-15 minutes. Hence modularizing material into smaller and self contained material accompanied with examples to support the theoretical concepts will have longer lasting effects on learning the material. In addition, by providing short videos of covered modules gives student the opportunity to review the material at a time that is convenient to them and to go multiple times over the material.

Keep it simple – It should be recognized that learning is a continuous process that requires the material to be presented in a straightforward manner without digression into different into unrelated topics. In a classroom setting faculty are tempted to discuss many related and not related topics, but they need to realize that students prefer structured approach with clearly stated objectives and expectations.

Connect new content to old and provide examples – The content should build upon the previously covered material in the course and across number of different courses so that students can understand the rationale for covering the breadth of material required to solve real world problems. Students react positively to review of the previously covered material and application in the context of the new material, which at the same time reinforces previously acquired knowledge and emphasizes importance of integrating various concepts into single body of knowledge.

Dole out new information in brief doses – In a traditional classroom setting it is typical that faculty would use the entire period to teach without any breaks. However, this method is not conducive to effective learning. Students' attention span is limited and after 10-15 minutes their attention starts to drift away from the covered topic. The same can be observed in the on-line synchronous modality where students, for a variety of reasons (slow connection, low bandwidth, issues with privacy etc.) decide not to join the class using the camera. In many cases students would also place their computer connection on mute, in which case instructor has no idea if the students are present and listening to the lecture. It has been observed and widely accepted that the optimal approach is to divide presented material into shorter modules, lasting 10-15 minutes followed by examples that would reinforce understanding of the covered material.

Make online learning as interactive as possible – In the online environment the biggest challenge of engaging students is keeping their attention and interest. One of the best ways to keep students interested in the material and keeping up with the learning is to make course as interactive as possible. Some of the more accepted techniques involve flipped classroom and blended learning. In both of these approaches it is expected that students would have access to well-structured course materials (lecture notes, worked-out examples, exercises, prerecorded lecture modules etc.). These materials would allow students to learn and practice on their own time which will free lecture time to discuss topics and concepts that need more in-depth explanation as well as discuss application areas and correlation with other domains in the area of study.

Balance synchronous and asynchronous learning – In distance learning it is quite common to see that faculty are adopting either synchronous or asynchronous approach. Each of the approaches has its benefits and downsides. In the synchronous approach the faculty would be teaching as if in the classroom, whereas in the asynchronous the lectures would be pre-recorded and additional material would be posted online for the students to access. In the first case

Assignments – This element is one of the greatest concern to instructors when it comes to on-line course delivery. The issue is related to potential cheating if the exams are not proctored. The faculty have tried different approaches to deal with this issue, from on-line monitoring using

cameras, applying software to check for plagiarism, to identifying central location where students can take exams under supervision. Each of these approaches has certain advantages and disadvantages, when it comes to using cameras during exam period students are concerned about their privacy. They do not want to have someone see where they live. In some cases internet connection does not have the speed and bandwidth to allow for monitoring of larger courses. When it comes to engineering courses that are calculation based, and especially the ones that require long-hand calculations and drawing figures and diagrams, there is no software that can check for plagiarism of such documents. Based on decades of working with students in their programs and knowing that cheating is minimal the authors have adopted the attitude that students can be trusted and will not resort to academic dishonesty. It has been observed that there is virtually no difference between results from proctored exams and take-home exams. So, authors have adopted the approach that students can be trusted.

Recognize the student preparation, needs, and circumstances - Probably the most important issue when dealing with student learning is to recognize student preparation level prior to taking the course as well as the length in the program. Students may transfer from other institutions, e.g. community college, or they may be taking one or two courses per semester, e.g. working adults. In the first case the course content may differ somewhat which requires some remediation and bringing student up to the level required to successfully complete the course. In the second case, working adults may be taking one or two course per semester, as their job and family obligations permit. In that case instructor needs to realize that students may need some refresher of the material that they have learned several years prior to taking the current course, instead of having that course in the prior semester.

In order to accommodate for all these differences instructor needs to show significant willingness to exercise flexibility and willingness to accommodate varying needs and circumstances. In the case of universities with traditional students and students with means, who can focus solely on studying this may not be a significant issue. However, in the case when universities are serving first generation students and non-traditional students this becomes a significant issue, as students need to tend to many other obligations, including work and family.

Results

The proposed approach is based on over ten years experience in delivering on-line courses and listening to students and implementing their feedback. Typically, there would be between 50-100 students enrolled in several distance courses per semester. At the end of each semester a course survey would be conducted and on average 60% of students enrolled in a course would respond both with numerical assessment as well as with written comments related to improvements that could benefit student learning. Every semester instructor would select 2-3 general comments on which to focus and make improvement to the course. The process was continuous, i.e. it was performed every semester. In some cases changes required substantial modifications and some recommendations would require minor changes. In the case of substantial modifications it would take a year or two to implement those changes, and for minor changes few weeks would suffice.

After ten years of constant modification of courses students started to express their appreciation for all the effort that went into course development which helped them effectively master presented material.

Some of the more common feedback related to modified courses includes:

1. Detailed course syllabus with clearly stated objectives and expectations, as well as clearly stated deadlines for submission of assignments.
2. Well organized detailed lectures that were accompanied with real world examples.
3. Well-structured and easily accessible videos of lectures that provided both coverage of theory and practice.
4. Application of modern tools to solve real world problems, (e.g. MATLAB)

Additional general feedback that students provided included:

1. Easily accessible instructor who expeditiously responds to their emails (in many cases in less than an hour).
2. Instructor who is respectful and answers all questions in a collegial manner.
3. Instructor who is accommodating and understands their daily life related requirements and allows some flexibility.

These changes require significant effort on the part of instructor. Creating detailed lectures notes (more than 200-300 pages per course) along with detailed worked-out examples (over 300-400 pages per course) took significant amount of time. In addition, instructor spent hundreds of hours creating videos covering various concepts and correlating them to the real-world applications. Also, in the cases when prerequisite courses are required, instructor provided refresher material that is relevant to the current course which students were encouraged to review whenever the course introduced topics that relied on the previously covered material. Overall, the effort to prepare the course material was significant, but the results were observable through students' success and satisfaction with the learning experience.

In addition to development of new material, the changes included modifying the assignment structure so that students can fully demonstrate their knowledge and mastery of material. Traditionally, students would have only a single attempt at quizzes and homework assignments. As a result, desired learning outcome would be limited as students would not go back to review questions and their answers. By providing them with multiple attempts while taking the highest score as a final score promotes learning and strengthens their mastery of the material. In case of exams similar strategy is applied, but instead of unlimited attempts students have only three attempts with final score being the average between attempts. In addition, to accommodate distance learners the exams are take-home, and are over three-day period. This is more realistic scenario for students who, upon graduation, will be working in a professional environment where solution does not have to be determined immediately and on the spot, but rather would have time to think about the problem and come up with the solution. This approach to exams recognizes environment in which student will work upon graduation and provides similar conditions for assessing their knowledge and problem-solving skills. In addition, this allows for grading on absolute scale instead of traditional grading on the curve and giving partial credit. In real world

there is no evaluation of solutions on the curve nor partial credit is given for incomplete work. It could be suspected that some level of “cheating” may be taking place, but experience indicates that little or no cheating occurs. Namely, there is reasonable distribution of grades that is to be expected on the type of the course and its difficulty level.

Conclusions

The COVID-19 pandemic brought great hardship across the world. It impacted every person in a negative way. However, it also brought opportunity to accelerate conversion of traditional learning into the age of digital learning. The education system has been moving towards hybrid and customized on-line learning with advances in on-line delivery, thanks to broad penetration of fast internet connection and advances in artificial intelligence. Advances in gamification are adding new and engaging dimensions to the learning process through application of virtual and augmented reality. It has been observed that some universities and faculty are better prepared for such changes than others. The universities and faculty who were already engaged in the distance on-line learning continued as if nothing happened while other universities and faculty had to re-invent themselves and adapt new learning methods and adjust to new learning environment. Transition period for later universities was inadvertently very short and learning curve was very steep. At the end everyone met the basic needs of students with varying degree of success and satisfaction.

The paper presents some of the experiences with on-line synchronous and asynchronous course, and practices that showed significant appreciation by students and resulted in improved learning outcomes. The effort required to make such changes is significant at the beginning and then requires methodical and constant updates. However, the end results are worth the effort which is evidences through students attention and attitude, and most importantly through improved mastery of material.

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