

COVID-19 AND ONLINE TEACHING CHALLENGES OF STEM COURSES IN UiTM PAHANG – A REVIEW

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Abstract: The outbreak of COVID-19 was unexpected, and it forced UiTM Pahang to launch live online programs of a total of 288 undergraduate online courses in order to ensure the normal teaching operation, with 5,771 students stay at homes in 2020. It is a massive, disruptive shift to move all the existing courses online in matter of days. In general, a complete online course requires an elaborate lesson plan design, teaching materials such as audio and video contents, as well as technology support teams. However, due to the sudden emergence of the COVID-19, most faculty members are facing the challenges of lacking online teaching experience, early preparation, or support from educational technology teams, especially for the science, technology, engineering and mathematics (STEM) courses. In addition to the challenges to the faculty, the students themselves tend to have ambiguous future career goals, lack active academic involvement, and spend more time in-class study compared with out-class study according to their study time. Students often have problems such as lack of self-discipline, suitable learning materials, or good learning environment when they are self-isolated at home. The aim of this paper is to review on those problem presented above and discuss how faculty can implement effective instructional strategies to prevent negative learning attitudes of UiTM Pahang students and ensure the effectiveness of online education on STEM courses.

Keyword: STEM; e-learning; UiTM; Covid-19 pandemic; affective approaches

Introduction

Since early of 2018, Universiti Teknologi MARA specifically, have been experiencing an unprecedented massive ‘migration’ from traditional in-class face-to-face education to online education. Due to the widespread of Coronavirus disease (COVID-19) in Malaysia, following the government’s requirement of ‘nonstop teaching and learning’, most Malaysian universities have started online education. In a short time period, many of faculties members started to teach in front of a computer screen, and their students must stay at home and take the courses through the internet.

Online learning is the newest and most popular form of distance education today. Within the past decade it has had a major impact on postsecondary education and the trend is only increasing (Sun, Tang & Zuo, 2020). Online learning is catalyzing a pedagogical shift in how we teach and learn. There is a shift away from top-down lecturing and passive students to a more interactive, collaborative approach in which students and instructor co-create the learning process. The instructor’s role is changing from the ‘sage on the stage’ to ‘the guide on the side’ (Kizilcec et al., 2020).

Students often comment that scientific courses are dry and boring. Many educators ignore such perceptions or give excuses indicating that STEM subjects are fundamentally abstract in nature; hence, there are no interesting ways to teach STEM courses (Seng & Mohamad, 2002). Audiovisual aids, modeling techniques, and live demonstration approaches have been widely used in teaching STEM courses, resulting in some degree of success. The main setback of these approaches is that students may not be able to use those teaching aids while revising their work. The conventional teaching approaches seldom provide adequate opportunity for students to critically think through the issues and arguments presented in class. The students are either too busy scribbling down notes from the lecture or trying hard to make sense of the rhetoric of the lecture. Consequently, the pure lecture format simply reinforces students’ feelings that the most important step in mastering the material is memorizing large amounts of scientific information from chunks of seemingly unrelated examples (Bao, 2020).

To gain some insight into the effectiveness of such large-scale online education, particularly in the field of science and technology, UiTM must explore alternative teaching approaches that provide quality learning opportunities to more students, without compromising the merit of education. Experts in education and economics have touted blended or fully online content delivery as a vehicle for expanding access to higher education (Chirikov et al., 2020). Experimental or quasi-experimental evidence indicates that online and blended approaches to content delivery can produce similar or somewhat lower academic achievement compared with in-person programs (Chen et al., 2020). These findings are based on comparisons between the modality of course delivery within the same university or the same course taught by one instructor. Yet, scaling up affordable access to STEM education requires a concerted effort across multiple universities and instructors at the national level.

During this pandemic COVID-19 outbreak, lecturer must adapt the pace of online teaching to consider an environment completely different from that of a classroom. Currently, it is often common to simply duplicate online the content of traditional classroom lessons. However, in the absence of face-to-face communication, lecturers need to put greater effort into preparing for online courses, innovating and designing lessons that will improve the attention span of the students. It also requires lecturers to patiently turn students from passive recipients to engaged learners through interactive question and answer sessions, tests, presentations and open discussions (Xu & Xu, 2019). Soon, it was expecting that the availability of 5G and artificial intelligence technology will break through the limitation of time and space and enable rapid replication and communication, optimal teaching resources, rich presentation tools and high-speed networks. Besides online courses, graduate and final-year undergraduate students must complete their thesis projects, which turns out to be even more challenging. Apart from research directly related to pandemic prevention and control, all other activities that require laboratory data collection, field sampling or site investigation have been suspended. This not only means that experiments are delayed, but also that extra care must be taken to properly preserve sensitive samples and maintain large and expensive equipment. As such, special measures for lab maintenance in situations of forced prolonged inactivity, like the one caused by COVID-19, should be established and implemented quickly.

Commons Problem in e-Learning of STEM courses at UiTM Pahang

The STEM courses in UiTM Pahang are mostly in the fields such as material sciences and engineering, construction engineering, design of hydraulic structures, wood machining technology, applied mathematics, agricultural systems and applied chemistry that are implemented in the form of comprehensive practices class which focuses on students' active participation and principal status in certain degree or diploma. The problem is that the online learning will limit the practices class. In some courses having deep theories such as construction engineering, the attempts for interdisciplinary fusion are very rare. Some reason is behind. One is that, the involvement of vast mathematical computations in construction engineering makes most students feel difficult and short of interest to participate in the learning activities of the online session class. In order to attract students' attention, some courses overly stress on the operations from field practices and cut down the class hours of the theory instructions.

Aside from having small practice classes, many students do not have access to the high bandwidth or strong internet connectivity that online courses need, and therefore miss virtual lectures. Their poor monitors make it difficult to follow the learning path, making their learning experience difficult. Since they were live off campus and find it difficult to keep in tune with the technical requirements of the STEM courses. According to Tryfona (2015), STEM courses are characterized by three different categories; (1) a high degree of multidisciplinary activities, (2) the requirement for specialized software and configuration, and (3) students with various diverse backgrounds along with the necessity to follow personalized educational paths to enter the workforce. Because of these factors, designing and developing a website is a time-consuming process. Simultaneously, most instructors or lecturers have pre-recorded recordings, with no collaborative sessions and no contact between students and lecturers. Many students fall behind after online learning is introduced, and they consider giving up because the challenges of using a technology medium seem insurmountable. Students must find the motivation to pursue current educational trends as well as better prepare themselves for future educational and career challenges.

Affective Approaches Recommended through e-Learning

Based on observations of online teaching on STEM courses at UiTM Pahang, some strategies were proposed to improve students' learning attention and assignment in order to accomplish a smooth evolution to online learning. In order to ensure that students focus on online study, lecturer should reasonably break down the content of the in-class teaching into diverse topics and adopt a modular teaching method. In other words, based on confirming a clear knowledge structure in the curriculum, lecturer divide the teaching material into some small modules with each lasting roughly 20-25 minutes.

In traditional in-class teaching, body language, facial expressions, and lecturers' voice are all important teaching tools (Larreamendy-Joerns & Leinhardt, 2006). When a course is moved to online instruction, however, body language and facial expressions are restricted since using these resources through screens is difficult, and only "speech" can be completely utilized. As a result, lecturers should properly slow down their speech when teaching online to enable students to catch key information points.

Besides dividing the teaching content and using "voice" in teaching, lecturers should strengthen students' active learning ability outside of class. In comparison to conventional in-class lectures, online teaching gives the teacher and lecturers less influence, and students are more likely to "skip the class" (Liguori & Winkler, 2020). As a result, the success of online teaching and the effectiveness of its learning outcomes are heavily reliant on students' high-level active learning outside of class. In order to improve students' active learning outside of class, lectures can use a variety of approaches to moderately change homework and reading requirements. Innovative lecturers and teachers are constantly looking for innovative and more efficient ways to offer teaching. One of the biggest challenges they face is figuring out how to teach their Generation Z or "digital native" students in a way that suits their digital savvy. It seems that incorporating games into classrooms is one of the answers to those burning questions, as that generation has honed their digital skills and brought multitasking to new heights from an early age. These kids like video games and a simple logic is that "by applying Evidence Centered Design (ECD), the game-based formative assessments address the needs of both students and lectures for reliable and valid real-time actionable data within a motivating learning environment". Furthermore, it is widely accepted that digital natives do not often need more time in the classroom to learn how to think and work in real-world situations. Efficient, immersive experiences that can inspire and actively engage them in the learning process are what they need. (Vu & Feinstein, 2017)

Conclusion

In view of the extraordinary large scale of online education, it is necessary to make contingency plans for addressing possible problems such as the traffic overload issue of the online education platform access to effective STEM courses through online education platform. Furthermore, since this online teaching 'migration' is implemented quickly during the outbreak of COVID-19, students' anxiety needs to be relieved in various ways to ensure that they can actively and effectively engage in online learning. By supplementing the learning online, students became more interested in their respective fields of study, and thus were able to participate in class discussions more freely. Learning online will make the course more interesting, and hat the students were consciously aware that they learned more on the process.

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Conflict of interests

The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report. We certify that the submission is original work and is not under review at any other publication.

References

- Bao, W. (2020). COVID-19 and online teaching in higher education: A case study of Peking University. *Human Behavior and Emerging Technologies*, 2(2), 113-115. <https://doi.org/10.1002/hbe2.191>
- Chen, T., Peng, L., Yin, X., Rong, J., Yang, J., & Cong, G. (2020, September). Analysis of User Satisfaction with Online Education Platforms in China during the COVID-19 Pandemic. In *Healthcare* (Vol. 8, No. 3, p. 200). Multidisciplinary Digital Publishing Institute. <https://doi.org/10.3390/healthcare8030200>
- Chirikov, I., Semenova, T., Maloshonok, N., Bettinger, E., & Kizilcec, R. F. (2020). Online education platforms scale college STEM instruction with equivalent learning outcomes at lower cost. *Science Advances*, 6(15), eaay5324. 10.1126/sciadv. aay5324
- Kizilcec, R.F., Reich, J., Yeomans, M., Dann, C., Brunskill, E., Lopez, G., Turkay, S., Williams, J.J.& Tingley, D. (2020). Scaling up behavioral science interventions in online education. *Proceedings of the National Academy of Sciences*, 117(26), 14900-14905. <https://doi.org/10.1073/pnas.1921417117>
- Larreamendy-Joerns, J., & Leinhardt, G. (2006). Going the distance with online education. *Review of educational research*, 76(4), 567-605. <https://doi.org/10.3102/00346543076004567>
- Liguori, E., & Winkler, C. (2020). From Offline to Online: Challenges and Opportunities for Entrepreneurship Education Following the COVID-19 Pandemic. <https://doi.org/10.1177/2515127420916738>
- Seng, L., & Mohamad, F. S. (2002). Online learning: Is it meant for science courses? *The internet and higher education*, 5(2), 109-118. [https://doi.org/10.1016/S1096-7516\(02\)00087-8](https://doi.org/10.1016/S1096-7516(02)00087-8)
- Sun, L., Tang, Y., & Zuo, W. (2020). Coronavirus pushes education online. *Nature Materials*, 19(6), 687-687. <https://doi.org/10.1038/s41563-020-0678-8>
- Tryfona, N. (2015, September). Teaching and Learning STEM Online: Challenges, Achievements, and Benefits. In *Innovations in Teaching & Learning Conference Proceedings* (Vol. 7).
- Xu, D., & Xu, Y. (2019). The Promises and Limits of Online Higher Education: Understanding How Distance Education Affects Access, Cost, and Quality. *American Enterprise Institute*.
- Vu, P., & Feinstein, S. (2017). An exploratory multiple case study about using game-based learning in STEM classrooms. *International Journal of Research in Education and Science*, 3(2), 582-588.