Enhancing Student Engagement in a Large Synchronous Online Mathematics Class: A Case Study with Working Professionals

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The recent global pandemic placed restrictions on physical gatherings, and as a result, online learning environments took center stage as a way of delivering instruction to students [1]. Instructors and students at universities worldwide had to quickly adapt as in person classes were converted to online classes. This was an extremely challenging task because a large majority of faculty were not prepared and had no prior online teaching experience. Of the various teaching techniques available, many instructors chose to continue to meet with students in real time class sessions, i.e., synchronous online instruction [2]. Yet, being novices to online instruction, they had trepidations about whether or not it would be possible to translate what they had been doing in the classroom to an online environment [3], [4]. Fortunately, there are instances of synchronous online education that were in place before the pandemic hit, and that therefore can be used as models. This article describes how an institute of higher education in India successfully ran a large synchronous online course with 132 students, demonstrating how this mode of instruction can provide an experience that parallels in person education.

Participants were enrolled in a Masters in Technology, Artificial Intelligence (MTech AI) Online program from all over India at the Indian Institute of Technology Jodhpur (IITJ). There were 22 female and 110 male students in this section of the course, with an average age of 32 years old. The course was taught by an instructor who has a doctoral degree in mathematics and seven years of experience teaching online mathematics courses at the university level. The target students were working professionals who were geographically spread out, therefore the course structure and materials were designed to be completely accessible online.

Synchronous Online Courses

A synchronous online course structure involves real time interaction between instructors and students using features such as audio, video, text chat, interactive whiteboard, application sharing, instant polling, emoticons, and breakout rooms. Of the alternative modes of delivering instruction online, the audio and video features of synchronous online instruction make it most like in person instruction. Using audio, apart from delivering a lecture, instructors can ask students if they have any questions. Students can verbally ask questions or make comments using a chat box that allows them to type short messages that can be viewed publicly or privately. The instructor can also use the chat system to communicate with students, for example as a means of sharing a link containing an assignment or activity. Through the interactive whiteboard, an instructor can explain the content using annotation tools such as free-hand writing, drawing lines, circles or rectangles, etc. Application sharing enables the instructor to share their screens or specific software from their computer, containing lecture slides, videos and any other educational material with students. Instant polling emulates the use of clickers in an in-person classroom and allows the instructor to quickly survey student responses. This synchronous mode supports active learning by providing an environment with the learning tools, learning materials, and opportunities for contextual discussion.

The key advantages of online synchronous learning include immediate feedback, an increased level of motivation and responsibility, more in-depth learning, and richer interaction. In fact, some students participate more in discussions in synchronous online instruction than they do in a face-to-face classroom. From a pragmatic perspective, online synchronous instruction eliminates the costs related to travel and time away from home or worksite, and compared with asynchronous online instruction, may increase the likelihood that a student stays on track and successfully complete their studies.

Methodology

The live sessions were hosted using WebEx (https://iitjodhpur.webex.com/), a video communication platform that supports user desktop sharing, video and audio sharing and recording, and chats. During lectures, students viewed slides that the instructor prepared ahead of each session, were displayed on using the WebEx sharing tool, and annotated by the instructor using a Wacom Tablet (Figure 1), a configuration of technologies that has long been recognized as a way of supporting the drawing of diagrams in synchronous online instruction [5]. Students interacted with one another, the teaching assistant and the instructor using an accompanying chat session. In this way, students received responses to their questions in real time in the same manner as they would in an in-person classroom. After the session was completed, the annotated slides and a recording of the session were posted on Google Classroom for reference.

Results of Participation and Perception
Data included survey responses, and chat communications captured by WebEx software for each of the eight live sessions. Students were very active, and the total number of chat contributions in all eight sessions was 7020. By far the largest number of chats (approximately 65%) were in response to questions posed by the instructor as part of the lessons. Such questioning patterns are applicable for instruction in “hard” disciplines, such as mathematics, where students expect the instructors to share their knowledge directly. Other dominant categories were social statements, classroom norms, access to resources, and questions about the lecture.

A survey given to students at the end of the course focused on their perception of their experience and the affordances of synchronous online learning, such as the ability to communicate with other students and with the instructor during the lectures. The accessibility and responsiveness of the instructor and the ability to communicate with her in real time were highly rated.

Conclusions and Discussion

Measures of participation, performance, and perception showed that synchronous class sessions can be used to support active participation in a class size exceeding one hundred students. This was evident by the number of chats from students during the online sessions in which they asked questions and responded to the instructor’s questions. Instead of simply being passive observers, students were engaged and following along in the discussion of the material and demonstrated their presence by promptly responding to quiz questions interspersed throughout the sessions. In addition, students appreciated how online lectures made education possible for them, and this was particularly true for female students.

Creating this active learning environment requires efforts from students and instructors. On the part of the instructor, synchronous online instruction requires fluency in the use and coordination of multiple technological tools simultaneously. Therefore, there is a continuing need for teacher training programs and professional development courses to facilitate the use of technology in instruction. For instance, it is important for instructors to promote student engagement during synchronous sessions through questioning, and then to follow through by monitoring and responding to chat activity while simultaneously delivering the lecture. Preparing and supporting instructors as they orchestrate online classrooms is critical to meet the needs of the current instructional landscape. Professional development opportunities, experience gained from practice, and technological developments will open the doors for a new era of emerging online instruction.

Despite the insight this study provides into the potential benefits of synchronous online instruction, there are limitations that need to be addressed in future research and in the development of supporting technologies. First, in our research, students used self-selected names and identification to enter the online classroom. Therefore we could not establish a relationship between the amount or quality of student activity and course performance. Also, online instruction could benefit from the continuing development of features that support discipline specific interaction. For instance, it is extremely challenging to communicate mathematics during synchronous online sessions in a chat window that does not support mathematical symbols and formatting.

There is no question that the pandemic has intensified the international need to explore and develop best practices for online education. Physical gathering limitations and travel restrictions between countries threaten the growth and spread of knowledge, thereby making the improvement of online education critical as a means of sustaining intellectual progress. This is a challenge that cannot be addressed by any single nation, but instead calls for a cooperative effort from many nations who have an interest in global education. In the world, India is second only to the US for the number of people taking online courses. Therefore, India has much to offer in development of e-learning techniques and practices. This article explored a successful large scale synchronous online course that was conducted in India and sets the stage for shared efforts to make improvements in this direction by the world.

References


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