Creating community and engagement in large cohort online STEM courses effectively

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ABSTRACT

CONTEXT

Nothing has changed the delivery of education as fast as the impact of COVID-19. Online learning is the 'new normal' with many STEM (Science, Technology, Engineering and Mathematics) courses having to rapidly make this transition from traditional on-campus teaching. The literature shows that rich environments of formal face to face lectures and verbally engaging workshops provide a sense of community, social contracts and development of collegiate relationships between students. It is essential that education providers continue to offer opportunities for students to experience this element of higher education, rather than overlook this component of learning, as it can easily be lost in computer screen to computer screen engagement.

PURPOSE OR GOAL

This paper described how the literature surrounding online engagement was applied to enhance student engagement in a large cohort undergraduate course. In particular the transition from face to face to online and mixed modalities was investigated. Key engagement metrics as outlined in the literature and student survey results were utilised to gauge student satisfaction when development of a social environment is taken into consideration during course development.

APPROACH OR METHODOLOGY/METHODS

This work examines a transitioned large cohort course to quantify the effects of creating online community that replicates much of the face-to-face environment. It uses teaching survey instruments to identify pre and post intervention effectiveness from past cohorts and those exposed to the intervention. Semi structured surveys in the form of open questions were used to elicit free form responses and word frequency analysis is used to measure engagement.

ACTUAL OR ANTICIPATED OUTCOMES

In content heavy subjects such as STEM disciplines, the development of the online environment and teacher presence as well as social presence in subject delivery has a demonstrable effect on student engagement as measured by student satisfaction and learning outcomes.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

Key elements in the learning environment were found to have contributed substantially to the outcomes. These include supporting students in time management, supporting developing brains in undergraduate cohorts, peer interaction and developing online community. Although there was concern that the inclusion of online activities and games would be perceived as additional work, these contributed to enhanced student engagement in the online space.

KEYWORDS

Engagement, online learning, Student satisfaction

Introduction

2020 will not be forgotten by university academics around the world for some time to come. While Australia wasn't the first country in line to experience the disruption of COVID-19, it was significantly impacted in the first teaching period of the academic year. Universities offering traditional on-campus courses pivoted quickly to the online space, and students were generally understanding and forgiving of the disruption while academics managed the transition (Aguilera-Hermida, 2020). With the onset of the next teaching term, it became apparent that while learning was still occurring, the students were not experiencing a cohesive feeling of being in a cohort. They hadn't had the opportunity to get to know other students in their courses, leaving many feeling isolated from peers, peer advice and study groups.

Many felt lost in the online environment, not knowing where or how to find access to academics or peers. There was a common misconception that, as this generation of students had grown up with computers and smart phones, they were tech savvy and unlikely to struggle with the transition. However, students were quick to point out that the various online platforms utilised by the University were as new to them as they were to the academics.

Online teaching is not a new concept across higher education and has long been a topic of discussion in literature. As early as 2000, Garrison, Anderson, and Archer proposed a conceptual framework to better the higher educational experience as the use of computer mediated communication was becoming prominent. Their framework revolved around three essential elements, cognitive presence, teaching presence and social presence. Initially, research was directed towards establishing and maintaining student socialisation in what was prominently a written chat-based world which lacked visual and social cues. Interestingly, social presence was originally coined in 1976 by Short, Williams and Christie, however current articles are still defining the concept (Kreijns, Xu and Weidlich, 2021). Irwin and Berge (2006) suggested that socialisation is the ability of people to establish connections. With the ubiquitous use of platforms utilising digital cameras and microphones, one might think that online socialisation would now be largely irrelevant, yet the problem of feeling isolation in present times continues.

It has been suggested that if students are to engage in their learning, first academics need to adopt engagement practices (Pittaway and Moss, 2014). This aligns with the notion of teaching presence which Garrison, Anderson, and Archer (2000) defined as the structures and processes used within the course, but also implies that students need to be able to connect with the teaching staff. This presence must be intentionally built into the course when delivered predominately via online technologies. The Gilly 5 stage model (Salmon, 2013) suggests that students should be guided through five structured developmental processes which develop expertise in learning online.

STEM disciplines have their own unique challenges in the online space. STEM courses are often content heavy and have emphasis on practical, hands-on activities as well as the development of critical thinking skills. Learning STEM is usually learning about 'things' for example, maths equations; the courses are not usually people centric (Su and Rounds, 2015) - the human component comes through working on activities together which is absent in a didactic online mode (Henriksen, Creely & Henderson, 2020). Ensuring that online delivery of STEM courses is student centric rather than product (STEM) focused requires deliberate inclusion in online course design.

The Gilly Salmon model (Salmon, 2013) outlines a framework for students to successfully learn in online environments. The model steps back from the knowledge push approach to examine the preconditions which facilitate learning. It serves as a useful framework to examine the transition to online learning encompassing many of the aspects associated with facilitating the learning process. These include accessibility through technology and

technological literacy, motivational factors, the development of an equivalent social structure to that of an in-person environment and information exchange. Social development is a by-product in face-to-face environments; however care must be taken to construct its equivalent in the online environment. While STEM disciplines transitioning to online have focused on content (knowledge) delivery, significant peer based and two-way information exchange with the knowledge provider need to be teased out and developed to ensure an efficacious online replication of the in person environment. This paper uses a reflective case study approach to determine the success of strategies aimed at increasing the sentiment of an online community and social presence, implemented in a previously face-to-face undergraduate course.

Methodology

Using Garrison, Anderson, and Archer's (2000) framework and specifically focusing on developing teaching and social presence in the online space utilising the first three stages of Gilly's five stage model; a first year, first trimester large cohort course within the Sciences Group at Griffith University was redeveloped in 2021 to align with pedagogical good practice for online delivery. This course is core to multiple degree programs within the Sciences had been traditionally taught face-to-face prior to pivoting to online delivery.

Enrolment in the 2021 offering of the course was high with 645 students, 79% of these students were commencing study for the first time and approximately 45% of the cohort were first in family. Due to travel restrictions, only 2% of students were identified as international, however almost a quarter of the cohort did not speak English at home. These factors suggested that overly complicated or multiple online platforms would be a hinderance to learning. There was a need to provide a comprehensive learning experience that engaged students without increasing their workload with superfluous activity.

Data Collection

Success in creating community and engagement was evaluated in this cohort using student satisfaction data. Students' experience of the course was measured initially with a survey called Taking Care of the Student Experience (TCoSE) which was issued by the University and conducted during week 5. Students provided anonymous short answer responses to four open ended questions:

1. What is going well and should be continued?
2. What is not working and should be stopped or changed?
3. What is missing and should be started?
4. Have you experienced or anticipate barriers or hurdles to successful completion due to recent lockdown restrictions? (Queensland had a short snap lockdown early in the trimester).

Just over 10% of the enrolled students responded to this survey. Student Experience of the Course (SEC) (https://www.griffith.edu.au/surveys/student-surveys/experience-at-griffith) measured student experience between weeks 10 and 12, closing just prior to Examinations. This survey had quantitative and open-ended questions requiring short answer responses. The response rate for the SEC survey was 18.6%. To measure success of the redevelopment, the course characteristics were analysed in a reflective capacity using thematic analysis of keyword frequency in free text responses (Guest, MacQueen & Namey, 2012) in the surveys to measure the successfulness in engaging online learners. Ethical clearance to use the survey data was obtained from the Griffith University Human Research Ethics Committee (Ethics number 2021/581).

Course Redevelopment

In 2020, the same course began as face-to-face and pivoted as a result of COVID-19 to online in week 4. During the first three weeks students had been able to visualise and engage with the teaching team and had begun to build rapport, especially as small group workshops had already been conducted. The University followed the State Based Health directive that no course with over 100 enrolments could have face to face lectures which continued into 2021. There were also looming threats of further lockdowns should community transmission of SARS-CoV-2 continue to occur. Therefore, the course needed to undergo significant re-design in 2021 to ensure that the incoming cohort would thrive in the University environment. It was especially important to take into consideration that the majority of the course cohort had a disruptive senior year at high school in 2020. The redevelopment of the course to the online space was scaffolded against the first three of Gilly Salmon's Five stage model as outlined below. This scaffolded progression through the course provided necessary supports to establish student confidence to take control of their own learning.

Stage 1. Access and Motivation

The initial change implemented stemmed from the decision to limit the digital platforms used to deliver the course content. This decision arose because the majority of students were commencing university and thus had limited experience in tertiary study, as well as in the use of a Virtual Learning Environment. Once a student accessed the course site in the Learning Management System (LMS), all content was available without having to navigate to another digital platform.

Online learning can be delivered in two ways: synchronously such as when students all join an online meeting at a scheduled time, or asynchronously when students access prepared content at different times. Due to uncertainty around employment since the start of COVID-19, students expressed their need to work when able. With such high numbers of students enrolled, it appeared prudent to allow the students to access course content asynchronously by using pre-recorded mini-lectures in a flipped classroom, enabling flexibility in time management of studies. The course consisted of modules broken into 3-4 topics. Each topic consisted of a short overview video along with content mini-lectures, reading, practice problems to complete prior to workshops and a games-based online activity. All modules followed the same configuration so that students knew what to expect as they progressed through the course. The topics facilitated concentrated bursts of learning with focused content and enabled students to identify gaps in knowledge and understanding. Of note, the accepted view is that online videos should not be longer than six minutes (Guo, Kim & Rubin, 2014). Within STEM disciplines that are content heavy, this would lead to multiple videos and cohesion would be lost, therefore it was decided that video length would be based on the content covered and usually ranged in length from 11 minutes up to 30 minutes.

Stage 2. Online Socialisation

Prior to the commencement of the course, the course convenor sent out a welcome video to the students which explained the purpose of the course, the layout of the course site in the LMS and allowed the students to 'meet' the convenor. The majority of correspondence from academics to students occurred through the announcement page of the LMS and concurrent emails. Information given to students outlined suggested best approaches to learning and the length of time required to spend on tasks. Students were reminded of topics to be completed in the week and assessment items due. Parker and Herrington's (2015) research suggests that development of community in online learning requires establishment of a positive learning environment by: building rapport (using inclusive communication and being approachable); engendering a sense of belonging (encouraging participation and recognising learning progress); and monitoring performance, providing feedback and setting clear goals. To encourage the development of community, announcements were presented with inclusive language portraying the learning process as a shared endeavour for the whole cohort, for example, students were addressed as 'Team' to build online community. During the

trimester, students were also on occasion reminded of the range of student support available to them within the University.

The weekly videos, at least initially, heavily featured the teaching academic, creating a strong visible teacher presence for the cohort. As the mini-lectures were replacing face to face lectures, they provided students with an opportunity to connect with the convenor presenting each weekly overview in a casual and friendly manner. Of note, not all videos used in the course were new recordings, in later modules, edited lecture capture was used with an additional overview of the topic recording which featured the academic. Videos were available with transcripts and closed captions assisting both students with accessibility requirements as well as those with English as their second language. This also provided a base for note taking and written clarification of scientific terms that students may not have been familiar with.

Peer to peer interaction is also an important part of online socialisation. This aspect was challenging due to the large numbers of students enrolled, making it difficult to have all cameras and microphones enabled, students utilised the chat function extensively during the synchronous online sessions and often answered other student's questions. Anonymous polls using multiple choice questions within Collaborate Ultra were utilised to include students who did not wish to participate in the chat. To meet the student cohort needs for peer to peer interaction, on campus workshops designed as virtual escape rooms were utilised. Activities in the escape rooms were structured so that students were required to work together. Each student had the opportunity to attend a total of four workshops during the Trimester. Results from the on-campus activities are outside the scope of this paper.

Stage 3. Information Exchange

Online weekly Collaborate Ultra sessions facilitated information exchange by presenting students with the opportunity to nominate the topics to be reviewed. This student centric approach encouraged students to self-assess their learning and identify gaps in knowledge and understanding. Open discussion increased social presence among students and feedback from peers.

In addition, each topic included an online game to be completed independently. This acted as a self-assessment tool for students to gauge their knowledge, which was more interactive and dynamic than additional quizzes or worksheets. Games were utilised that were simple and easily accessible, and platforms were re-used in order to provide familiarity with these activities. Some activities included timers and scores so students could play and repeat games to master content knowledge.

Stage 4. Knowledge construction and Stage 5. Development

These aspects of the five-step model concern the learner starting to take control of their own learning and then integrating knowledge. The outcomes of these steps can be measured using assessment; however, this is outside the scope of this reflective case study.

Results

Stage 1 Access and motivation.

In response to the TCoSE survey (Table 1) 78% of students thought the mini-lectures were an important aspect of the course that should be continued. Students mentioned that they liked the flexibility of having the recordings available to watch at a time that suited them. Although the mini-lectures were longer in length than generally recommended, no students commented that they were too long. There were seven comments in response to Question 3 regarding the need for face-to-face lectures which was low (11%) in comparison to the overwhelming support for the mini-lectures. 41% of the respondents found the course layout,

including navigation and content display, to be working well. A representative statement of this was "This course has been really well-structured, especially for first-years like me who are new to the L@G [LMS] site. All our modules, videos and topics are so organised on where to go and what to do in the course site". In response to Question 4 above, students felt that due to the organisation of the course content, even though they experienced a lockdown, their learning experience wasn't particularly affected, with one student writing "this was the only course that I wasn't stressed about because of the COVID lockdown". Students indicated their appreciation at the amount of thought and time that had gone into the organisation of the course.

These responses were mirrored in the end of trimester SEC survey (Table 2) with the question "This course was well-organised" receiving a mean of 4.5 (out of 5), well above the comparative mean of 4.1 for similar sized first year courses. The question regarding the course structure also received a mean score of 4.5. In this survey, 33% of students spoke favourably of the mini-lectures with only 3% of respondents thinking that fewer, longer length videos would have been better, and 4% stating the course would have been better with face-to-face lectures.

Table 1. Thematic analysis of keyword frequency in free text responses to the TCoSE survey.

TCoSE survey: 63 Respondents							
Working		Not working		Missing		Barriers due to COVID-19	
Videos	49	Synchronous session needs to be longer	2	Practice quizzes	2	Motivation	5
Activities	19	Content should be bundled based on weeks, not topics	1	Answers to Cloze sheets	2	Lack of face-to-face	6
Content Display/ LMS Navigation	26	Too content heavy	1	In person lectures	10	No barriers in this course	29
On campus Workshops using virtual escape rooms	26	Content is available at start of week, should be earlier	2	More workshops throughout trimester	4		
Synchronous online revision session	18	Having the workshops in person	1	More online activities	5		
Cloze (summary) sheets	12			In person laboratories	2		
Mastering A&P	10						
PASS	12						
Marked Reviewed button	8						

Stage 2 Online Socialisation.

Students resonated strongly with the provision of a welcome video. They bonded to the course prior to starting and were surprised that all courses didn't have one (personal communications). Having the lecturer feature prominently in the mini-lectures for the first part of the course made the students feel connected, with one student commenting directly to one of the authors (Willis) 'It's strange this is the first time we've met but I've watched the mini-lectures, so I feel like I already know you'. Students also appreciated the email communications with representative comments such as "helped in organising my week" and "Charlene is extremely approachable".

Stage 3 Information Exchange.

Of the respondents to the TCoSE survey (Table 1), 30% mentioned the benefit of having the online activities and games within the course helping in both content knowledge and being fun. There were multiple comments requesting an increase in the number of online activities. Students (29%) also noted the benefit of attending the synchronous online class that occurred every Friday. They liked that they could nominate the topic for revision. Comments showed that having a commitment to turn up to a class on Friday motivated them to stay on top of the self-paced learning. However, motivation and mental health was an issue for the cohort as mentioned by multiple students in response to Question 4 above. In the end of trimester SEC survey (Table 2), the question "This course engaged me in learning" received a mean score of 4.1, well above the mean comparison score of 3.8 or similar sized first year courses. The overall satisfaction rating for the course was 4.3 (with a mean comparison of 3.9 for similar sized first year courses).

Table 2. Thematic analysis of keyword frequency in free text responses to the SEC survey.

SEC survey: 103 Respondents			
Done well: 80 Responses		Could be improved: 75 Responses	
Videos	26	Course is content heavy	12
Activities	13	The layout of the course	1
Content Display/ LMS Navigation	17	Needs face to face lectures	3
On campus Workshops (using virtual escape rooms)	25	Needs more workshops throughout trimester	10
Synchronous online revision session	8	Long lectures instead of short videos	2
Cloze (summary) sheets	4	Release content earlier than start of week	2
Mastering A&P	4	Need more online activities	2
PASS	3		
Marked Reviewed button	2		

Of note, assessment tasks were changed for the course in 2021, student grades cannot be compared across cohorts which is why student grades are omitted from the analysis of the success of the course redevelopment.

Discussion

The value of the traditional lecture has been under discussion for a number of years, especially in the divisive age of Lecture Capture. Although new pedagogy such as active and student centric learning has kept the relevance of the traditional lecture alive (Cananagh, 2011), there is no mistaking the lack of student attendance especially when many students have multiple commitments for their time including work and family. It was surprising when students didn't immediately respond positively to online learning when it was thrust upon universities in 2020 which traditionally taught face-to-face. In this author's experience at the time of the pivot, less students attended online classes than had previously been present on campus.

With the State Based Health directive in 2021 stating that courses with more than 100 student enrolments could not hold lectures on campus, it was decided that this large cohort, first trimester core course should be redeveloped to foster student engagement and satisfaction in the online space.

The first consideration was the design of the course in the LMS. Due to the majority of students enrolled in the course being unfamiliar with university and online studies, the decision to limit the number of platforms the students needed to access was successful with students finding the course easy to navigate. The next consideration was the flexibility of synchronous versus asynchronous online lectures and how this might impact student's time

management. A recent systematic review concluded that the use of asynchronous multimedia usually improves student learning outcomes (Noetel, Grifith, Delaney *et al.*, 2021). The mini-lectures were a success, and although students were given the opportunity to switch to synchronous online lectures at the end of week two, >95% of participating students voted to continue having the course content delivered via the mini-lectures. Student approval was also voiced in both the TCoSE and SEC surveys conducted during the teaching period. Student preference for asynchronous mini-lectures due to the inherent flexibility was also reported in a recent study based in China (Ramo, Lin, Hald & Huang-Saad, 2021). There is some discussion around the presence of academics in pre-recorded videos as some students find it distracting, however the general consensus is that including the academic visually within pre-recorded material makes it more engaging (Kurzweil, Marcellas, Henry & Meyer, 2020). Student comments in the current study indicated that the strong lecturer presence in the videos was appreciated as it made them feel that the lecturer was approachable and provided connection with the course. The mini-lectures were longer in length than the commonly accepted view but this did not appear to be detrimental to the student experience and is perhaps explained by the large amount of content that needed to be covered in the course. Benefits of the mini-lectures included that they divided the content up into manageable sections and that they could stop and start the videos to enhance comprehension.

The 2021 cohort had higher than usual numbers of students who commenced University directly from high school. This age group biologically has more difficulty with time management and extrinsic motivation because the prefrontal cortex of the brain has yet to fully mature (Choudhury, Charman & Blakemore, 2008). Although there was concerted effort both within the course structure and the weekly announcements to ensure student were aware of tasks that needed to be done in specific weeks, there were student comments that suggested that a small number of students did lose motivation and fall behind during the trimester.

Overall student satisfaction with the online version of the course was very high, as shown by SEC quantitative data, suggesting that the changes to the course had a positive impact on the engagement of students in the online space. These results demonstrate that students that might have expectations of face-to-face learning due to historical experiences, can be successful and satisfy learners in the online environment when the course is structured around their requirements.

Recommendations

The take home messages are:

- Students require a strong teacher presence in the online space, at least initially, to foster a sense of belonging.
- Students value the asynchronous approached as learning can be undertaken when convenient, however this approach requires heavy support from the academic. Throughout the course LMS site were lists of things to do, timetables of assessment and at least weekly emails, yet still some students fell behind and lost motivation.
- To foster engagement, some synchronous learning where two-way interactions can occur is beneficial. Students can identify as partners in these sessions and determine the direction of their learning.
- Online activities such as gamification hugely enhance the student experience and are a sought after component of online study.

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