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Evaluating Microlearning: A Cross-faculty Case Study of a Sino-foreign University

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Background

Emergency remote teaching (ERT) is a term that emerged at the start of the COVID-19 pandemic. Since, many institutions have pivoted to it during lockdowns. This term has been commonly used in literature to describe any ad-hoc adjustments that have been made to teaching and learning delivery methods to compensate for the lack of face-to-face contact with the students. Hodges et al. (2020) make a clear distinction between emergency remote teaching and carefully planned online courses. The main disparity between the two can be seen in different expectations from the outset. Further, there is also a large degree of improvisation due

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to time constraints associated with emergency remote teaching. Hodges et al. (2020) add that such a mode of delivery is temporary in character.

Emergency remote teaching was initiated at the University of Nottingham Ningbo China (UNNC) in February 2020. Mainland China, being at the epicentre of the pandemic, was under a strict government lockdown and saw families in different provinces unable to leave their households for several weeks. The uncertainty was also reflected in the teaching and learning environment where students' learning lacked specifics and any long-term planning. The unprecedented situation put considerable demands on teachers, who had to fundamentally shift their delivery modality and redesign their curricula accordingly. This pivot led to novel learning needs, and differing expectations of students to those in a traditional educational setting. Teachers had to find a way to engage with, monitor, and assess students in a new teaching and learning delivery environment which needed to be convenient, attractive, yet relatively simple to access and easy to use by all students, irrespective of their technical skills and motivation.

These sudden changes put additional demands on students who had limited experience with online learning and were learning how to quickly adapt to this new situation. This was certainly the case in this context, as undergraduate students tend to require additional support when adjusting to a new learning environment (Dickinson, 2020; Fawns et al., 2020). This was particularly important due to high levels of uncertainty that our students were experiencing during that time.

Challenges Presented by Lockdown

In the home, the lockdown situation created an increased demand for space, computers, and internet access, as well as for quiet to focus on work or learning. Many families in China rely on the support from grandparents; in just under a third of households, there are three generations living together under one roof (National Bureau of Statistics of China, 2019). Students often lacked support in adjusting to this new learning environment. Parents were likely to have their distractions with working from home and typical family setups often meant other relatives

such as grandparents were in the same household. These aspects often resulted in students being unable to have longer, uninterrupted time for study.

Internet access proved a particular obstacle for students in China, home broadband connection is widely used, even in very remote areas (National Bureau of Statistics of China, 2019). However, with many people potentially connected to the internet together in one household, bandwidth decreases, leading to poor connectivity and low download speed. This can negatively affect the overall learning experience, particularly when it is being delivered or supplemented with large video files. The bandwidth issue is consistent with the situation in the Higher Education setting in the UK (Dickinson, 2020; Fawns et al., 2020; Markowitz, 2020), Vietnam (Maheshwari, 2021), India (Muthuprasad et al., 2021), and Thailand (Todd, 2020). These studies have found that poor connectivity and internet speed can negatively affect engagement. This additional pressure can have a direct effect on the Virtual Learning Environment, which at UNNC is the Moodle (Module Object-Oriented Dynamic Learning Environment) platform. All these factors combined made streaming and downloading potentially difficult and frustrating for students when attempting to access course materials via the Virtual Learning Environment (Gill, Irwin, Towey, et al., 2020a).

According to the UNNC Staff and Student survey conducted in the early stages of the lockdown of 2020, access to a computer was a problem for some students. Nearly 10% of them lacked access to a computer and had to resort to using portable devices, such as tablets and smartphones. Even those with computer access often had to share with other family members working from home at that time. Since a laptop is also a portable device, it typically needs to use WiFi to connect to the internet which has the risk of an unstable connection, subject to drop-outs and low speed. This challenging situation was highlighted by student responses in the Staff and Student Survey, citing technical problems when trying to access digital materials.

In addition to the difficulties with access to a desktop computer and bandwidth, there were also other issues related to streaming of long lectures. Synchronous and asynchronous lectures, delivered in a traditional one-hour-long format, were potentially overwhelming for students who

were having to adapt to the new mode of teaching and learning n an unfamiliar setting. Some teachers divided their lectures into shorter chunks, making it more accessible to students. However, Gill et al. (Gill, Irwin, Ng, et al., 2020b) argue that shorter video clips are better when adapted and fit into the course in a more strategic manner, instead of being simply cut-outs of an existing lecture. This could be achieved through follow-up activities, such as quizzes, polls, gaps fill and matching tasks as well as forum discussions. While such teaching and learning environments look more coherent and potentially appealing to the learner, we would suggest designing online learning in a different way, to be better able to address learning outcomes. Research suggests that compared with longer videos that recreate lectures, shorter videos focused on a single learning outcome can better support individual learning needs (Buchem & Hamelmann, 2010) as the information is broken down into 'bite-sized' chunks (Gill, Irwin, Ng, et al., 2020b).

Microlearning

Microlearning has shown promise in responding to these unique needs of students attempting to adapt to the remote learning environment. Microlearning helps students fit learning intervals into their daily routine in lockdown while having limited access to a quiet space, electronic devices, and the internet. In principle, microlearning should consist of shorter videos that are easier to access and consequently avoid unwanted distractions (Markowitz, 2020). Focused on single learning outcomes, microlearning can prevent overload and anxiety caused by high demands placed on learners. It promises more effective and enjoyable learning experiences thanks to its flexible nature that allows students to learn at their own pace; anytime, anywhere (Gill, Irwin, Ng, et al., 2020b). Videos using microlearning can be standalone clips, but the very nature of microlearning prompts students to complete additional tasks related to the video. This combination, if well designed and supported by teachers, allows students to fully engage with the materials. When high engagement is realised, there is generally a positive effect on academic performance (Beer et al., 2009).

Learning Analytics

Due to lack of face-to-face contact, it is important to regularly track student engagement with the new teaching and learning mode. Learning analytics is a relatively new tool in higher education, which allows educators to collect and analyse data related to student online engagement. This information provides evidence of student activity online and can then be used to inform teachers and help to identify areas in which students are not engaging, while highlighting those which are successful. Such data can be instrumental in improving quality of teaching and learning materials (Panopto, 2021). While a high level of student engagement with video material does not detail all aspects of their learning, it can often help identify individuals who need extra support (Summers et al., 2020) or inform future decisions with regard to the course content and the lesson-delivery method. Critics argue that data generated by analytics can be 'ambiguous' (Siemens, 2014, p. 2) and only showing engagement but not performance (Gasevic et al., 2016). While this may be true, analytics needs to be supported by evidence of student engagement with follow-up tasks completed during or after watching a microlearning video content. Such evidence paired with data from analytics can offer insight into student performance.

Panopto

Panopto was identified as a potential solution to the internet problems outlined above. This platform allows subscribers to host video content on a local server, which improves accessibility and connection speed. This content can then be easily accessed using most web browsers. Panopto boasts minimal delays due to buffering which generally results in a higher-quality viewing experience. Additional features allow for multiple streams and seamless switching between different sources on the platform (Panopto, 2021). Based on our experience, Panopto has two main advantages in Emergency Remote Teaching: easy access and tracking. The former can be helpful to students with limited or poor connectivity in their

households, while the latter allows teachers and content creators to track student engagement with every video via the analytics outlined above.

During the lockdown, there were several courses that utilised microlearning in their design.

Case Study 1

At the beginning of the lockdown at HEA1, microlearning was introduced in the Product Design and Manufacture (PDM) programme, within a year 2 undergraduate class of 52 students, which focuses on teaching fundamental perspective-sketching and marker-rendering techniques relevant to the product design industry. Prior to the lockdown, the class was taught face to face, using live demonstrations, examples, and lectures which presented each technique to students, and were assessed through in-class tests. The main reported issue with this arrangement was that, as the techniques became more complex over the course of the academic year, the duration of the live demonstrations increased, resulting in little to no time for formative feedback as the class progressed. Moreover, due to time constraints, the live demonstrations were often introductory or simplified, and rarely applied in more advanced contexts.

In light of these issues and due to the lockdown, microlearning was implemented as an online learning resource, in the form of video demonstrations. The in-class tests also had to be changed to online submissions, submitted via the Moodle virtual learning environment. Each technique was broken down into several short video demonstrations, each video focused on a single learning outcome and was usually around 7–10 minutes in duration, although some videos were longer, due to a summary demonstration akin to the live demonstrations. The online learning resource contained in-depth explanations and demonstrations, with links to real-world applications and examples that were beyond what was possible in the pre-lockdown format. Students could access the videos on demand, provided they had a suitable internet connection, and watch them as often as they wished. If they had difficulties understanding any aspects of the techniques, students could contact the tutor via email.

The Panopto learning analytics data indicates that videos which demonstrated more complex and challenging techniques received more unique views, by an average increase of 35%.

After introducing microlearning, the average student mark increased from 64% to 73%, compared with the previous year; 18% of students received a final mark of greater than 80%, which was an increase of 12% compared to the previous year. Through the end of semester student survey, learners reported being more satisfied with the class than ever before, giving an overall satisfaction rating of 94%, which was an increase of 10% when compared to the previous year. This highlighted that, regardless of the learning environment, teaching and learning can be delivered to a high quality, and in this case, it was largely due to introduction of microlearning to the class format. The following are some student comments on the class:

> 'The course contents are covered in detail and enrich my understanding of sketch and rendering skills.'
>
> 'Lot of explanation of the knowledge is on the Moodle.'
>
> 'The online videos are great, I can re-watch them multiple times. Which makes it easier to understand.'
>
> 'Prefer online demonstrations because I pay more attention to the detail and improve the quality of my sketches.'
>
> 'Perfect module! Online teaching is great.'

Going forward, the online learning resource will be adopted as supplementary content in a flipped classroom manner and replace the lengthy live demonstrations during class time. It has been observed that this flipped classroom approach allows for new possibilities during the classes that were not previously feasible. For example, the implementation of the supplementary online learning resources will mean that students have a basic understanding of the technique at hand before it is formally introduced. This allows for a more in-depth introduction, with focused demonstrations and practical activities using real-world examples during class times, as discovered in this intervention. Additionally, it has been noted that this change allows students to practice the techniques under supervision and receive direct formative feedback, utilising the class time more

effectively. This intervention also fundamentally changes the dynamics of the class from a demonstrative and teacher-centric model to a more practical and student-centred learning model, as the in-class content can revolve around the students' needs, give more practical application of techniques (using real-world examples), and allow for more student-teacher interactions through formative feedback.

Case Study 2

The second course that adopted microlearning in emergency remote teaching was focused on the basics of the C++ programming language for 60 Year 2 undergraduate Engineering students. The course aimed to equip students with basic object-oriented programming knowledge. The microlearning portion of the instructional design was originally created before the COVID-19 lockdown to solve a learning problem in the computer laboratory classes related to the large number of students. Some found it difficult to follow the pace of a live demonstration of coding by the tutor in front, and others at the far end also experienced difficulties in viewing the demonstration. However, during the lockdown, all videos had to be further adapted to suit the remote learning environment. There were challenges for both tutors and students to meet online synchronously due to time zone differences and variable internet speed. It was, therefore, decided the short tutorial videos were then converted into an asynchronous virtual laboratory tutorial to help students to complete their programming assignments. The tutors then engaged with the students in smaller groups in the synchronous office hours, typically 10–15 minutes per group each week, to discuss their assignments. This was also a good opportunity to check their engagement in the course.

Here are some comments from those students:

'Truly love the video recordings. I don't always understand the material the first time, but now I can review the highlights of a subject many times.'

'…lab videos are just excellent to get started with new concepts.'

'This module has a unique way of teaching which has eventually made C++ a fun learning subject and not a burden.'

There were challenges converting existing videos into a full online delivery. The original pre-lockdown videos varied between five to 24 minutes in length, while the microlearning generally recommends not more than 6–10 minutes. While it proved difficult to ensure that some more complex concepts fit into those boundaries, it was essential that those videos had a single learning outcome.

Data from the Panopto learning analytics tool shows that the 85% of correlation of the number of views corresponds to the total number length of the videos in minutes. Further investigation, including the observation of unique visitors, shows that almost 70% of the students watched the videos more than one time, particularly the videos running more than 15 minutes in length. In other words, the longer the length of the video the more repeated views.

Discussion and Implications

Being based around single learning outcomes, microlearning leads to more focused learning. By offering a high degree of flexibility, it puts students in control of their learning (Buchem & Hamelmann, 2010), which is instrumental in both traditional teaching and learning settings (Dent & Koenka, 2016) and online (Broadbent & Poon, 2015). Paired with the lack of direct teacher guidance and peer support, it has been observed that taking responsibility for engagement is key for the learner in the transition to emergency remote teaching, and this can be a pivotal factor in their academic success Despite the lack of face-to-face instruction, Nouri (2016) found that flipped classroom model using short videos embedded on the virtual learning environment leads to 'effective (…) and more active learning' (p. 9). He also shows that this model can be more beneficial for 'low achievers' who struggle with traditional full-length lectures (p. 9).

Still, identifying students 'at risk' is more difficult in emergency remote learning. This is an area where analytics can be applied to track online engagement. This is important as even merely making these students aware of being 'at risk' can help increase their engagement (Summers et al., 2020). In turn, this can result in improved academic performance

(Agudo-Peregrina et al., 2014). The total time spent on virtual learning environments has also been shown to contribute to higher grades (Summers et al., 2020) and in particular related to solely online learning (Agudo-Peregrina et al., 2014). As undergraduate students often struggle with time management (Krygier, 2020), they may require stricter monitoring in the initial two weeks (Summers et al., 2020). From a practical standpoint, microlearning enables easier tracking thanks to the material based presented in micro chunks. Lack of engagement with a series of short videos is more apparent compared to missing one lecture in a long format.

Recommendations

Firstly, microlearning content should be embedded on the Virtual Learning Environment platform. It has been noted that familiarity and simplicity are key to ensuring user satisfaction. It also allows for seamless switching between videos and follow-up activities, both of which are tracked for evidence of student engagement. Further, creating a library of microlearning resources for standalone emergency remote teaching use is an important first step. Such collection over time can become a supplement to traditional face-to-face courses delivered in a flipped learning format. Finally, our experience shows that more training is needed for teachers and content creators. Microlearning videos need to fit specific criteria in terms of length, pace, and visual aspects to be more attractive to students. More research in this area is required to identify the specific needs of the Higher Education students.

These were the first attempts at microlearning at UNNC. There were some difficulties in designing longer videos as some more complex concepts required more detailed explanations or demonstrations. These microlearning videos, however, will be further adapted based on the current teaching and learning delivery mode. Our case studies show that microlearning can be effective on skills-based or practical programmes. Based on our reflections, however, we believe it can be successfully applied on other programmes, outside of STEM, and even more so on postgraduate programmes for more mature students.

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