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VIRTUALLY THERE: THE POTENTIAL, PROCESS AND PROBLEMS OF USING 360° VIDEO IN THE CLASSROOM

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ABSTRACT

Aim/Purpose	This paper presents an exploratory case study into using 360° videos to present small segments of lecture content for IT students in an Australian University. The aim of this study was to understand; what is the impact of incorporating 360° videos into class content for students and teaching staff? In this study the 360° videos are described as "learning atoms". Learning atoms are short duration videos (1 to 5 minutes) captured in 360°.
Background	Within this paper we conducted experiments in the classroom using 360° videos to determine if they have an impact on student's feeling of presence with class content. Additionally, to follow up, how does the inclusion of 360° impact on the teaching experience.
Methodology	The methodology used in this study focused on both quantitative and qualitative aspects. Data was captured at the same time during the teaching period to address the research questions. In order to gauge the feeling of presence within the classroom a short survey was administered to students in the undergraduate IT class at the start (pre) and end (post) of the semester using the same questions to measure any change.
Contribution	The main contributions from this study were that we demonstrated there is a potential for providing an alternative 'immersive' content presentation for students. This alternative content took the form of 360° learning atoms, whereas further showed our nuance process for creating and publishing of these atoms.
Findings	The results show that for students, learning atoms can help improve the sense of presence, particularly for remote students, however the interactive experience

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	can take student's attention away from the lecturer. The results present potential for providing an alternative 'immersive' content presentation for students, however problems for uptake are present for both students and teachers, such as image capture quality and file size
Impact on Society	We foresee this approach as being a new approach to teaching students in higher education within online spaces to increase engagement and move towards having a richer virtual experience no matter the location.
Future Research	Future research will be conducted to resolve whether presence and engagement is supported by the inclusion of 360° videos in the classroom.
Keywords	virtual reality, students, improving classroom teaching

INTRODUCTION

Recent years have seen the higher education experience progressively shifting from a typically didactic teacher driven model to a more student-centred model supported by technology. Short video recordings, either cut from larger presentations or specifically produced for new platforms such as MOOCs, are becoming popular and are presenting challenges for teachers as they learn how to apply this new approach in their delivery of education (Scagnoli, McKinney, & Moore-Reynen, 2015). Concurrently the audience encountered by teachers has also been changing, with students often joining classes having experienced video content from sources such as YouTube (Chintalapati & Srinivas, 2017), thus arriving with expectations of similar quality of content for any resources. Within the scope of this problem this research considers the application of 360° videography for the preparation and delivery of learning resources (e.g. video tutorials, lecture recordings). In conducting this research, we have considered pedagogical issues, technical issues, and the overall potential impacts of this new technology on the learning experience. To explore the need for providing short videos to support students learning in higher education, this study used an exploratory case study research design to address the aim of; what is the impact of incorporating 360° videos (or what we defined as 'learning atoms') into class content for students and teachers? To address this aim two research questions were posed: 1) How does inclusion of 360° videos impact on student's feeling of presence with class content? 2) How does inclusion of 360° videos impact on the teaching experience? To guide this study in addressing the research questions the literature provided information on the use of rich-media, such as videos, to provide classroom experiences that provide presence and a sense of connection for those who may not be attending in person.

LITERATURE REVIEW

Lectures have traditionally been of a single directional style and of long duration, an approach out of favour with students who have shown that attention levels naturally drop after the first 20 minutes (Spence & McKenzie, 2014). Video recording to present both classroom content (lecture) and knowledge concepts have been used in higher education classrooms since the early 2000s (Hew, 2009; Kay 2012; Kirkwood & Price, 2014). Recording of lectures is now common, and in some cases are replacing the traditional face-to-face lecture (Guo, Kim, & Rubin, 2014). If created well, video recordings can also be used in future offerings of the unit, thus potentially saving time for the teacher in the long-term, and act as an archive of learning for students to access anytime and anywhere. Conversely however, video recordings may introduce problems as they can increase a teacher's workload due to the time required to setup and manage (Universities Australia, 2013), and video recordings may not be ideal for students with learning disabilities or non-English speaking backgrounds if the audio isn't of high-quality (O'Callaghan, Neumann, Jones, & Creed, 2017).

Student engagement has been identified as a key contributor to their learning and academic success, achieving higher grades and outcomes from tests, and also towards the completion of school and courses in general (Fredricks, Blumenfeld, & Paris, 2004; Wang & Fredricks, 2014; Wang & Hol-

combe, 2010). Recorded videos have been shown to improve student engagement, such as by Guo et al. (2014) who measured engagement by analysing how long their students were watching a short video, and if they attempted to answer a range of questions that came about after the video was finished. High-quality pre-recorded classroom lectures did not rate as well however, possibly resulting from restrictions on student attention span (Guo et al., 2014).

The shift from entirely classroom-driven teaching experiences to the introduction of distributed online systems has resulted in a variety of new advantages and disadvantages from the traditional model. The use of online learning has steadily progressed due to wider availability of high-speed Internet, a preference over face-to-face delivery for mature-aged students embarking on degrees (Cavanaugh & Jacquemin, 2015), and an increase in students working part-time while studying (Wells, Barry, & Spence, 2012) among other factors. The impact on student outcomes between face-to-face, online-only, or blended delivery appears equally effective (Cavanaugh & Jacquemin, 2015); however, online-only, and somewhat blended delivery also, introduces concerns regarding the potentially lowered student experiences of presence (Garrison & Vaughan, 2008; Richardson & Swan, 2003).

Presence refers to the subjective experience of being or existing in an environment (Witmer & Singer, 1998), even when located elsewhere. This is notably a key focus in virtual reality (VR) where measures of a successful VR experience are immersion and virtual presence; indicating the artificial nature of the VR are being interpreted as if they were real (Sanchez-Vives & Slater, 2005). Presence is largely assumed in real-world classroom situations where limited artificiality is used; students can directly speak to each other and their teachers and exist within physical proximity to teachers. However, use of some of the previously listed forms of teaching materials such as video recordings for remotely located (online) students may be unlikely to foster the same degree of presence as they lack synchronicity and interaction. Lessiter and Freeman (2001) note that higher degrees of realism can compensate for the absence of control over the experience. The use of 360° videos over, or in conjunction with, traditional 2D recorded videos may allow for the same level of learning experience for the students as traditional approaches, while additionally enhancing student experiences of presence. Hitherto research into the application of 360° video within education has been somewhat limited. Significant improvements to student engagement were observed by Harrington et al. (2017) in the context of medical education where an actual surgery was recorded using 360° video which was then augmented with various additional illustrative imagery such as patient ultrasounds. In this study the 360° videos captured were defined as learning atoms, captured during a particular class. Further information on how the learning atoms were curated in this study is described next.

LEARNING CONTEXT

This study revolved around preparing "learning atoms", short duration 360° videos covering a component of knowledge normally presented in full-length classes, viewable by students outside of class. The subject of study was an undergraduate subject focusing on the design and development of audio and visual content for games and virtual reality where attendance was small, but a large online/distance cohort existed. The students in the class were a second-year cohort, indicating previous experience in lecture video recordings and online learning. The teaching staff in this study were experienced university lecturers, coming from an IT background.

Each learning atom created as a part of this study was captured during a live class, with the teaching staff member an active part of the recording. Each recording was edited in post-production to emphasise the content being presented with written materials. While no prior training was provided, the teachers worked with an assistant to produce the 360° learning atoms to manage the post-production editing. Figure 1 is a screen shot of one of the learning atoms.

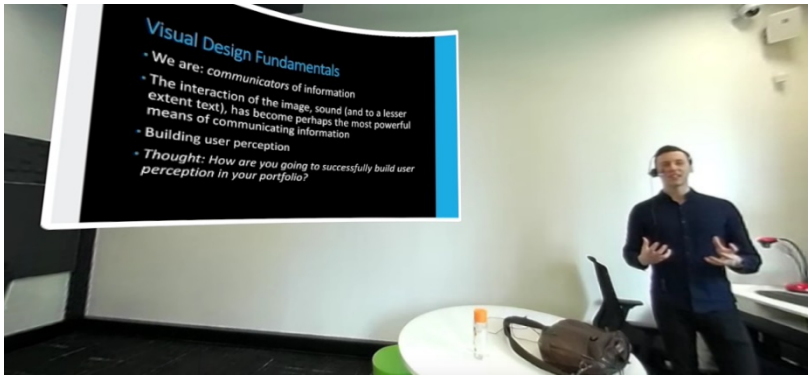

Figure 1. 360° learning atom screen capture

Classes were recorded for the semester, totalling approximately 20 hours of footage, which were then edited to create learning atoms of 1 to 5 minutes duration. The learning atoms addressed topics such as: visual design fundamentals, composition of presentation of assets, what is computer animation, audio and emotion in design. Learning atoms were released to students each week over the teaching period (12 weeks), starting from week 2. A total of 10 atoms were released. Learning atoms were uploaded to a public YouTube account (e.g. McKenzie et al., 2017) for student viewing using either YouTube's web interface or via a VR headset for an immersive experience (e.g. Google Cardboard, HTC Vive). YouTube was the chosen delivery platform due to integration of 360° viewing capabilities from a browser. In addition to the learning atoms, traditional full lecture recordings were also provided to students, through automatic recordings.

METHODOLOGY

An exploratory case study research design was used to address the aim of this study, which is; what is the impact of incorporating 360° learning atoms into class content for students and teachers? Two research questions guided this study: 1) How does inclusion of 360° videos impact on student's feeling of presence with class content? 2) How does inclusion of 360° videos impact on the teaching experience?

Both quantitative and qualitative data was captured at the same time during the teaching period to address the research questions. To gauge the feeling of presence within the classroom a short quantitative survey was administered to students in the undergraduate IT class at the start (pre) and end (post) of the semester using the same questions to measure any change. The survey items were drawn from Dinh, Walker, Hodges, Song, and Kobayashi (1999), and Slater, Usoh, and Steed (1994), which explore the concept of physical presence. The survey asked the students their age and gender, and questions such as 'How often do you watch lecture content online?'. In addition, the survey asked students to self-rate their experience on a scale of 1 to 10 (one being low in engagement/presence or disagreement, 10 being high in engagement/presence or agreement) in response to the following questions: 1) 'Does watching lecture video recordings make you feel separated from the class', 2) 'Do you feel the lecture video recordings keep your attention', 3) 'Do you feel more involved/immersed when watching lecture video recordings', 4) 'Do you get distracted easily when watching lecture video recordings', 5) 'Do you feel like the lecturer is addressing you directly when watching lecture video recordings', 6) 'Do you feel lecture video recordings save you time'. In addition to the above questions, the post survey also asked 'Are the provided 360° 'learning atoms' a more engaging resource than traditional 2D lectures'? The results were collated and analysed using descriptive statistics.

To explore the impact of 360° learning atoms on teacher experiences reflective journals from the teaching staff of the undergraduate IT class were maintained, updated on a weekly basis. Teaching staff were asked to report on student understanding of concepts as related to each learning atom and

note any issues/concerns with using 360° to support teaching. As the teaching staff appeared in the learning atoms and lecture recordings, it was not suitable to provide teaching staff with the same survey as students. Rather their classroom experience was of consideration. To explore impact of 360° recordings on classroom experience, the research team individually interviewed the teaching staff about their experiences at the end of the semester, using a semi-structured approach to address research question two. The interviews and journals were inductively analysed to identify common themes. Two researchers independently completed coding to ensure theme consistency.

RESULTS

To address research question one, focusing on the student experience, the survey explored students' feelings of presence and engagement with 360° "learning atoms". Due to scheduling problems a sample of nine student's response to the pre- and post-surveys were captured, drawn from a population of 75. Seven male students and two female students responded whose age ranged from 18 to 50 years in range. All respondents indicated in the pre-survey that they watch lecture content online at least a few times throughout the semester, with no change in the post-survey. Figure 2 outlines student responses to the questions on presence and engagement, with the numbers indicating student response in the pre- and post-survey for each item. A larger number indicates were the group of responding students noted their experience, on a scale of one to five (one being strongly-disagree, five strongly agree).

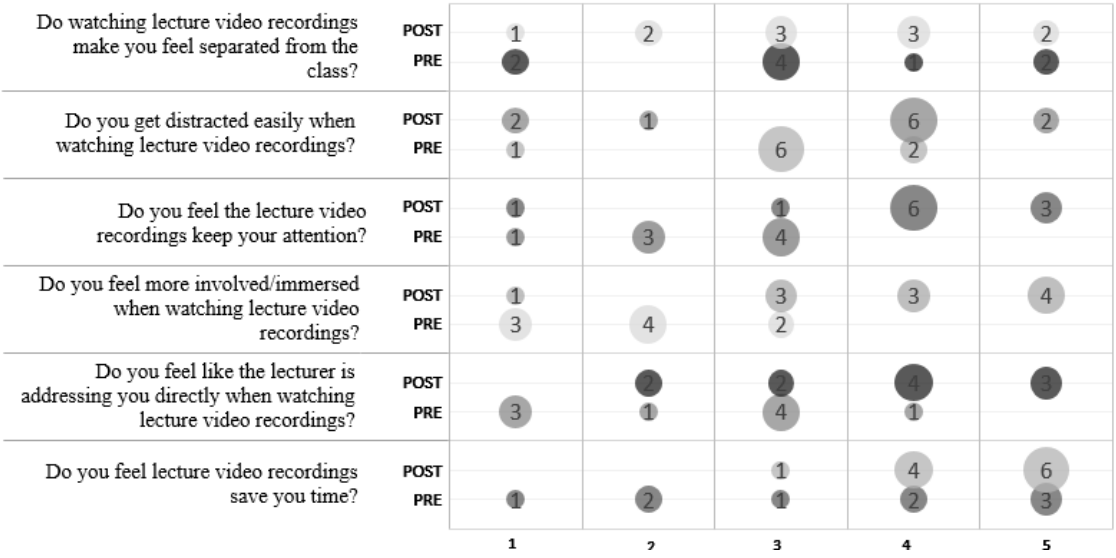

Figure 2. Students' response in pre- and post-survey on presence and engagement, with bubble size indicating number of responses.

Responses to the post-survey suggest that 360° video helped to keep the students' attention, feeling of immersion, and students felt they were being addressed directly by the lecturer. The responses also suggest however that students were more distracted by the use of 360° learning atoms. This could indicate that 360° video can help improve the sense of presence for remote students, however the interactive experience can take student's attention away from the lecturer. Overall students were somewhat in agreement regarding the use of 360° video resources over traditional 2D lectures to provide engagement, with 40% agreeing or strongly agreeing, and 60% answering neutral. This result indicates that students remain unsure about the immersive content provided overall.

To address research question two, focusing on the teacher experience, teacher reflective journals and interview data were analysed using qualitative thematic analysis techniques to determine key out-

comes. Two teachers' journal and interview data were captured and analysed. Two key themes emerged from analysis.

Managing Alternative Content Presentation

During class, teachers noted that the inclusion of 360° recording equipment required an increased focus on classroom management. In particular, rather than the camera being focused solely on the teacher, the audience now control the viewing angle of the 360° camera. Teachers had to refine their presentation style to consider the camera, having to think about where to direct their attention. As one teacher commented, "I needed to be conscious of what was in a direct line of sight from the camera, such as the computer screens of other students". While it is reasonable to expect that students, who are physically situated in a classroom may be able to momentarily view the work and activities of others in the room with relative ease, the use of a camera adds a more permanent record of this.

Supporting Classroom Experience: Content Clarity

The 360° learning atoms offer students an opportunity to experience the classroom from an online learning environment using audio, visual images and interaction. The learning experience however relies on audio as a central component to connect the visual elements and hardware issues were encountered when capturing classroom activity. In particular, students and teachers occasionally struggled with inconsistencies in the audio presentation. As one teacher commented, "Clarity in audio content, and capturing ambient classroom noise, was often a problem with creation of the 360° learning atoms. In a knowledge delivery situation, audio is a key communication channel". Another notable limitation of the available audio capture was the lack of positional audio. While a viewer can turn to observe the video from any direction, the audio capture that was in mono or stereo is unaltered and can therefore create a noticeable disconnect between where the lecturer appears to be and the source of the audio.

Discussion: Potential, Process and Problems

Potential 360° Video as a Learning Delivery Method for Students

360° learning atoms indicate a potential to increase student presence and engagement, however further exploration is needed. The audience have control to explore the room and see other students, much like the controls for a VR world, although present technology does not give students the ability to virtually move within the room. While there are no specific learning advantages to being able to move the direction of the virtual camera to look around the physical room, the ability may satisfy online students' curiosity in how others are learning, and potentially encourage them to study as other students' study, being able to see other students' behaviours during a class.

Process and Problems of Using 360° Video: Technical Considerations

Several problems and technical challenges were encountered in the producing of 360° learning atoms. Reviewing the recordings demonstrated that the camera's built-in microphone did not adequately capture audio beyond approximately 2m, and written content on presentation slides was difficult to read. To resolve these issues, a headset was introduced to capture a clearer audio from the lecturer, and high-quality images of each lecture slide were composited over the presentation slides during post-production of recordings to resolve readability. Lighting also played a significant role in viewing quality, whereby large windows or bright lights (particularly fluorescent lights) could cause overexposure to the immediate surrounding area; obscuring detail and text. This is a difficult issue as unlike a

regular camera that can be directed away from bright light sources, 360° camera recordings are likely to include bright light sources such as ceiling lights, screens and data projections in the image. This means adjustment to one setting such as exposure or contrast affects the entire recording from all angles. Positioning of the camera also required adjustment throughout the semester. Being 360° one may assume that placing the camera in the center of the classroom would provide the most immersive experience for students, however some students would not like their view of the lecturer obstructed (and vice versa). Additionally, most 360° video lacks stereoscopic depth and consequently can give a distorted impression of size. This is most prominent if the camera's height is below that of the presenter, giving a giant, looming appearance to the presenter. The student's privacy of their activities had to be considered too; particularly when their computer screen or notebooks were in view of the camera.

YouTube was selected for the delivery platform for students due to its tools and support available for 360° videos, and its ability to downscale video resolution for viewers with restricted bandwidth, an important feature given that the file size of a 360° learning atom, even <5 minutes in duration, can easily exceed 1GB. Restrictions in network bandwidth also limit on-demand streaming of 360° videos. File size and limits to streaming suggests that access to 360° video may be restrictive for some students.

CONCLUSION

This paper has presented an exploratory case study into the impact on the use of 360° "learning atoms" on students and teachers. During this exploratory case study, the student and teaching staff experience was investigated, highlighting some uptake by students with problems remaining for complete implementation. The results demonstrate there is potential for providing an alternative 'immersive' content presentation for students, however consideration of image capture quality and file size are relevant in the learning environment. The process for creating and publishing learning atoms was established. A limitation in this study was the small number of student participants viewing the 360° videos, highlighting limitations in uptake of the video resource. Further research to resolve whether presence and engagement is supported by the inclusion of 360° videos in the classroom is being planned for the next offering of the same subjects discussed here.

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Dr. Nicholas Patterson is a Senior Lecturer within the School of Information Technology. He is the course director for the Master of IT Leadership and developed several Massive Open Online Courses. He teaches in areas related to cyber security, digital literacy and technological thinking with a strong focus on delivering premium education to students in online spaces.