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## **A CASE STUDY OF POLYSYNCHRONOUS LEARNING IN UNIVERSITY BIOSCIENCE EDUCATION**

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### **Introduction**

Contemporary university students are engaging in new ways with teachers, peers and content in and out of class capitalizing on the affordances of mobile devices and new kinds of synchronous and asynchronous online learning tools. The multiple ever-present communication streams that are emerging through these new tools and devices are leading to learning scenarios incorporating interaction patterns that have the potential to transform the learning process. The term 'polysynchronous learning' has been co-opted and adapted to capture these new learning scenarios. This paper draws on the findings from a case study of polysynchronous learning within a university Histology subject in order to illustrate some of the key aspects of these scenarios and the ways in which the student learning experience is changing as a result.

### **Polysynchronous learning**

#### ***Synchronous and asynchronous learning***

Traditionally interactions between learners and teachers or between learners and learners have occurred either synchronously (participants communicating at the same time), or asynchronously (communication occurring over a period of elapsed time). For example, learning designs in face to face settings have traditionally relied primarily on synchronous verbal communication between students and teachers and between students and their peers in conjunction with independent engagement with subject content and learning resources outside of class time. In online settings, learning designs have tended to focus primarily on asynchronous participation by students (Abrami et al., 2011), through access to online resources and through the use of asynchronous discussion forums to engage with peers and teachers. Researchers and learning design scholars have tended to treat synchronous and asynchronous participation as an either-or proposition. Bernard et al. (2009), for example, has published a highly cited meta-analysis of studies comparing the value of each modality.

More recent developments, however, have led to a questioning of this notion of synchronous or asynchronous communication being a fixed attribute of face to face learning on the one hand or online learning on the other. For example, in face to face contexts the availability of asynchronous discussion forums and social media tools has introduced the possibility of a separate asynchronous communication stream that allows in class discussions to continue

after the conclusion of face to face classes and allows communication and collaboration between students while engaging with learning resources outside of class. In online contexts it is becoming clear that there are potential benefits from synchronous real-time communication alongside asynchronous communication. Real-time synchronous communication can help students to develop the professional communication and collaboration capabilities expected within the modern workplace and to undertake certain kinds of cooperative learning activities more easily. Rapid synchronous exchanges of dialogue, and synchronous sharing of visual material can allow a depth of communication that generally doesn't occur in a purely asynchronous context. Web conferencing systems in particular (e.g. Adobe Connect or Blackboard Collaborate) have made synchronous communication and resource sharing more feasible for online students.

In addition to the way in which the introduction of asynchronous options within face to face contexts and synchronous options within online contexts, has challenged existing assumptions about the learning process in these contexts, the delineation between synchronous or asynchronous is becoming less clear. The distinction between synchronous and asynchronous modality is becoming complicated by i) the creation of digital interaction 'footprints' through recording of synchronous audiovisual presentations and chat logs (see Wexelblat & Maes, 1999), which can be a hub for ongoing asynchronous engagement, ii) the idea that instant responses to asynchronous text chat postings illustrates a third modality, which Garcia and Baker Jacobs (1999) refer to as quasi-synchronous, and iii) the ubiquitous availability of mobile devices which turn asynchronous discussion into quasi-synchronous or synchronous discussion by increasing the likelihood of an instant response.

### ***Student interaction and engagement***

In exploring the ways in which synchronous and asynchronous learning experiences can be integrated it is valuable to consider the different kinds of interaction or engagement that occur in a typical learning scenario. In this context, Moore's (1989) categorisation of interaction provides a well-accepted framework for understanding and exploring student engagement in both face to face and online settings. Moore (1989) describes three categories of interaction, learner-instructor, learner-learner and learner-content. In face to face learning contexts, for example, learner-instructor and learner-learner interaction would occur synchronously through verbal communication, while learner-content interaction would occur both synchronously in class and in follow up asynchronous private study. In online learning contexts, learner-teacher and learner-learner interaction would normally occur asynchronously through, for example, a discussion forum, while learner-content interaction might occur asynchronously through engagement with online learning resources. As discussed above, however, recent developments, are questioning the rigid association of synchronous communication with face to face contexts and asynchronous communication with online contexts.

Additionally, the gradual introduction of blended learning options where students undertake some face to face and some online learning activities is also challenging traditional notions of

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student interaction and engagement. In particular the need to cater for the situation where some students are physically present, some students participate synchronously from a remote location, while other students participate asynchronously at a later time, is leading to new thinking about ways of blending synchronous and asynchronous learning.

The other key change that is occurring as combinations of asynchronous and synchronous interaction are introduced within face to face, online and blended learning contexts is the introduction of multiple streams of communication. In traditional face to face contexts there is a single stream of verbal communication which is shared by all students and the teacher, and consequently in large classes there is little opportunity for active student participation in the discussion by virtue of the minimal time available to each student within this audio stream. The introduction of one or more streams of asynchronous or quasi-synchronous discussion alongside the main audio stream provides students with the opportunity for much greater participation and engagement with peers and teachers.

### Polysynchronous learning defined

The term polysynchronous learning has been used to capture the distinct type of learning experience afforded by the emerging learning scenarios described above. Dalgarno (2014, p.4) defines polysynchronous learning as “the integration of learner-learner, learner-content and learner-teacher interaction through a blending of multiple channels of face to face, asynchronous online and synchronous online communication”. Figure 1 helps to illustrate the way in which polysynchronous learning differs from traditional face to face and online learning by representing the differences in patterns of interaction across modalities in face to face, traditional online and polysynchronous learning environments.

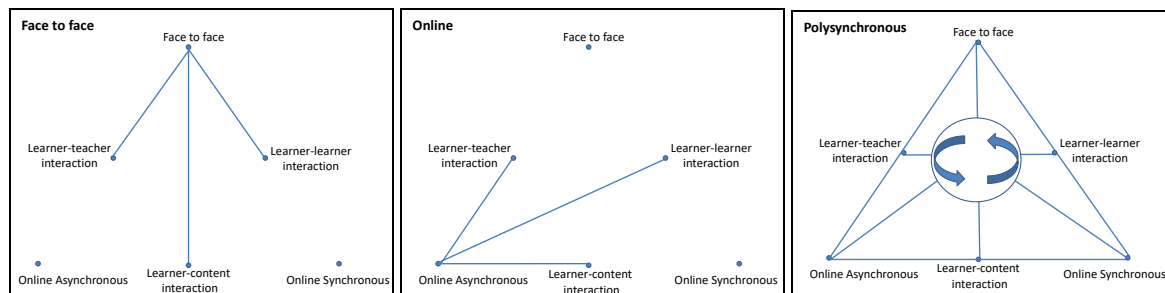


Figure 1. Interaction patterns in Face-to-face, Traditional online and Polysynchronous learning environments

## Methods

### Background

In the study, ‘Blended synchronicity: Uniting on-campus and distributed learners using media-rich real-time collaboration tools’ (an Australian Office of Learning and Teaching Innovation and Development Grant funded project) seven case studies involving blended learning designs were explored (see Bower et al., 2014). The study explored blended learning designs using video conferencing, web conferencing and 3D virtual worlds. The particular case study described here occurred within a 2<sup>nd</sup> year university histology subject within a

medical science course in a regional university within Australia. The lesson used Adobe Connect to bring together 12 on-campus students in a computer laboratory and 11 distance education students participating from off-campus locations to perform an interactive review of material for an upcoming exam. The key intended learning outcome during the lesson was the ability to apply an understanding of normal vertebrate tissue structure in the context of histology microscopic image analysis.

### ***Data collection***

The face to face learning activities during the lesson were video recorded as were the online activities within the Adobe Connect session. This allowed student interaction patterns to be analysed after the completion of the lesson. Student reflections on the lesson were gathered through a questionnaire completed by 10 students present on campus and 3 students participating remotely. The questionnaire included Likert scale items asking students questions about the degree to which the lesson allowed them to effectively interact with local and remote peers and share resources and about their perceptions about the learning experience along with open ended questions allowing students to comment on aspects of the lesson. The 12 on-campus students participated in a focus group interview following the lesson and all remote students also participated in a focus group interview two weeks later when they were on campus for a residential school. The teacher was also interviewed before and after the lesson. Recordings of student activity in class and online were analysed in order to identify patterns of student behaviour as well as being used to cross-check and verify themes emerging through qualitative analysis of the students' open ended questionnaire responses and comments during focus group interviews. Identified patterns of behaviour and emergent themes were then verified by other members of the research team in order to avoid researcher bias.

### ***Lesson design and delivery***

During the first part of the lesson, the teacher, wearing a microphone to allow her speech to be audible to remote students through Connect, presented a series of multiple-choice and short-answer questions. Students (on campus and remote) answered the questions using the Connect student-response (polling) tools. Summaries of student responses were presented graphically, and the teacher explained why each answer was correct or incorrect. Students asked clarifying questions either verbally (on-campus students) or using the text chat tool in Connect (remote students). During the second part of the lesson, students were grouped in pairs and asked to complete microscopic tissue image identification and labelling tasks in breakout rooms within Connect. Group members reported back at the end of each activity and the teacher supplied feedback and clarification. The face-to-face classroom view and the remote student view are shown in Figure 2 below.

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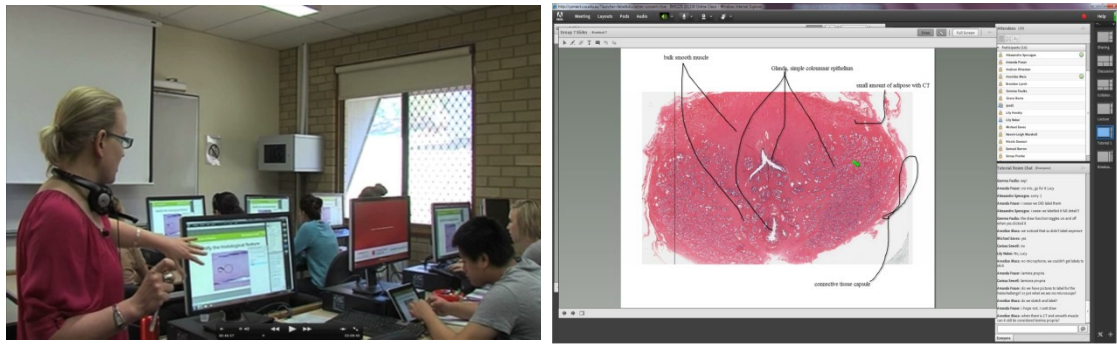


Figure 2. Face-to-face classroom view (left) and remote student view (right)

## Results

The majority of face-to-face and remote students responded positively to all items on the questionnaire. For example, all 13 respondents agreed with the statement on the questionnaire “I was able to communicate verbally in an effective manner with people in the face-to-face class” and 11 out of 13 respondents agreed with the statement “I was able to communicate verbally in an effective manner with people who participated remotely”, with one student disagreeing and one neutral. All 13 respondents agreed that they were able to “effectively share visual artefacts with others”, “jointly create, edit, and share material with others”, and “effectively indicate my status to others”. Similarly, all 13 respondents agreed that they felt present with “people who were participating remotely” and with “people who were in the same room as the teacher”. Finally 11 out of 13 respondents agreed that “the collaborative technology provided clear and accurate representation of information and people” with the remaining two students being neutral.

In explaining why they were so positive about the lesson, face to face students during the focus group interview highlighted the additional engagement with content that occurred through the use of the polling tool and the additional opportunity to ask questions and participate in discussion that occurred through the use of the text chat stream. These perspectives are exemplified by the following student comments:

*This lesson is so much more engaging than your average lecture or tutorial. I find personally I'm more attentive, and the active participation components help the information to sink in more easily.*

*It's a better way to ask questions as well, you know you take one of our normal lectures and if you have a question, there's usually so many people in that lecture theatre that you kind of have to wait until you go home and post it on the forum, and you have to wait another 3 days from the lecture for someone to answer it.*

Remote students commented on the similarities and differences in the learning experience depending on whether participation is face to face, synchronous online or asynchronous via a recording of the lesson, as illustrated by the following comments:

*It's not too different to being [there] ... you can still ask questions it's like being in the class really as long as [the lecturer] is watching the screen.*

*When it's a recording you sort of just go oh yeah I think that's this and then you don't think much of it but then when you actually have to make a decision and say A, B, C or D I find that sort of works a lot better.*

*And even watching those recordings afterwards where you've got time where everyone's thinking you think about it yourself and then you see the answer come up anyway so even the recordings of the tutes are good.*

Finally, the following comment illustrates the benefits for learner-learner interaction of the text chat stream, as well as the way in which these kinds of tools and techniques are consistent with the way students use social media on a day to day basis.

*We all communicate using the chat room and we are able to have a conversation with each other. It's not a difficult task to comprehend because we do this everyday over social media. Everyone feels comfortable in the chat room and it feels like they are in the room with us.*

## **Discussion**

This case study illustrates some key elements that emerged during a number of different case studies within the wider Blended Synchronous Learning project, including the following:

- Simultaneous remote and face to face participation;
- Multiple channels of communication between peers, small groups or the whole class (allowing students to ask questions without interrupting, undertake a stream of dialog between each other, and explore and share content) leading to a much more active learning experience where students are constantly constructing, articulating and querying their own knowledge representation;
- Interaction with peers and teachers in the context of problem-focused engagement with content (through whole class activities such as quizzes using the polling tool, or paired or small group activities such as the microscopic slide analysis and annotation activity in this case study) allowing the well-established benefits of cooperative learning to be harnessed both in class and in their private study (see, for example, Johnson, Johnson & Smith, 1998; Slavin, 1996); and
- Recording of sessions (allowing recorded sessions to be viewed/listened to later and an asynchronous discussion to emerge building on the discussion during the synchronous session).

## **Conclusions**

The case study described in this paper has illustrated the way in which synchronous learning experiences can be transformed through the use of technologies and pedagogical strategies which allow for simultaneous remote and face to face participation, multiple channels of synchronous and asynchronous communication, problem focused collaborative engagement with content and the creation of digital artefacts through the recording of sessions. Additionally (although not evident within this case study) the ubiquitous availability of mobile devices, can turn the normally asynchronous private activity of viewing content, engaging in problem solving or exploring learning resources, into a synchronous or quasi-synchronous social activity.

We have argued in this paper that the integration of synchronous and asynchronous activities, including activities involving learner-learner, learner-teacher and learner-content interaction, which we term polysynchronous learning, can result in a learning experience that is qualitatively different than the sum of the component parts. Such activities can potentially have a major positive impact on learner engagement and consequently learning outcomes.

However, there are challenges for course and subject designers and for teachers in providing a focussed and well organised learning experience for students in polysynchronous environments. Poorly designed polysynchronous learning environments can potentially have a detrimental effect on learning, with learners becoming distracted by irrelevant dialogue within multiple communication streams, struggle to maintain concentration due to the high cognitive load in attending to multiple sources of content and discussion simultaneously, or engage only at a shallow level due to the rapid and abbreviated responses which are the convention in mobile communication channels. More research is needed which derives learning design principles and guidelines for teachers applicable to polysynchronous environments. Earlier research has demonstrated the value of interaction through designed rather than incidental learning activities (e.g. Borokhovski et al., 2012), especially when designed activities are informed by well accepted principles such as constructive alignment (see Biggs & Tang, 2011), and cooperative learning (Johnson, Johnson & Smith, 1998; Slavin, 1996). The challenge is to identify how best to apply what is known about learning design and about teaching to polysynchronous contexts.

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