Three Stages of Student Engagement in a Flipped-classroom Environment

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ABSTRACT

The literature suggests that students tend to prefer in-person lectures to video lectures. This paper identifies potential causes of this phenomenon and triggers of student engagement in a flipped-classroom environment.

Eight short in-house mathematics videos were prepared and made available to foundation engineering students on the university’s virtual learning environment, prior to each topic being discussed in class. The in-house videos were viewed more than accompanying external on-line video lectures for all topics covered. Students preferred in-house videos with a voice describing a drawing as it is being drawn, not one drawn earlier, and an equation as it is being written, not one written earlier. In-house videos that were produced using high numbers of pre-prepared pages tended to be viewed less. These findings suggest a gradient of student engagement from the external on-line video lecture to the interactive group learning experience. Three evidence-based stages of student engagement are proposed: (1) external video, (2) in-house video with high numbers of pre-prepared pages and (3) in-house video with low numbers of pre-prepared pages. Further validation of these stages of student engagement, and an exploration of lecturer preparedness and social presence during the production of short in-house mathematics videos, is recommended.

Keywords

Engagement │ Evidence-based │ Flipped-classroom │ Interactions │ Learning spaces

INTRODUCTION

‘What is the best use of face-to-face time with students?’ is ‘the one question’ Bergmann and Sams (2014, pg 3). Should it be to provide instruction or facilitate learning, (Barr and Tagg, 1995)? Moving direct instruction from the group learning space to the individual learning space (Bergmann and Sams, 2014, pg 6) and students watching or listening to lessons at home and doing their ‘homework’ in the timetabled session (Fulton, 2012), is now termed flipped or inverted learning (Flipped Learning Network, www.flippedlearning.org). Evidence is gathering to support the hypothesis that doing this significantly improves students’ learning and achievement in mathematics (Bishop and Verleger, 2013, Day and Foley, 2006, Fulton, 2012), however, many studies are based on subjective opinion survey or informal assessment (Bishop and Verleger, 2013, pg 11).

Students still ‘tend to prefer in-person lectures to video lectures, but prefer interactive
classroom activities over lectures’ (Bishop and Verleger, 2013, pg 2), suggesting social presence (Short et al., 1976) the ‘degree of salience of the other person’ (pg 65) plays a part in the learning. For example, how important is it that a flipped-classroom video is produced by the person taking the class? Does the ‘personal touch’ have a part to play a part in the flipped-classroom learning experience?

Research Question 1: In-person

If a flipped-classroom model is to be followed then are students more likely to engage with a video prepared by the lecturer (in-house), or to a video produced by a third party (an external on-line flipped resource)?

‘Crafting a great four-to six-minute video lesson poses a tremendous instructional challenge: how to explain a concept in a clear, concise, bite-sized chunk’, (Tucker, 2012). This may well be the case on a technical and pedagogical level, but could the ‘social presence’ of the video producer especially in online learning scenarios (Gunawardena, 1995) influence the dynamic of the learning interactions (Williamson, 2015)?

Research Question 2: Interactive

If on-line resources are too well-crafted then could this undermine the salience of the student and reduce student engagement in the individual learning space?

Methodology

The opportunity to introduce a flipped-classroom learning environment arose when the mathematics team at the University of Bolton was asked to deliver a foundation mathematics course to two groups of 31 and 30 students in the School of Engineering. During the first semester of the academic year 2016-17, eight, four to six-minute in-house videos were prepared by the author, and made available to the students on the university’s Virtual Learning Environment, Moodle, prior to the topic area being discussed in class. The content of the videos was informed by the indicative module content, and predictions about the nature of student misconceptions.

A Panasonic SDR-S70 78x Zoom video camera and tripod was borrowed from the university’s Media Support Office, and videos were produced by simply standing the camera on a table and directing it onto a piece of A4 paper at table height. All videos were planned carefully before recording, the aim being to explain concepts ‘in a clear, concise, bite-sized chunk’ (Tucker, 2012). Some of the videos were produced using a blank piece of paper approach, for example, Video 4: Areas and Volumes (Appendix 1) while others featured pre-prepared pages, for example, Video 7: Circles and Lines (Appendix 2). The number of sheets of A4 paper allocated for each video was restricted to eight. The in-house videos were planned and notes were made of the intended content of each page. Recording was repeated if the author judged this to be necessary, that is, if the video contained a mathematical mistake, a visual learning aid was miss drawn or a verbal explanation was ambiguous or clumsy.

Video pages were categorised as: - ‘Unprepared’: written on only during the recording (Type 1) ‘Prepared’: completed prior to recording (Type 2) or ‘Both’: written on before and during the recording (Type 3). A simple measure of preparedness is therefore:

\[ 0 \times \text{Number of Type 1 pages} + 1 \times \text{Number of Type 2 pages} + \frac{1}{2} \times \text{Number of Type 3 pages} \]

That is, a video that scored 0 would consist of eight Type 1 unprepared pages.

The video files were downloaded from the camera onto a university laptop, given an mp4 extension and uploaded to Moodle. Students were notified that a new video was available by a post on the module forum linked to their inboxes.

Ethical approval was obtained for the research element of this work and completion of a questionnaire was to be taken as the giving of informed consent to participate. Twenty-six out of a possible thirty-one students, in one of the student groups, agreed to participate in the study, and gave their feedback using the twelve-item questionnaire (Appendix 3) during the last week of the first semester.

Selected links to videos and exercises on the MathTutor website (www.mathtutor.ac.uk) were posted on Moodle alongside the in-house videos, and again, students were notified that a new MathTutor video was available by a post on the module forum linked to their inboxes (Appendix 4).

A Moodle activity report was used to find the number of views for each in-house video and external flipped classroom resource.

RESULTS

Reports of student perceptions of the flipped classroom were mixed, in line with the findings of Bishop and Verleger (2013).

Most of the students (96%) considered that the flipped-classroom approach had the potential to be, and had been, helpful to their learning (questions 1 and 2). However, 50% felt that the content of the videos (question 8) had no
effect on their motivation to learn, while 69% of the students reported that the knowledge that videos were being prepared for the classes made them feel more motivated to learn (question 6).

More than half, 62%, of the students said that the knowledge that videos were being prepared for the classes had no effect on their likelihood of attending classes (question 7), two students reported that this made them less likely to attend and 31% reported an increased likelihood of attendance to the group learning space.

It seems that the videos did support the students' understanding of the concepts applied in the sessions (question 9); students reporting that the content was a little (8%), somewhat (31%), very (38%) or extremely helpful (23%) in this respect; and perhaps this explains why 96% of students considered that the flipped-classroom approach had been helpful to their learning.

The students' modal response to the question which of the following video titles do you recall viewing 'never', 'just once' or 'more than once' was 'just once' for every title. That is, students tended to view videos just one (question 3). However, 18% of the responses indicated that the videos were viewed 'more than once'.

Nearly half, 46%, of the students reported that they watched the videos mostly before the session (question 4), while 23% said that they saw it for the first time when it was played at the start of the session. More than half, 58%, of the students reported that they attempted the task suggested by the videos sometimes during and sometimes after the session (question 5); only 31% stating that they attempted the task before the session in line with the traditional flipped-classroom approach.

Thirteen out of twenty-six students wrote a response to the questions 10 and these comments were positive, for example, ‘being able to watch a subject being explained makes it a lot easier to understand, and unlike in class you are able to watch the tutorial numerous times until you fully understand it’ and ‘to the point, informative, accurate’. Sixteen out of twenty-six students wrote a response to the questions 12 and all, except one, of these comments was positive, for example, ‘I don't think it worked as not many people were viewing the videos’, compared to ‘I generally work better 1 to 1 so very helpful’ and ‘very good way of learning, it’s like extra help when revising at home’.

Research Question 1: In-person

A Moodle activity report provided the total number of views for each in-house video and external flipped-classroom resource. These data were plotted against the eight weekly topic titles (Figures 1 and 2). The results show that the in-house videos had a consistently higher number of views for all topics. The total number of views...
Figure 2: Views of external inline flipped resources.

Figure 3: Scatter-graph of number of in-house video views against number of pre-prepared sheets.
were 697 and 302 for the in-house and external resources respectively.

Research Question 2: Interactive

Students were asked to rank the four features of a maths flipped classroom video (question 11): 1 = most helpful to 4 = least helpful and the total rankings for each category are shown in Table 1. The features: voice that describes a drawing as it is being drawn, and voice that describes an equation as it is being written; were the most popular (with the lowest total rankings); suggesting that students preferred a lower level of preparedness (expression (1) above).

Table 1: Response to Question 11. Please rank these features of the videos by how they helped to you learning maths: 1 = most helpful, 4 = least helpful.

<table>
<thead>
<tr>
<th>Feature of a maths flipped classroom video</th>
<th>Total Rankings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice that describes a diagram drawn</td>
<td>59</td>
</tr>
<tr>
<td>Voice that describe an equation written earlier</td>
<td>53</td>
</tr>
<tr>
<td>Voice that describes a drawing as it is being drawn</td>
<td>47</td>
</tr>
<tr>
<td>Voice that describes an equation as it is being written</td>
<td>46</td>
</tr>
</tbody>
</table>

Further, the number of views for each in-house video was plotted against video preparedness (Figure 3) suggesting that there is a tendency for videos with a higher level of preparedness to be viewed less.

DISCUSSION

This paper has suggested that video lectures being produced by lecturers who are not personally known to students is a potential reason for them tending to prefer in-person lectures to video lectures. Further, a low number of pre-prepared pages in a video lecture (preparedness) has been identified as a trigger of student engagement in the flipped-classroom environment.

These findings are compatible with the fact that the external MathTutor videos were produced using no pre-prepared pages by a lecturer unknown to the foundation engineering students. The fact that the external videos were still viewed less frequently than the in-house emphasises the lecturer being personally known to the students, the ‘personal touch’ is the dominant factor.

The video-view comparison (Figures 1, Figure 2) suggest that external on-line flipped resources were engaged with less than short in-house videos (even those with a high level of preparedness). This statement has been interpreted as evidence to support the placing of Stage 1 before Stage 2 in Figure 4 ‘Three Stages of Student Engagement’. Further, the rankings in Table 1 suggest a student preference for lower levels of preparedness, and the scatterplot in Figure 3 supports this conclusion. In Figure 3 student engagement, as demonstrated through video views, tends to fall as the level of preparedness rises. In summary, these statements have been interpreted as evidence to support the placing of Stage 2 before Stage 3 in Figure 4.

The staged conceptual framework proposed here (Figure 4) represents one aspect of a student experience lived by one cohort of foundation engineering students at the University of Bolton ‘favoured by an online learning environment and
the reflexive profile of the student’ (Kahn et al., 2016).

‘Student engagement’ is the effort and commitment that students give to their learning. The National Survey of Student Engagement (2017) considers ways in which active and collaborative learning, the level of academic challenge, interaction between students and faculty, and a supportive campus environment all influence such engagement. Video-viewing statistics may serve as a rudimentary indicator of student engagement. Perhaps the video viewing figures, reported in this research, are a component part of student engagement embedded in one of more of the Academic Engagement Scale (AES), Intellectual Engagement Scale (IES), Online Engagement Scale (OES) and Beyond-class Engagement Scale (BES) of Krause and Coates (2008). It seems that viewing figures are to the individual learning space what attendance is to the group learning space. Video views may have been influenced by students’ need for support on a topic area, novelty value of the first video uploaded (183 views), and attendance at the group learning sessions, for example, if students did not attend a session then they may be more likely to view the video. A high number of views of an on-line learning resource nevertheless demonstrates engagement in the individual learning space, but the multi-dimensional nature of student engagement, (Krause and Coates, 2008; National Survey of Student Engagement, 2017) serves as a warning not to oversimplify the model.

Dewey (1938) proposed that education is a social process requiring interaction in a flexible environment that is not overly structured, with the individuals involved supporting the learning with their presence and perhaps it would be important to note how at ease, improvised or scripted these individuals are?

Reviewing, and reflecting on, Videos 4 and 7 (Appendix 1 and Appendix 2) suggests that Video 4: ‘Areas and Volumes’ was fluid and that the lecturer (the author) was at ease with the topic and the delivery of it, being given the opportunity to draw, which he enjoys. When viewing this video there is an impression that the lecturer could be making it up as he goes along. In contrast to this, Video 7; ‘Circles and Lines’ is less spontaneous perhaps because of its high number of prepared pages. It is as if the planning of this video forms a barrier between the lecturer and the student, that is, the lecturer is not communicating directly to the student through the medial, a third party: the video plan, is present. Video 7 seems like a close neighbour to the external flipped-classroom resource, because a lecturer, who is known to the students, has lost his ‘presence’, almost equivalent to becoming an unknown perpetrator. Video production time can be saved if diagrams are drawn and equations are written down, either fully or partly, before recording begins: a ‘play it safe’ strategy; but it is also a strategy that makes it possible to hide mistakes!

Perhaps the potential to make mistakes is associated with the ‘making of meaning’ in student’s minds; a subconscious realisation that risk taking is a prerequisite to deep learning. Could this ‘ad lib’ behaviour demonstrated in Video 4 ‘Areas and Volumes’ have even facilitated learner autonomy, a source of a motivation for the students to engage (Lam, 2015)?

Finally, if on-line resources are too well-crafted then could this undermine the personality of the lecturer as a creator, affect the student’s learning experience, suppress opportunities to express their salience, and consequently reduce their engagement in the individual learning space.

The three stages of student engagement proposed in this paper are, perhaps, intuitive. The model is, in part, supported by subjective opinion survey, that is Question 11 of the questionnaire; but also supported, perhaps more robustly, by the video view data (Figures 1 and 2) and video preparedness (Figure 3).

Perhaps the liberal-low-preparedness production of Video 4 promised students a context in which learning interactions could take place later in the classroom, and gave the author an opportunity to project himself socially and emotionally as a real person (Garrison et al., 2000).

It may seem that the paradigm shift in emphasis on the individual learning space has shifted the role of the teacher or lecturer to being also a part-time film producer/director necessarily perhaps in need of a ‘flipped professional development’ as they learn innovative approaches for their own teaching when viewing each other’s videos (Fulton, 2012).

CONCLUSION

It may seem that the paradigm shift in emphasis on the individual learning space has shifted the role of the teacher or lecturer to being also a part-time film producer/director necessarily perhaps in need of a ‘flipped professional development’ as they learn innovative approaches for their own teaching when viewing each other’s videos (Fulton, 2012).

REFERENCES


AUTHOR CONTRIBUTIONS
The author confirms being the sole contributor of this work and approved it for publication.

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CONFLICT OF INTEREST STATEMENT
The author declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

SUPPLEMENTARY MATERIAL
The Supplementary Material for this article can be found online.
Appendix 1: https://bit.ly/2QgYgRM
Appendix 2: https://bit.ly/2Py5KTF
Appendix 3: https://bit.ly/2D1ej2l
Appendix 4: https://bit.ly/2zuIHhp