Science & Justice xxx (xxxx) xxx

Contents lists available at ScienceDirect

Science & Justice

journal homepage: www.elsevier.com/locate/scijus

Just by being here, you aren't halfway there: Structured active learning and its integration in virtual learning environments and assessment

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ARTICLE INFO

Keywords:
Flipped learning
Gamification
Engagement
Participation
Assessment
Active learning

ABSTRACT

Flipped learning with the incorporation of certain elements of gamification aims to improve student engagement, motivation and attainment. In this study we present an analysis of two approaches used in consecutive years on two modules. A traditional flipped learning approach "standard learning" where material is released weekly online and there are supporting tutorials and an end of term assessment; and a "structured active learning" strategy where a more scaffolded approach is applied, requiring participation to progress. In this approach students' work on the virtual learning environment and in tutorials could be used to contribute towards their end of term assessment (no more than 10% of the module credit), connected to a learning outcome on the breadth or range of topics. Students received feedback in rubric form throughout the topic, to see their progression. It was found that for module 1, over 90% of the students had accessed the pre-released material by week 2 in the structured active learning approach while this level of engagement was only reached in week 5 using the standard approach. Participation in learning events was far better using the structured active learning approach when compared to the standard approach, for example rising from 40% to 78% in week 2. The second module, with a different cohort of students, followed similar trends with the active learning approach attracting higher levels of engagement and participation far earlier in the term. Following the increased engagement, the structured active learning approach was beneficial in assessment with improved grade profiles.

1. Introduction

Flipped learning is a tried and tested method of teaching and learning which has been described as where "students gain first exposure to new material outside of class, usually via reading or lecture videos, and then class time to do the harder work of assimilating that knowledge, perhaps through problem-solving, discussion or debates" [1]. Its adherents claim many advantages including student driven work pace [2], the promotion of active involvement and adoption of personal responsibility [3], and reduction in the perception of course difficulty [4].

Detractors, however, report active disengagement, and dislike of activities, amongst other things [5,6]. Flipped learning is usually manifested in the form of a set of resources, made available to students to be digested individually before a discussion, and student led interpretation of the materials facilitated by the teacher.

The negative impact of disengagement is well understood and has been reported extensively [7,8]. However, engagement is crucial to success! Many strategies have been reported such as pre-lesson worksheets [9], goal setting and reflection [10] and pre-class online activities linked to assessment [11]. Engagement itself has been the subject of much debate. As examples, Kahu and Nelson [12] suggested that engagement is understood as the interface between student and institutional factors, and Krause and Coates [13] focused exclusively on first year university students in Australia. For a review of the recent literature see Lo and Hew [14], in which the authors identified several challenges to be overcome; student related, teacher related and operational.

Gamification in flipped learning is one approach to increase engagement. The definition of gamification varies from place to place but can be captured as "… the selective incorporation of game elements into an interactive system without a fully-fledged game as the end product …" [15]. In general, it selects and incorporates some of the features and language of computer gaming as ways of motivating and engaging students in learning activities. These game elements have been listed many times in the literature (see Kapp [16] as an example) and are couched in the language of gaming typically the Dungeons and Dragons (D&D) genre. A selection of these is discussed by Huang, Hew and Lo

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https://doi.org/10.1016/j.scijus.2022.05.005
Received 31 January 2022; Received in revised form 13 May 2022; Accepted 31 May 2022
Available online 2 June 2022

Table 1
Feedback for individual active learning activities.

Decision / Grade	Example Feedback
Engaged	Engaged with a range of well articulated ideas. Considered different areas and/or added discussion points to other threads. Presented and engaged with group, preparation, discussion and articulation of points shows learning in this area.
Participated	Posted with some sensible ideas. Participated in tutorials and engaged with group work or pre-prepared solutions Engaged well but only in one session
No participation	No engagement / not yet started / below threshold

Table 2
Overall grading scheme and feedback for students at end of period.

Decision / Grade	Example Feedback
Excellent	An excellent grade in this component, you do not need to complete part B in the assessment.
Pass	A passing grade in this component, you do not need to complete part B in the assessment, but a solid performance there could improve your grade
Threshold Pass	A low, but passing, grade in this component, it would be beneficial to complete part B in the assessment, and could considerably improve your grade.
Below Threshold	You need to complete part B in the assessment.

[17] including; badges (to be won), leaderboards (for the competitive), levels (achievement and status), and progress trackers (feedback elements). Yildrim [18] used the same set of game elements in a flipped classroom setting and found that this proved more successful than a traditional flipped class strategy in terms of achievement and student attitude.

2. Approach to active learning and assessment

This study examines two modules in stages 2 and 3 of a four year BSc (Hons) degree, modules can be taken in a number of Applied Science subjects and are core for Forensic Sciences. The modules ran primarily using online material and synchronous online whole-class tutorials. In years 2020–21 a "standard learning" approach was used and for some topics in 2021–22 a structured "active learning" approach was applied. Modules are 20 SCQF (10 ECTS) credits, the structured active learning was applied to topics including regulation, quality management, physical and chemical evidence analysis and interpretation. For these topics there are approximately six teaching weeks before the relevant assessment. Student comments on the formats come from focus groups, individual interviews, and in-module surveys. Metrics are collected from the virtual learning environments, and aggregated where appropriate. The median class size was 24.

In the standard learning model, material is released weekly and assessment is at the end of term. Online lectures are divided into short components, usually videos of 5–15 min, with four to six released each week with supporting links, reading material and discussion points. Discussion points included specific questions related to the last lecture component, finding and commenting on an appropriate article, or discussing a scenario. Tutorials include group work on scenarios or application of understanding, similar to the flipped classroom approach [1]; discussion of pre-released set questions similar to a traditional tutorial; and journal clubs, where students worked in groups of two or three to present and discuss an article with the rest of the class. In the structured active learning model the material is very similar, but a more scaffolded approach is applied, requiring participation to progress. The emphasis is less on the delivery of information and more on the active use of the students' newfound knowledge. The students must watch the short lecture component to get to the discussion point and then answer the discussion point to get access to the next piece of material. Their work over these elements contributes a small component of their final module grade. A three grade approach for each activity was chosen, as shown in Table 1, whether this was contributing to discussion board or presenting an article in a journal club.

Marks were not awarded for attendance; the model is based on marks given for engagement and a reasonable attempt at set questions, collectively contributing to a small percentage of overall mark for the module, which has been demonstrated in a model in physics teaching [19]. A peri-hoc change included the addition of the phrase "below threshold" as well as "no engagement" where the student achieved no credit for a particular event or activity. This was related to work in a tutorial to clarify a short definition of active learning as, "doing something", compared to passive learning, "watching someone else do something". In other words, "Just by being here, you aren't halfway there". We found an intermediate grade was appropriate for journal club presentations, to adequately distinguish different student's performance. For repeat approaches or larger classes, a single grade of threshold engagement may be more appropriate to retain positive effects whilst reducing staff assessment burden. However, in most cases the pre-populated rubric comment was all that was needed for feedback on the structured active learning elements.

The module learning outcomes specify both depth and breadth of knowledge and understanding. To link to the final assessment, the structured active learning component was used to evidence the student's achievement of understanding a range of techniques, and contributed 7.5% to 10% of the final module grade. The bulk of the assessment was an in-depth analysis of a single or limited range of techniques (such as in the style of a laboratory report). An assessment rubric for the structured active learning component was open to the students throughout the topic to enable them to see their progress on the course, with five to seven elements over the topic. This covered a range of discussion boards, questions, tutorials and journal club activities. The final attainment was calculated as shown in Table 2, this was visible after the students had had a chance to conduct each element. The calculation of this was points based from the individual elements, the different elements had different weightings, with participation weighted 1 or 2 and full engagement 2 to 7. A threshold pass was equivalent to participation in each of the elements.

For the tutorial based work, some student comments suggested that participation in tutorials as part of active learning was unfair on more introverted students. Whilst crucial overall, presentation skills and oral communication are not directly assessed in these modules, students did not have to each present individually to the whole class. We provided small-group work for students to develop communication skills with less anxiety than presenting to the whole class and to more fully express themselves. In addition, and to also reflect the class size and ensure opportunities for all to engage if they wished, we provided discussion boards for these activities, opened after the event. As well as giving an opportunity to extend the discussion, these can also be used by students who were uncomfortable in speaking out to the whole class. Consideration can be given to additional signposting of these processes or alternative activities; however, this may be detrimental to group attendance and skills development overall, as it may inadvertently offer a rationale for disengagement. Whilst the development of communication skills over the whole degree course has always been integral, the structured active learning activities are also part of a separate initiative linking the student work to development of a portfolio of competencies, this is outwith the scope of this paper.

This structured active learning method has reduced assessment load for students, as they can use tutorial and Virtual Learning Environment (VLE) work as evidence of achieving learning outcomes, without this the final assessment would be bigger and broader. However, the option was

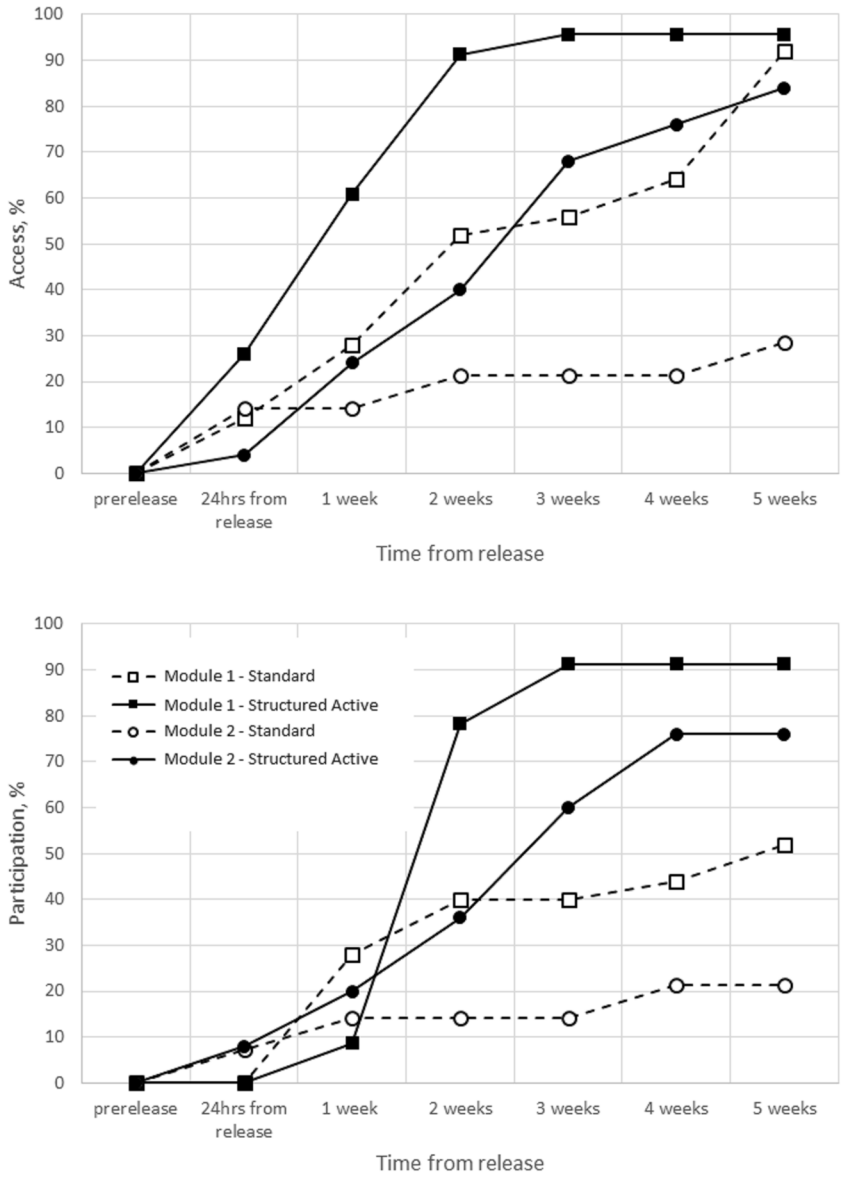

Fig. 1. Cumulative percentage of engagement with material from week 2 of the topic, as a function of time from material release. Showing (top) access to material and (bottom) participation in the technical discussion forum. Lines are a guide to the eye, solid lines and markers show structured active learning, dashed lines and open markers show standard learning data, marker shape indicates different modules.

retained to complete all of the assessment at the end of term (e.g. failing the active learning, or not adequately engaging), with an alternative assessment enabling the student to demonstrate achievement of learning outcomes at this point.

The active learning does allow students to work at their own pace, but does enforce an order, they are "required to complete one week's work before accessing the next". This is a new form of learning for these students. Students like the ability to use the pre-recorded material at their own pace, repeat videos, take notes and help them answer questions, this was a recurring theme in the focus groups and they asked for this to be continued in the future. Whilst not all students liked the structure or activities, as seen in previous studies [5,6], even students who said they didn't like the model highlighted that the work has "taught them a lot of information [they] didn't previously know". Some students felt that it was difficult to plan work when it needed to be unlocked, so were unsure how much was needed. We therefore provided enhanced information about content length at the beginning of each sub section, with number of videos, approximate times and question sets or activities expected. Appropriate signposting and clarity of expectations is beneficial.

3. Metrics

Overall for the structured active learning cohort, 52% of students achieved an "excellent" grade in the active learning, and therefore needed to complete no additional work relating to demonstrating a range of techniques/applications within the end-of-unit assessment. 15% were below threshold and a further 13% achieved a threshold pass; all submissions of the final assessment with these grades included an attempt at the additional work available to demonstrate this learning outcome. Of the students that achieved a "pass" grade, 10% attempted the additional work available to help improve their grade.

A few students had a final grade of 'non submission' for their end of unit assessment. All of these were below the threshold in the active learning component, giving an additional route to flag early for engagement, progression and retention of students.

In comparable assessments, 65% of the structured active learning cohort achieved A or B grades (equivalent to a "good" honours degree

level) with 4% below a grade C (a third class or below). 52% of the standard learning cohort achieved A or B grades and 22% below a grade C.

Fig. 1 shows the cumulative fraction of the class accessing the online material, and contributing to the discussion points, across the two modules. For both modules the active learning approach shows an increase in engagement with material and rapidity of engagement from point of release. For this topic in Module 2, there is a traditionally low level of engagement, with the delivery of this material after the students' exam-style assessment, to support coursework which is submitted after a vacation. The active learning approach has increased the proportion of students accessing the material from 29% to 84% and those contributing to the discussions from 21% to 76%. For module 1, the active learning cohort and standard learning had a similar overall proportion access the material (96% and 92% respectively). However, the speed of engagement is quicker with active learning, for example within two weeks post release 91% of the active learning cohort had accessed the material, compared to 52% of the standard approach cohort. Engagement with discussions at the same time point is increased from 40% to 78% with structured active learning. Whilst in general metrics may be affected by year-on-year variation and external factors, this is somewhat mitigated in this study, as a proportion of students taking the standard route on one module participated in the structured active learning approach in the other module, implying a material effect, rather than a cohort effect.

For the journal club style tutorials, participation was 31% for standard approach and 81% for the structured active learning. Students commented, "I really like the journal clubs. I think I've learned a lot from it … going into like doing a literature review now I'm less anxious… it was really interesting to see why people chose certain methods over others…[and] to explore other methods that we wouldn't necessarily get to do in the practical". However, the lower levels of engagement in journal clubs were highlighted by students on the standard learning route as being a barrier to effective learning and discussion. The structured active learning approach helps boost that engagement and enhance the learning opportunity, for the whole class, including the students who would have engaged without the additional scaffolding.

The structured active learning model does not introduce any additional work for students; without the active learning structure the possibility to do all the activities was available and significantly aided students in preparing for their assessment, but their performance in tutorials and in VLE activities would have no direct effect on their final assessment grade. Students engage more when work is in itself credit bearing [20]. Cvetkovic et al. [21] show feedback adds to motivation, regardless of gamification aspects. Yildrim [18] found gaming elements proved more successful than a traditional flipped class strategy in terms of achievement and student attitude. Hanus & Fox [22] discuss gamification elements such as pointification and keeping a visual display of progress to enhance motivation, however, the requirement to complete a level or Boss level to continue to the next level can act as a barrier to progression. Our structured active learning process is scaffolded, but not stratified. Students have to participate to progress, but don't have to meet any achievement levels until their final assessment. The approach has significantly boosted engagement and learning.

4. Conclusions

Two modules were delivered in a standard and active learning format in successive years. Active learning is an approach which requires the student to listen to/watch/read some material, and then do something with it, for example, apply their new knowledge to a scenario, find a relevant paper, or participate in a discussion. Performing the activity unlocks the subsequent material. They receive brief rubric-style feedback as they conduct the module, to see their own progression, and can use this activity as part of the final assessment. The structured active learning approach saw increases in access proportion, speed, and engagement, with one module the active learning approach has increased the proportion of students accessing the material from 28% to 84% and those contributing to the discussions from 21% to 76%. Overall the assessment performance is increased, with first and second class equivalents rising from 78% to 96%. The structure and link to assessment, promoting engagement with the activities and material, are the cause of the increase.

Ancillary

This work has been approved by the Abertay University research ethics committee approval number EMS4569.

CRediT authorship contribution statement

B.J. Jones: Conceptualization, Methodology, Investigation (active learning approach, student focus groups), Formal analysis, Visualization, Writing. **K. Sturrock:** Investigation (student focus groups), Writing.

Acknowledgements

Thanks to Dr Alan Greenwood, University of Coventry, for active engagement in quality assurance to enable this learning model and study to be conducted.

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