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Student Behavioural Engagement in Self-Paced Online Learning

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It remains a challenge in online settings to engage students as independent learners without teacher presence. This has led to increasing attention investigating the factors influencing student engagement in this context. As part of a PhD study, this paper investigates students' behavioural engagement with online learning modules without teacher supervision or peer support. The study examines three key constructs of behavioural engagement: student engagement with the task, effort level the student applies to task-completion and finally, following instructions. First, the findings suggest that student engagement was high in 'video' and 'feedback' sections as compared to 'simulation' activities. Second, students invested high effort in task-completion when the learning modules were delivered with instructional guidance. Finally, non-visual learners exhibit more difficulty following instructions in unsupported online settings. The results of this study will contribute to the burgeoning research field promoting the development of online modules that encourage participation of diverse learners.

Keywords: Self-paced learning, online learning, behavioural engagement

Introduction

Engagement is a construct used extensively in learning to explain a variety of behaviors that students display in the learning environment. Researchers have suggested that the meaning of student engagement is still broad and there is no concrete agreement on its meaning, definition, and measurement (Boekaerts, 2016; Harris, 2008; Parsons & Taylor, 2011). This study uses the Fredricks, Blumenfeld, and Paris (2004) theoretical framework that distinguishes student emotional, cognitive and behavioral engagement during the learning process. From these three engagement components, this study only discusses the aspects of student behavioral engagement, as it is the most common key construct in almost all definitions of engagement (Hospel, Galand, & Janosz, 2016).

Behavioral engagement is a construct with several meanings being proffered in different domains and educational settings (Hospel et al., 2016). Fredricks et al. (2004) to explain behavioral engagement as the student behavior on a learning task, which includes student persistence, effort, and their contribution towards their own learning. In recent studies, behavioral engagement is defined in terms of student participation, effort, attention, persistence and positive conduct towards the learning activity (Fredricks et al., 2016). Wang, Fredricks, Ye, Hofkens, and Linn (2016) define it within the context of a domain specific engagement in terms of asking and answering questions, participation, persistence or giving up easily and not to paying attention. Though the understanding of behavioral engagement is well developed and has been investigated in face-to-face contexts in many studies, student behaviors are found to be different in the online settings (Louwrens & Hartnett, 2015). This different behavior in online settings received less attention so far and our study investigates this conferred issue considering the absence of teacher and peer support. However, the nature of engagement in online learning does not differ noticeably from that delineated by key definitions of the construct as applied in traditional educational settings (Casimiro, 2015). Therefore, in online self-paced settings, this study does not differ from the constructs of behavioral engagement articulated by Fredricks et al. (2016). It measures student behavioral engagement in terms of time-on-task, student persistence in doing the allocated work and the level of effort the student invested toward the completion of the task. In addition, we consider student behavior in following the instructions when studying and engaging online (McGowan & Gunderson, 2010).

The Study Environment, Data collection and Data Analysis

The total number of participants in this study was 30; these participants were first-year science students from an Australian university. The online modules were designed to engage students for about 50-60 minutes. During the learning activities, students were required to interact with a range of visual media such as simulations, videos, animations and pictures to understand the given concepts. Interactive visual media, especially simulations were the centre of the learning activities. All the learning modules were developed, deployed and delivered as web contents. Students were invited to engage in the learning activity with a pre-setup computer in a study room. While the students were interacting with the online web content, their computer screen activity was monitored and recorded by the pre-installed software. Each student's computer screen activity was live casting so that the researcher was able to monitor the progress of the investigation, noting points for discussion. Once students finished the activity, the researcher conducted a stimulated recall interview using the recorded student activity as the stimulus (O'Brien, 1993).

The data derived from the recorded student activity, observational notes and interviews were examined and coded to find the patterns and relationships across the data sets. The findings were further interpreted with the focus on the construct of student behavioural engagement. In addition, some basic quantitative data analysis has been shown to support the findings whenever necessary.

Findings

In this study, we investigated student engagement based on the constructs of behavioral engagement with a focus on student engagement with the allocated work, the degree of effort to complete the task and following the instructions.

Engagement with the allocated work

Engagement with the allocated work refers to student time-on-task behavior. Students were required to engage by undertaking a number of activities in the module. To measure the level of engagement, whether it is 'High' or 'Satisfactory', a minimum time has been set for each activity. Students who engaged below the minimum threshold time set for 'satisfactory' were coded 'Low'. It should be noted however that 'High' engagement does not necessarily mean a deeper understanding of the concepts. In this study, the core activities required students to interact with the simulations to understand the concepts. In addition, students were required to understand the concepts demonstrated in the videos. These concepts, supported by pictures and text, were embedded in the activity. Finally, the students were required to answer concept check questions to demonstrate their understanding. At the end of the submission of their responses, students were given the opportunity to clarify their answer from the immediate online feedback provided. The following *figure 1* illustrates the percentage of student engagement across the different sections of the online module.

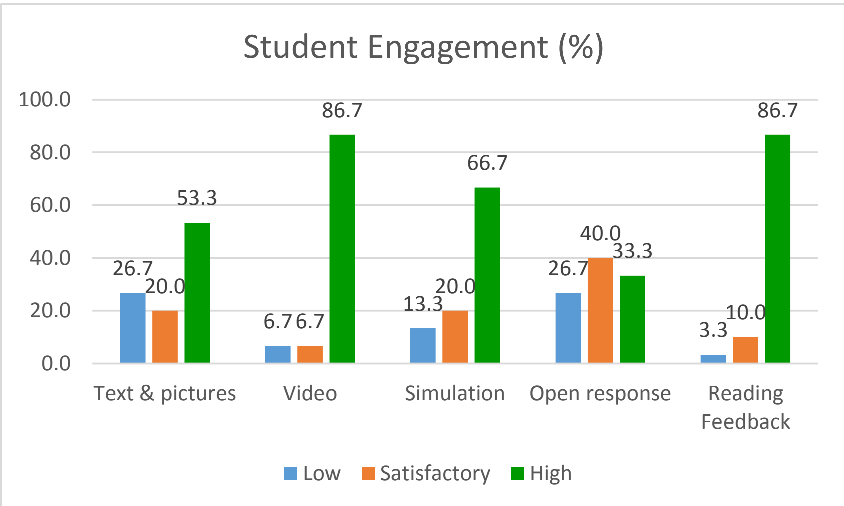

Figure 1: Student engagement across different visual media and events during the online module

Student engagement was found to be *high* on the *video* activities and *reading the feedback* of their responses compared to the core simulation activities. Student revealed several reasons for the higher engagement with the video compared to simulations in the interviews. Some of the key reasons that were identified from the student interviews include the simplicity of the video content by focusing only on a specific concept; it took less time and did not speak about a volume of information; and the video talked about real life misconceptions but it did not require students to give input or expect interaction with the content.

Feedback on different activities is another section where student demonstrated high engagement. They found this feature to be very useful for learning. For example, from the feedback when students realized their presumed understanding was incorrect; they re-visited the simulation model and re-explored the concepts. It assisted them to further enhance understanding of what was happening at the molecular level. According to one student-

> "When I got it wrong, I went up again (to the simulation). And then I cooled it down. OK, now I understand how the intermolecular bonds like just expand and contract." [htsem104]

Figure 1 above also revealed that where an answer to an open response question was expected, this type of response proved to be the least engaging requirement in the modules. The result suggests that, because an open response required student input where an explanation of their understanding, or a possible explanation of the problems in the given text box, was required, this created a cognitive workload (and perhaps overload), demanding physical effort of students as well requiring them to provide written, explanatory input. Similarly, in the case of concept check questions, the student also needed to provide a written explanation of their understanding. Overall, the demands of the open-response format impacted on the level of student engagement. On the other hand, the feedback sections, where the misconceptions and clarification student answers were given, elicited high engagement.

The degree of effort students put to complete the task

Student degree of effort was investigated in different instructional conditions by varying the level of teacher guidance. The *systematic investigation* of student *persistence* has been pursued to understand the degree of student effort while undertaking the task activity (Fredricks et al., 2016; Wang et al., 2016). In this study, student *persistence* refers to the continuation of exploring the simulation for a prolonged time even when the consequence of this exploration does not contribute significantly to the learning of a concept. Sometimes a student wants to explore all features and functionalities of the simulation in spite of having difficulties in understanding how these contribute towards learning the concepts. However, this exploration might not involve a systematic or organized study of the concepts. Student persistence was coded as 'High' or 'Low' depending on their attempt to explore all the functionalities of the simulation irrespective of their understanding of the concept. On the other hand, systematic investigation refers to the structured exploration of the concepts, that is, student attempts to understand a particular concept by exploring it in detail. This type of exploration might engage a student for a prolonged period in endeavouring to understand a specific concept. This concentrated focus appeared to relate to a student forfeiting the opportunity to explore the other possible activities pertaining to the simulation. Student behaviour was coded as 'High' or 'Low' depending on their attempt to understand a specific concept in an organized exploratory way.

To explore and understand the student persistence and effort towards the task, a simulation activity was studied. The simulation 'States of Matter: Basics' was taken from the PhET Interactive Simulations project developed by the University of Colorado Boulder (PhET, 2016). This simulation comprises multiple concepts with multiple variables that the student can manipulate. Students might, for example, be involved in an organised effort to explore the concepts without demonstrating persistence throughout the activity. Students' behaviour was considered 'High' when they demonstrated at least one systematic investigation to understand a concept. The simulation activities were provided to students in different instructional settings. Students were randomly assigned to each activity. The following tables reveal how much effort students put towards the systematic investigation and how persistent they were in undertaking the activity.

Table 1: Student effort level towards the simulation activity

Simulation name	Student ID	Persistence	Systematic Investigation	Overall Effort Level	Types of guidance (Adams, Paulson, and Wieman (2008))
States of Matter Basics (PhET) This is a multi-concepts simulation	Student 1	Low	High (1 concept)	Low	Open Exploration (No guidance)
	Student 2	Low	Low	Low	
	Student 3	Low	High (1 Concept)	Low	
	Student 4	Low	Low	Low	
	Student 5	Low	High (2 concepts)	Moderate	
	Student 6	Low	Low	Low	
	Student 7	Low	High (2 concepts)	Moderate	
	Student 8	High	High (2 concepts)	High	Moderately Guided: Initial instruction to lead open exploration and then some guidance in the form of questions
	Student 9	Low	High (1 concept)	Low	
	Student 10	High	High (1 concept)	High	
	Student 11	High	High (More than 2 concepts)	High	
	Student 12	High	High (More than 2 concepts)	High	
	Student 13	Low	High (1 concept)	Low	
	Student 14	High	High (All concepts)	High	Strongly Guided: Instructions have been provided to investigate four specific concepts.
	Student 15	High	High (All concepts)	High	
	Student 16	Low	High (2 concepts)	Moderate	
	Student 17	High	High (All concepts)	High	

The data from *Table 1* illustrates that the degree of effort is 'High' when the activity is either moderately or strongly guided. In a self-paced environment, an open exploration does not offer any stimulus for students to invest high effort in completing the interactive activity.

Following the instructions

Instructions embedded in the online module are vital components for students to attend to and follow if they are to become successful learners in the self-paced learning context. As there was no teacher supervision, instructions helped to guide students interacting with the learning module. They directed students' involvement in productive activity and helped them to regulate their thinking to learn systematically. Due to the varied capacities of students and their diverse learning needs, it was a challenge to deliver a structured online learning module that could provide the best learning requirements for each individual. In this section, each student's behavioral perspective of following the instructions has been studied under two broad categories of students, namely visual and non-visual learner. The students were classified as visual and non-visual based on their own self-assessment; this was also supported by observing their performance in the learning module. Students were asked in the interview to give their opinions and preferences on different instructional settings. The difficulties in following the instruction was measured from the observation. Table 2 below summarizes the student's behavioral approach in following the instructions.

Table 2: Student behavioral approach towards the instruction

Behavioral construct	Visual learners (21 students)	Non-Visual learners (9 students)
Instructional preference (multiple preferences are considered)	Forms of instruction: -Prefer initial instructions and then open exploration: 19% of the students -Step by Step Instructions/ prefer instructions throughout: 5% of the students -Prefer instruction on important things/ prefer specific instruction on what to learn from each activity (Not throughout): 33% of the students -Prefer open exploration (No instruction or less instruction): 14 % of the students -Prefer combination of instruction and independent learning: 33% of the students Medium of instructions: Prefer visual instruction to textual instruction: 5% of the students	Forms of instruction: -Prefer initial instructions and then open exploration: 11% of the students -Step by Step Instructions/ prefer instructions throughout: 22% of the students -Prefer instruction on important things/ Prefer specific instruction on what to learn from each activity (Not throughout): 56% of the students -Prefer open exploration (No instruction or less instruction): 0% of the students -Prefer combination of instruction and independent learning: 11% of the students Medium of instructions: Prefer voice instructions (Audio instruction): 11% of the students
Difficulties in following instructions	Difficulties in following instructions: 24% of the students	Difficulties in following instructions: 44% of the students

The above table shows that the most of the visual learners did not want either step-by-step instructions or the open exploration. In fact, the least percentages of visual learners wanted step-by-step instructions. The other perspective of this finding suggests that most of the visual learners indicated that they wanted some sort of instructions, and only a few (14% of students) wanted an open exploration with no instruction or less instruction. On the contrary, all the non-visual learners want some sort of instruction. In following the instructions, the majority of the visual learners did not reveal any difficulties. In contrast, a significant number of the non-visual learners experienced difficulties following the instructions.

Discussion

High student engagement with the video in contrast to the simulation suggested that the video format provided a less cognitive load in the learning process as students were not required to interact with the video during the learning process. The video provided less information to process during learning. Nor were students required to give input thus allowing students to become passive learners in the learning process. In contrast, learning with the simulations required active participation. Students need to invest initial time to explore the simulation environment before engaging with the concepts. Therefore, students found the simulation activity much more demanding than viewing the video. Another dimension of student high engagement with the video was that it created student interest by generating cognitive conflict. All the videos in the module began by addressing misconceptions commonly held by learners. This piqued student interest and helped them to engage in clarifying their misconceptions. In the simulation format, the elements that created cognitive conflict were provided before starting the simulation activity in the form of questions. Questions were posed that addressed misconceptions. Students needed to investigate the simulation to clear up their misconceptions. The entire process of investigating and learning from the simulations was found to be less engaging than the videos.

Student task effort increased when instructions and guidance were provided. During the open exploration, no student demonstrated high effort level. This behaviour was supported by the student statement of preferences for different forms of instruction. The majority of the students wanted some sort of guidance in doing the tasks. Therefore, student effort level towards the task was affected when no instruction or guidance was provided. The challenge that remains a challenge is that many students still found it difficult to follow instructions even in their preferable instructional settings. Especially the non-visual learners face greater difficulties in following the instructions. This opens another dimension of research to investigate, that is, the expert vs novice learner performance in online settings and is the key focus of one author's PhD thesis.

Conclusion

A possible drawback of providing heavily guided instructions is that it will lessen the independence of student learning. The main purpose of providing a self-paced learning environment is to make the student an independent learner. Therefore, a balance between personalized instruction and open learning is always preferable when appropriate scaffolding techniques are provided in both formats. In addition, the online content needs to be developed in consideration of the competency level of diverse learners. Both the visual and non-visual learners exhibit differences in their learning preferences. This points to the importance of providing a variety of ways for students to address learning when using online learning resources.

References

Adams, W., Paulson, A., & Wieman, C. (2008). *What levels of guidance promote engaged exploration with interactive simulations?* Paper presented at the AIP Conference Proceedings.

Boekaerts, M. (2016). Engagement as an inherent aspect of the learning process. *Learning and Instruction, 43*, 76-83. doi: http://dx.doi.org/10.1016/j.learninstruc.2016.02.001

Casimiro, L. (2015). *Engagement-for-Achievement: Creating a Model for Online Student Engagement*. Paper presented at the EdMedia: World Conference on Educational Media and Technology 2015, Montreal, Quebec, Canada. https://www.learntechlib.org/p/151597

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School Engagement: Potential of the Concept, State of the Evidence. *Review of Educational Research, 74*(1), 59-109. doi: 10.3102/00346543074001059

Fredricks, J. A., Wang, M.-T., Schall Linn, J., Hofkens, T. L., Sung, H., Parr, A., & Allerton, J. (2016). Using qualitative methods to develop a survey measure of math and science engagement. *Learning and Instruction, 43*, 5-15. doi: http://dx.doi.org/10.1016/j.learninstruc.2016.01.009

Harris, L. R. (2008). A phenomenographic investigation of teacher conceptions of student engagement in learning. *The Australian Educational Researcher, 35*(1), 57-79. doi: 10.1007/bf03216875

Henrie, C. R., Halverson, L. R., & Graham, C. R. (2015). Measuring student engagement in technology-mediated learning: A review. *Computers & Education, 90*, 36-53. doi: http://dx.doi.org/10.1016/j.compedu.2015.09.005

Hospel, V., Galand, B., & Janosz, M. (2016). Multidimensionality of behavioural engagement: Empirical support and implications. *International Journal of Educational Research, 77*, 37-49. doi: http://dx.doi.org/10.1016/j.ijer.2016.02.007

Louwrens, N., & Hartnett, M. (2015). Student and teacher perceptions of online student engagement in an online middle school. *Journal of Open, Flexible and Distance Learning, 19*(1), 27.

McGowan, H. M., & Gunderson, B. K. (2010). A Randomized Experiment Exploring How Certain Features of Clicker Use Effect Undergraduate Students' Engagement and Learning in Statistics. *Technology Innovations in Statistics Education, 4*(1). https://doi.org/10.5070/T541000042

O'Brien, J. (1993). Action research through stimulated recall. *Research in Science Education, 23*(1), 214-221. doi: 10.1007/BF02357063

Parsons, J., & Taylor, L. (Cartographer). (2011). Student Engagement: What do we know and what should we do? Retrieved from http://docplayer.net/237109-Student-engagement-what-do-we-know-and-what-should-we-do.html

PhET. (2016). States of Matter: Basics. *PhET interactive simulations.* Retrieved July, 2016, from https://phet.colorado.edu/en/simulation/states-of-matter-basics

Wang, M.-T., Fredricks, J. A., Ye, F., Hofkens, T. L., & Linn, J. S. (2016). The Math and Science Engagement Scales: Scale development, validation, and psychometric properties. *Learning and Instruction, 43*, 16-26. doi: http://dx.doi.org/10.1016/j.learninstruc.2016.01.008

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