Developing Personalized Nudges to Improve Quality of Comments in Active Video Watching

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Abstract: AVW-Space is an online video-based learning platform which aims to improve engagement by providing a note-taking environment and personalized support. This paper presents a PhD project focusing on the nudges about the quality of comments learners make on the videos in AVW-Space. We first automated the quality assessment of comments using machine learning approaches. Based on the predicted quality of the comments and the learners' profiles, we developed nudges which encourage students to write better comments. Finally, we conducted a study in a first-year engineering course to analyze the learning effects of these nudges. This PhD research contributes to the development of personalized educational support for engagement in video-based learning via fostering better comment writing behavior.
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1. Introduction

Video-based learning (VBL) has been a popular method in e-learning. Videos combine text, visual aids and sound to simplify complicated concepts for learners. Educational videos allow students to learn at their own pace and anywhere (Gilboy, et al., 2015). VBL is used in formal education, such as flipped classrooms, blended learning and Massive Open Online Courses (MOOCs), or for informal learning such as YouTube. However, VBL can be a passive form of learning since it lacks direct interaction between students and teachers (Yousef et al., 2014). Another challenge for VBL is supporting different types of learners (Chatti et al., 2016). There have been several approaches to providing personalized support for engagement in VBL, such as embedding annotation tools, forums and visual learning analytics (Chatti et al., 2016; Giannakos et al., 2016).

AVW-Space (Mitrovic et al., 2016; 2017) is an online VBL platform developed at the University of Canterbury. This platform aims at increasing engagement in VBL by a variety of approaches such as providing a note-taking environment, micro-scaffolds (aspects), reviewing notes and intelligent and personalized prompts (Dimitrova et al., 2017; Mitrovic et al., 2019). In AVW-Space, the teacher firstly selects instructional videos from YouTube. Then, the teacher should define some aspects as mini-scaffolds to direct the attention of students to the key concepts or to encourage students to reflect on their relevant experience or knowledge. Learning happens in two main phases in AVW-Space: Personal Space and Social Space.

In Personal Space, the learner can watch a video and pause it to write a comment. The learner must use one of the aspects defined by the teacher as a tag for the comment. Integrating a video annotation tool with VBL systems is a method to increase students' engagement (Aubert et al., 2014). Previous studies on AVW-Space show that commenting causes deeper thinking and reflection (Mitrovic et al., 2017; 2019). The analysis of learners' reflections has been an area of research which aims at gaining insights on learners' engagement and their educational characteristics (Hoppe et al., 2016; Joksimović et al., 2018; Taskin et al., 2019). The knowledge extracted from the analysis of comments can help in developing pedagogical support for fostering engagement in different types of learners. AVW-Space has some simple nudges as personalized interventions in Personal Space to develop active learning behaviors. However, these nudges are only for writing a comment on videos and using various aspects (Mitrovic et al., 2019).

In the second phase, the teacher chooses the comments to be shown in Social Space anonymously. Students read and rate the comments made by their classmates using the rating options defined by the teacher. The rating activity improves learning by sharing learners' understanding. However, rating comments could be a frustrating task since the list of comments to rate includes many poor-quality comments. Thus, encouraging the students to write high-quality comments could make reviewing task more useful for the students (Mitrovic et al., 2017).

The goal of AVW-Space is to foster the essential metacognitive skills for effective learning such as self-explanation, self-reflection and self-regulation (Bannert et al., 2008). One of the early studies with AVW-Space showed that aspects scaffold engagement and reflection (Mitrovic et al., 2016). The rating options provided in Social Space also trigger reflective thinking (Mitrovic et al., 2017). Therefore, it is beneficial to provide more adaptive and direct support for self-reflection via nudges. There have been several computer-based learning environments which provide prompts to support meta-cognitive skills (Bannert et al., 2013; Daumiller et al., 2018). However, AVW-Space has no explicit nudges for fostering meta-cognitive skills in comment writing.

The main objective of this research is to develop a pedagogical intervention in AVW-Space to increase learning and engagement by improving the quality of comments. The initial nudges for commenting and using various aspects have previously been used successfully in AVW-Space to foster commenting behavior (Mitrovic et al., 2019). Thus, This research focuses on designing nudges which provoke deeper thinking and reflection in students while commenting. The following research questions should be addressed to achieve this goal:

1. How reliably can a quality scheme be used for assessing the quality of comments by human coders or machine learning models?
2. How can we design and develop personalized nudges to improve the quality of comments?
3. Do the nudges for improving comments quality increase learning effectiveness?
4. Can these nudges and quality assessment approach be applied to other types of skills in AVW-Space?

2. Methodology

In this project, we use data collected from the previous studies with AVW-Space (Mitrovic et al., 2016; 2017; 2019) where the students used AVW-Space as an online resource for training on giving oral presentations. All previous studies used the same videos: four tutorials on giving presentations, and four examples of real presentations. The data collected from the studies include comments made by students, their ratings and the profiles of the students who used AVW-Space. The learner profiles were gathered via surveys questions on demographics, background experience in giving presentations, and the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1990). After using AVW-Space, students were asked to answer a post-study survey that included questions about giving presentations again to investigate whether students have learnt the new skill. The students were also given two other surveys: 1) NASA-TLX (Hart, 2006) to analyze the cognitive load and 2) Technology Acceptance Model (TAM) (Davis, 1989) to assess usefulness perception after using the platform.

To design nudges for improving the quality of comments, we first developed a quality assessment model. As a basis for this model, we proposed one quality scheme for comments on tutorial videos and another one for example videos. The scheme for tutorial videos classifies comments into five categories: 1) affirmative, negative or off-topic, 2) repeating, 3) critical and analytical, 4) self-reflective and 5) self-regulating comments. However, the scheme for comments on example videos only includes three categories: 1) affirmative, negative or off-topic, 2) repeating and 3) critical and analytical. After evaluating these schemes, statistical analysis and machine learning approaches were applied to drive insights from comments in different categories and automate the quality assessment of comments using a cost-sensitive random forest model (Mohammadhassan et al., 2020).

After analyzing the correlations between the student profiles and the quality of their comments, we designed a set of nudges to encourage students to improve the quality of comments. The design of the nudges follows the choice architecture-driven framework, where the nudges are in the form of a game dialogue: N=<G, P, T, O> (Dimitrova et al., 2017). In this game dialogue, G defines the pedagogical goal of the nudge, P represents the conditions where the nudge should be given to the student, T is the text template of the nudge, and O is the expected behavior change after receiving the nudge. The P element evaluates the student profile, a history of nudges given to the student for the current video, the quality of comments made by the student on the current video and the video status. We designed seven new nudges for tutorial videos, and three new nudges for example videos. These nudges guide students towards critical-thinking and self-reflection. For example, if a student writes a short affirmative comment like “This is helpful”, the student will receive an immediate nudge for elaborating more on the video content. If a student often writes comments which merely repeat the video content, a nudge will be given to ask the student to think about the advantages, disadvantages, causes and effects. At the end of the videos, a nudge will be given to students who have not made any self-reflective comment on the video, asking students to relate their previous experience to what they have learnt from the video and plan how they can improve their skills in future.

To assess the effects of the new nudges on learning and engagement, we conducted a study with students enrolled in a first-year engineering course at the University of Canterbury, similar to the previous studies. All of the students used the same version of AVW-Space, which included the new nudges. We followed the ICAP framework (Chi et al., 2014) for characterizing students’ engagement. ICAP framework classifies learners’ overt behavior into four types: Interactive, Constructive, Active and Passive. Passive learners only receive information by watching videos. Active students perform additional actions like commenting, but their comments usually repeat the received information. Constructive learners add new information that was not explicitly taught, such as writing about their reflection on the video or their previous experience as well as their future plans for improvements.

We found that the students who made high-quality comments improved their conceptual knowledge significantly between pre- and post-test. A causal analysis indicates that only high-level comments contribute to the increase in knowledge. The comparison of the data from this study with previous studies showed that the new nudges increased the number of constructive students. Also, students made more comments in this study than in the previous studies. To investigate the differences in student characteristics and behaviors, we analyzed the students’ profiles for the different categories of students (their MLSQ scores, the number of videos they watched, the time spent in the system and the average interval between comments they made). This analysis showed that the constructive and active students spent more time watching videos and made comments in shorter intervals. However, there was no significant difference in the MSLQ scores. We also reviewed the feedback from students on the system to extract opportunities for improving the nudges and the system in future. The students found the nudges helpful in guiding their thoughts and reflections more than in previous studies. However, some students wanted to customize the frequency of nudges. Other students would like to see their progress in AVW-Space and review the nudges they received later. We analyzed the activities that students had in the whole study to mine constructive behaviors. We found constructive students pause and play the videos more often than other students. Also, most students write comments only when they receive a nudge, whereas constructive students show more initiative and write comments without waiting for a nudge.

3. Future Research

We plan to enhance AVW-Space in accordance to the student feedback from the study we conducted. We will then re-evaluate it in the second study with the same experimental design. These improvements could include adding an open learner model to the system and improving the nudges to make them easier to understand. Finally, we will investigate the generalizability of our approach by implementing it in different types of courses using AVW-Space. We have identified three main challenges of generalizing nudges to other domains so far. Firstly, we need an approach that could extract the domain vocabulary of the course. Secondly, the quality prediction model might need to be improved to capture different domains. Thirdly, we need to investigate whether the current nudges are applicable and useful for other topics. We will try to address these main challenges in the further work of this project.

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