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Supporting Interactive Learning in Active Video Watching

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Abstract: The potential of Active Video Watching (AVW) to train soft skills is evident. Despite considerable achievements in learning via AVW, the capacity of interactive learning has yet to be explored. This PhD research aims to investigate and support interactive learning in AVW via (a) interaction among learners, and (b) intelligent and adaptive interaction between the system and learners (comment recommendations). To this end, I initially provided learners with the possibility of responding to other learners' comments on videos and calling attention to them by Like/Dislike rating mechanism. In the second phase, a comment recommendation engine will be developed, based on the learner model and a specific-domain ontology with respect to the target soft skill. I will also augment comment recommendations with verbal and visual explanations to increase transparency of the recommendations in hope of enhancing learners' engagement, interactions, and learning.

Keywords: Active video watching, interactive learning, recommender system, ontology

1. Introduction and Literature Review

Video-Based Learning (VBL) is increasingly used in informal training as well as in formal settings (Yousef et al., 2014). Learning through video watching has multiple advantages, such as providing flexible, self-controlled learning opportunities, and raising learners' motivation (Chatti et al., 2016; Sablić et al., 2021). It can also pave the way for learning transferable skills (Anthony & Garner, 2016; Mitrovic et al., 2016). However, merely viewing videos is a passive activity that leads to limited engagement and shallow learning (Chi & Wylie, 2014). Another issue with most VBL systems is that they treat all learners the same way, while it would be more beneficial for learners if they could be adaptive and apply appropriate methods, such as collaborative learning, micro-teaching, and student-centered learning, tailored for diverse learners (Yousef et al., 2014).

According to the ICAP framework (Chi & Wylie, 2014), learners' behaviors are classified into four types of learning modes: *Interactive*, *Constructive*, *Active* and *Passive* based on their overt behaviours. In this classification, the learning effectiveness is reduced in the following order: *Interactive*> *Constructive*> *Active* > *Passive*. To learn effectively from videos, learners need to engage with video content. This is possible by incorporating some activities with video, called Active Video Watching (AVW). Numerous studies have been recently conducted to investigate the significance of and improvements in AVW (Dimitrova & Mitrovic, 2022; Gostomski et al., 2019; Mitrovic et al., 2016; Mitrovic et al., 2019; Mohammadhassan et al., 2022; Piotrkowicz et al., 2018).

AVW-Space, as a notable example of AVW platforms, provides a wide range of supports for learners' engagement including commenting on videos, visualization of learners' activities, reviewing and rating comments, proposing micro-scaffolds or aspects, and embedding intelligent nudges to prompt learners to exhibit constructive behaviors, like writing high-quality comments (Dimitrova et al., 2017; Mitrovic et al., 2017; Mitrovic et al., 2016; Mitrovic et al., 2019). However, interactive behaviours like direct interactions among learners have not been employed in AVW. As interactive mode of learning has a great learning effectiveness in general (Chi & Wylie, 2014), the purpose of this research is to investigate and support it in AVW, as described in more detail in the following section.

2. Project Details and Methodologies

This PhD project aims to cover both aspects of interactions - human-human and human-computer - in AVW. The research question for the first study is as follows.

- **RQ1:** What are the effects of using an interactive form of comment reviewing/rating on learners' engagement and learning in AVW?

To answer this question, I provided learners with an interactive activity of replying to peers' comments in AVW-Space (a platform that implements AVW) so that they could discuss their views. This way, learners can share their views on video content, see opinions and reflections of their peers, and ultimately contribute to *social learning* (the philosophy that people can learn from each other through observation, imitation and modeling (Bandura & Walters, 1977)). To provide direct interaction between students, I implemented a reviewing/rating approach in which students could Like/Dislike comments, but also respond to comments as well as previously written responses in two nested levels (level 1: respond to comment, level 2: respond to response), as shown in Figure 1.

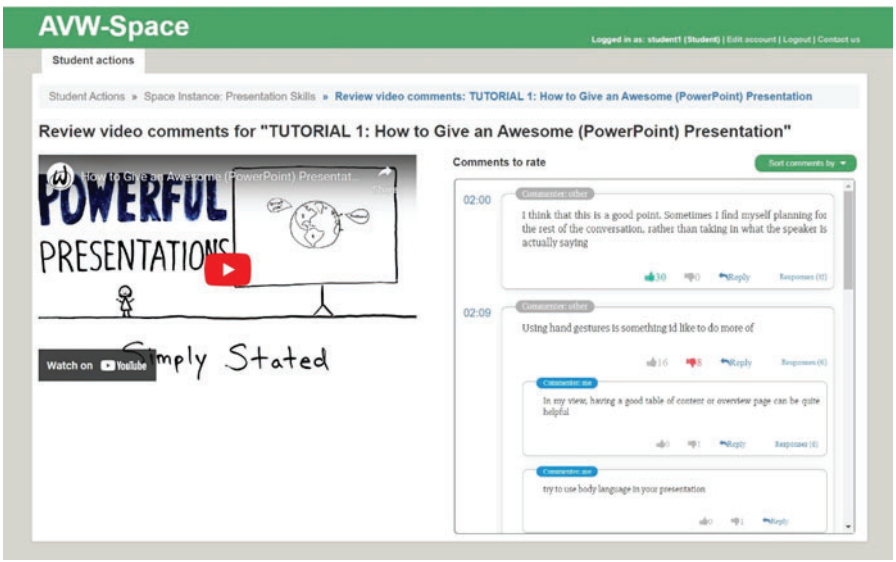

Figure 1. A screenshot from reviewing comments in AVW-Space

In former instantiations of AVW-Space, as for rating comments, choices were limited to pre-defined rating categories and learners were only able to choose the closest one to their thoughts. They were unable to express their views directly. Instead, I added a Like/Dislike rating and the possibility of expressing their views through responding to comments. The number of Likes and Dislikes can imply the majority opinion about proposed ideas. I employed this numerable rating mechanism for both comments and responses to let individuals engage with and feel encouraged to contribute to one another's perspectives. Learners can raise positive and negative points about existing comments, which will bring about separate consequences in discussion (Norris et al., 2010), i.e., negative feedback has a stronger impact than positive feedback on attention, perception, and motivation (Norris, 2021).

Furthermore, learners in previous studies (Mohammadhassan & Mitrovic, 2022a, 2022b) reported that they were given a large number of comments to rate, which are time-consuming and overwhelming to review. All learners received the same list of comments, some of them repetitive or uninformative. These issues indicate that the review phase in AVW is not adaptive to diverse learners. Hence, the main objective of my second study is to develop a new component that can offer adaptive comment recommendations. I aim to design an ontology-based learner model and leverage a comment recommendation engine to cover adaptively the areas of weakness of a given learner. With that in mind, the following research question was formulated:

- **RQ2:** Is there a causal effect of recommending relevant comments on learners' engagement and learning?

To implement a recommender engine, it is necessary to assess learners' knowledge. I will create a learner model based on a comprehensive domain-specific ontology, as employing ontology facilitates content recommendation and navigational sequencing in learner model (Mitrovic et al., 2007; Vesin et al., 2013). Hence, I will initially create an ontology for a soft skill (e.g., empathy skills). Along with the ontology, I will utilize a classifier like Bayesian Classifier (BC) to generate and update the learner model, as BC is highly effective in text categorization (Go et al., 2009; Pedregosa et al., 2011). Before watching videos, the classifier will receive the learner's responses on a survey. Then, it will receive information about the activities the learner performs, such as commenting on videos, responding to/rating comments or responses. Recommendations of comments will be made to cover learners' areas of weakness (the concepts they have not yet written about, or those for which learners have written only low-quality comments). The learner model will be updated when the learner writes a response to or rates a comment.

The transparency of recommendations (or expressing the rationale behind the recommendations) plays a crucial role in individuals' trust and satisfaction (Barria-Pineda et al., 2021; Kulesza et al., 2013). Therefore, in the third study, I aim to investigate the effects of leveraging explainable comment recommendations on learners' engagement and learning outcomes. Hence, the third research question is:

- **RQ3:** Do explanations of comment recommendations give rise to more engagement, interactions and learning among learners?

Two forms of explanations (verbal and visual) will be provided. I will employ the learner model to foster these two forms of explanations. Explanations reveal the reason(s) why a comment is recommended to the learner. According to the learner model, the areas of weakness will initially be identified, and then a personalized list of comments along with reasons (explanations) will be created. The system will generate short paragraphs for each unit of verbal explanation indicating the target concept and the reason for recommending a given comment. Visual explanations correspond to the main concepts in the ontology. The number of visual elements is the same as the number of concepts of ontology that the learner has not learned. Each recommended comment will be accompanied by these visual explanations (labeled to these parts of ontology) shown with varying intensity of colours according to the number of relevant phrases included in the comment.

All aforementioned approaches will be implemented in AVW-Space and tested in several experiments on different soft skills and learner groups, including university students and ICT professionals, to evaluate the generalizability of my research. Each experiment will contain two phases. Initially, learners will complete Survey 1, consisting of questions on demographic, training, and experiences with a target soft skill, as well as a knowledge test. Then, they can watch and comment on videos in AVW-Space. A number of comments will be selected manually to be shown (in study 1) or recommended by the system (in studies 2 & 3) for learners to review, rate, and respond to. At the end, learners will complete Survey 2, containing a knowledge test plus some open-ended questions about the usefulness of our approaches and modifications.

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