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Enhancing Social Learning in Active Video Watching

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Abstract: To learn effectively by watching videos, learners need to engage actively with video content. Writing comments on videos (also known as video annotation) is a common way of engagement in Active Video Watching (AVW). Reviewing comments on videos written by peers, as a form of social learning, has also been shown to increase learning. In this paper, we extended social learning in AVW by enabling learners to respond to comments written by their peers (rather than just reviewing peer comments) and replacing a categorical comment rating design with a numerable binary one. We investigated the impact of using such a form of comment reviewing on learning, engagement, and students' perceptions. The findings show that our intervention results in increased learning, engagement and student satisfaction compared to the situation when students could not respond to comments.

Keywords: Active Video Watching, Social Learning, Comment Rating

1. Introduction

Educational videos, particularly in the past two decades, have been widely used in e-learning, including visual and auditory learning, flexibility and accessibility, personalization, and self-paced learning (Kuhlmann et al., 2023). Video-Based Learning (VBL) systems utilize video as a primary medium for delivering instruction and facilitating learning experiences (Sablić et al., 2021). Learning through video watching has multiple positive aspects, such as providing flexible self-controlled learning opportunities and raising students' motivation (Chatti et al., 2016; Sablić et al., 2021).

The major challenge of VBL arises from the lack of user engagement (Chatti et al., 2016). Since watching videos is often a passive activity leading to shallow learning (Chi & Wylie, 2014), it is necessary to adopt proper strategies to avoid passive learning (Yousef et al., 2014). Learners who do not engage with video content are less likely to be successful in learning (Mitrovic et al., 2019). Unlike passive watching, Active Video Watching (AVW) is a way of watching videos in which the learner actively and consciously participates in their education (Mitrovic et al., 2016).

AVW makes use of cognitive abilities, engages the learner with the material, and uses additional activities to improve understanding and retention (Prince, 2004). The aim of AVW is to transform the viewing experience from passive information gathering to an engaging and productive learning experience (Mitrovic et al., 2016). Considerable investigations have been done to develop strategies for user engagement in AVW, including commenting on videos, adding visualization, prompting learners to reflect on their individual experiences or plans, write high-quality comments on videos, as well as incorporating social learning into AVW by reviewing and rating comments written by other learners (Dimitrova et al., 2017; Mitrovic et al., 2017; Mitrovic et al., 2019).

Despite considerable achievements in learning via AVW, there is a potential for enhancing social learning further. In this paper, we describe an intervention which allows students to respond to their peers' comments in addition to only rating peer comments. To investigate the effect of our intervention, we conducted a study over three years with 1,192 engineering students enrolled in a first year engineering course, employing two versions of

AVW-Space, an online AVW platform implemented at the University of Canterbury. In 2021 and 2022, we used the version allowing students to review and rate comments written by their peers using five teacher-specified rating categories. In the version used in 2023, students could additionally respond to comments made by their peers, and we replaced the categorical rating system with a numerable binary (Like/Dislike) rating system. Our investigation is guided by the following research questions:

- RQ1: What is the effect of allowing students to respond to comments and using a numerable binary rating system on learning?
- RQ2: What comment rating mechanism (numerable binary or categorical) results in higher engagement?
- RQ3: What are learners' perceptions of the benefits, challenges, and preferences regarding comment rating?

2. Literature Review

The ICAP framework, proposed by Chi and Wylie (2014), classifies students' learning behaviours into four modes: Interactive (I), Constructive (C), Active (A) and Passive (P), on the basis of students' overt behaviours during learning. The four modes represent different levels of learner engagement and involvement in the learning process. The Passive mode of engagement refers to learners who are oriented towards gaining information from instructional materials without making overtly any additional activities. The Active mode covers situations in which learners engage with instructional materials through some kind of explicit physical action or manipulation. Constructive behaviours are those in which learners add value to instructional materials through summarizing, elaborating, or reflecting on their past experiences, knowledge, or their future plans. Interactive mode of engagement implies dialogs with other learners and/or teachers. In the context of AVW, Passive learners only watch videos, while Active and Constructive learners write comments on videos (Mitrovic et al., 2019). Comments written by Active learners repeat the video content, while Constructive learners write comments which extend the video content by reflecting on their experience or planning for the future (Dimitrova et al., 2017). The interactive mode is characterized by conversations between learners, or learners and tutors. Chi and Wylie (2014) found that the interactive mode results in highest learning, and that learning decreases in other modes (I > C > A > P).

Several approaches to increasing user engagement with videos have been proposed, such as in-video quizzes (Giannakos et al., 2016). Although quizzes can foster engagement with videos, they may cause students to pay less attention to the key points, and focus only on answering questions (Kovacs, 2016). Another element is visualization, which is used either for presenting the key points in video or for raising awareness of users in terms of user-video interactions (Chatti et al., 2016). Mitrovic et al. (2017) proposed the requirements for intelligent support with AVW in AVW-Space, a platform for AVW, and investigated the effect of adding nudges to increase engagement (Mitrovic et al., 2019). Nudges refer to subtle hints designed to encourage viewers to engage more actively with the video content. Another AVW platform grounded in the ICAP framework was proposed by Dodson et al. (2018) to describe students' behaviours during video-based learning. They carried out a field study involving 460 undergraduate participants enrolled in an Applied Science course. They utilized a specially designed video player that promoted active viewing by supporting interaction with visual and textual representations of video content and personalization with highlights and notes. Dodson et al. (2018) found that if students were given a video player designed for active viewing, they would participate in a variety of behaviours, including constructive (highlighting and note-taking) and active (changing playback speed, re-watching, pausing) to aid their learning.

Given all these endeavours for supporting learners in VBL, there is still a gap in the use of interactive mode of learning in VBL. Hence, leveraging such an enormous capacity in VBL can be explored further.

2.1 Social Learning

Social learning is the major component of human behaviour and development, which has been extensively researched and applied to diverse areas such as personality development, aggression, and organizational behaviour (Davis & Luthans, 1980). Social Learning, which has its roots in social cognitive theory, posits that people learn via observing and imitating behaviours of others and their consequences (Bandura & Walters, 1977). Social environments, groups, and cooperative activities that encourage individuals to participate in mutual engagement, conversations, and shared experiences facilitate and support this type of learning.

The seminal contributions of Bandura and Walters (1977) to the social cognitive theory laid the foundation for understanding the mechanisms of social learning, which highlights the importance of observation, imitation, and modelling. Vygotsky and Cole (1978) offered a sociocultural theory that explores social learning in educational settings. Their theory expresses that social interactions, cultural context, and collaborative activities play a vital role in the learning process. The cognitive-affective-social theory of learning in digital environments (CASTLE), recently proposed by Schneider et al. (2022), provides evidence that individual learning in digital environments is influenced by social processes. CASTLE posits that social cues in digital materials activate social schemata in learners, leading to enhanced (para-)social, motivational, emotional, and metacognitive processes. In simple terms, social learning is about picking up new knowledge, skills, and behaviours through watching and engaging with other people and sharing knowledge in a social or group setting. In the context of AVW, social learning is implemented via reviewing/rating comments written by other learners and employing visualizations to illustrate engagement.

3. Experiment Design and Results

We invited all first-year engineering students at the University of Canterbury during the years 2021 to 2023 to use the AVW-Space platform to improve their knowledge of presentation skills. Participation in the study was voluntary. In all three years, students first watched and commented on eight videos. Later on, comments were opened to the class for reviewing and rating. In 2021 and 2022, students were able to review their peers' comments and rate them by choosing an option from teacher-specified rating categories: "*This is useful for me*", "*I hadn't thought of this*", "*I didn't notice this*", "*I don't agree with this*", and "*I like this point*". To support more discussion between learners, in 2023 we extended AVW-Space to allow students to respond to their peers' comments or existing responses, share their thoughts, and raise their views. Also, in 2023, we replaced the categorical comment rating system with a numerable binary rating system (Like and Dislike for each comment/response).

AVW-Space was introduced to students as an optional online training they could use. The training consisted of two phases. In phase 1, participants completed Survey 1, which contained demographic questions, as well as questions related to training and experiences with presentation skills. In this Survey, as a pre-test of domain knowledge, students were also asked to write as many phrases as they could on giving presentations. Then, they watched and commented on eight videos. In phase 2, selected comments were provided to the whole class to review and rate. Students did not have to review or rate all comments. At the end, students were invited to complete Survey 2, containing the same questions on giving presentations and additional open-ended questions about the usefulness of reviewing and rating others' comments.

We measured learning by counting domain-specific terms used by students in Surveys 1 (pre-test) and Survey 2 (post-test). The responses were marked automatically, using the ontology and code developed previously for studies on presentation skills in AVW-Space (Dimitrova & Mitrovic, 2022). In this way, we obtained Conceptual Knowledge scores before and after using the system, CK1 and CK2, respectively. We used these scores as a proxy for measuring learning.

We classified the participants post hoc based on their observable learning behaviours using the ICAP framework (Chi & Wylie, 2014). Passive students watched videos without commenting on them. Participants who wrote comments on videos were classified as Active or Constructive, depending on the quality of comments they wrote. To determine comment quality, we used the comment quality classification approach previously developed by (Mohammadhassan et al., 2020). In this classification approach, High-quality (HQ) comments elaborate on the video content, show reflection on experience or planning for future presentations, comments of quality 2 repeat the video content, and quality 1 are short comments which are off-topic, irrelevant, and affirmative. After determining the median value for the number of HQ comments, we classified students whose HQ comments were greater than the median as Constructive and the rest as Active. In 2023, we also distinguished Interactive students as those who wrote at least one response to comments/responses, whether they had written comments or not. We compared the learning results for students who completed both surveys (Table 1). There were no significant differences between the three years on the CK1 scores. The ANOVA test on the learning gain (CK2 - CK1) revealed that there is a significant difference between the three sets of participants ($F = 3.41$, $p < .05$, $df = 2$). We performed pairwise comparisons with the Bonferroni correction and the only significant difference was between the 2021 and 2023 cohorts ($p = .01$).

Table 1. Comparison of CK Scores -- Mean (Std)

	2021 (n=277)	2022 (n=196)	2023 (n=493)
CK1	14.19 (6.06)	13.91 (6.14)	14.04 (5.82)
CK2	13.53 (6.47)	13.47 (6.41)	14.74 (6.75)
Ck2-CK1	-0.66	-0.44	+0.70

To investigate the effect of our intervention on learning (RQ1), we conducted causal modeling using the thinkCausal tool (apsta.shinyapps.io/thinkCausal/), which is based on the Bayesian Additive Regression Tree (BART) algorithm (Hill et al., 2020). This tool estimates the average treatment effects and is suitable for observational studies. The results show that our intervention led to an increase of 1.38 in CK2 compared to what would have happened if the participants had not received the treatment. Moreover, for the 2023 data, we conducted an ANCOVA analysis on CK2 as the dependent variable, CK1 as a covariate, and students' categories as a fixed factor. It reported that CK1 ($F = 128.83$, $p < .001$, partial eta squared =.21) and student categories ($F = 5.59$, $p < .001$, partial eta squared = .03) had significant effects on CK2. Pairwise comparisons on estimated marginal means of CK2 revealed that CK2 scores of Interactive learners were significantly higher than those of Active learners, at the .05 level.

We analyzed the engagement of all students who completed Survey 1 and watched videos. Students' engagement is measured by the number of times students visited comment review pages, number of ratings, and number of responses written. Table 2 shows the means (and standard deviations) for these variables along with the results of ANOVA tests.

Table 2. Comparison of Students' Engagement in Different Years – Mean (Std)

	2021(n=351)	2022(n=258)	2023 (n=645)	Significance
Review_Pages	7.39 (3.84)	7.41 (4.36)	8.05 (3.59)	$F = 4.48$, $p = .01$
Ratings	23.55 (52.26)	29.34 (40.27)	16.69 (21.51)	$F = 12.04$, $p < .001$

Pairwise comparisons with the Bonferroni correction revealed that the average number of ratings in 2023 was significantly smaller compared to 2021 ($p < .005$) and 2022 ($p < .001$). However, the average number of visits of the review pages in 2023 was higher than in prior years ($p < .01$ in 2021 vs 2023). A potential explanation of these findings is that there was a different mechanism for rating comments in 2023. The latent potential in the "numerable" feature of the rating mechanism used in 2023 might have discouraged students from rating a comment, particularly when there are already a lot of ratings. For example, one of the students

clearly expressed that "*No point rating comment with 100 likes and 1 dislike*". In 2023, Interactive students wrote 441 responses, including 419 responses to comments and 22 responses to responses. 60.50% (144 out of 238) of available-to-rate comments received responses, with the range of 1 to 19, and the median of 2.

In Survey 2, we asked students for feedback on the usefulness of reviewing comments, rating comments, and replying to comments (only in 2023). Table 3 presents students' perceptions after manual classifications of the responses. The Kruskal-Wallis test did not indicate statistically significant differences between the groups for both reviewing and rating comments. As for the feature of responding to comments in 2023, there were 411 positive (78%), 46 neutral (9%), and 67 negative (13%) responses. Chi-square test reported the polarity of the responses is significantly different ($p < .001$).

Table 3. Students' Perceptions of the Usefulness of Reviewing and Rating Comments

Usefulness	Positive			Neutral			Negative		
of	2021	2022	2023	2021	2022	2023	2021	2022	2023
Reviewing Comments	222 (83%)	160 (84%)	464 (88%)	11 (4%)	11 (6%)	20 (4%)	34 (13%)	19 (10%)	44 (8%)
Rating Comments	183 (68%)	132 (70%)	411 (78%)	25 (9%)	18 (9%)	36 (7%)	62 (23%)	39 (21%)	79 (15%)

After examining all negative responses regarding the categorical rating mechanism, 31 of them (15 in 2021 and 16 in 2022) pointed out that the options were too broad, generic, somewhat constraining, or not specific enough to express their views properly. They mostly suggested being able to respond to comments. Also, eight students (one in 2021 and seven in 2022) stated reviewing/rating comments is boring since many comments are the same, repetitive, or uninformative. Some of the negative responses related to liking/disliking comments were:

- "*It is too vague*" because they might really like or really dislike some parts of a comment.
- "*There are no clear criteria for what comments deserve a like and what deserve a dislike*", or "*It is hard to know what the threshold for a comment to deserve a like/dislike is*".
- "*It could be bad, since it subjects people to group-think*", "*it just gives the option of going with the crowd*", "*people were only liking the top comments*".
- Some responses stressed that using *dislike* "*could provide an inaccurate or extremely negative response towards the commenter*", "*seems quite harsh*", "*obsolete*", "*rude*", or "*makes them feel terrible about themselves*".

4. Conclusions

We investigated the effects of allowing students to respond to comments on learning, engagement, and learners' perceptions. Our intervention, which allowed replying to comments/responses and a numerable binary rating system, was compared to comment reviewing via a categorical rating system without being able to respond to comments.

In response to RQ1 (what is the effect of allowing students to respond to comments and using a numerable binary rating system on learning?), the findings showed that our intervention resulted in higher learning. Learners who responded to their peers' comments played a crucial role in increased learning. Some participants stated in the feedback that replying to comments can help provide additional viewpoints on a comment, which is important as they not only may be constructive and aid in comprehending the original comment but also can aid learners in retaining the points. To respond to RQ2 (what comment rating mechanism (numerable binary or categorical) results in higher engagement?), our findings showed that the categorical comment rating mechanism is more engaging than binary. Although students' engagement decreased significantly in rating comments using our intervention in 2023, it resulted in a higher number of visits to review pages. To address RQ3 (what are learners' perceptions of the benefits, challenges, and preferences regarding these comment rating

designs?), student satisfaction with reviewing and rating comments was higher in 2023. Due to the “numerable” feature used in 2023, students could benefit from a cumulative insight regarding each comment or idea, which was helpful for them in highlighting key points of the videos. Students also expressed that using the numerable binary rating system in reviewing comments was easy to do and resulted in a 78% learner satisfaction with rating comments. However, it oversimplifies the process of evaluating comments, reducing complex opinions to black-and-white choices without considering nuance.

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