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Integrating Explainable Artificial Intelligence in Active Video Watching

Raul Vincent LUMAPAS[a*]
[a]*Computer Science and Software Engineering Department, University of Canterbury, New Zealand*
*raulvincent.lumapas@pg.canterbury.ac.nz

Abstract: The use of videos in learning has increased over the past years. Along with the popularity of video-based learning is the surge in the interest in Artificial Intelligence in education. Previous studies explored the use of Artificial Intelligence technologies in Active Video Watching, a form of video-based learning. A particular case of Artificial Intelligence in Active Video Watching would be Active Video Watching (AVW)-Space, a video-based learning platform developed by the University of Canterbury. The use of AI in AVW-Space, for example, in assessing the quality of comments made by users, has resulted in an increase in student engagement and learning. Student feedback in recent surveys on the use of Active Video Watching showed an interest in explanations of how the system's AI makes decisions. A way to integrate explanations to the system is through Explainable Artificial Intelligence (XAI). Therefore, this research aims to provide additional insights into the use of XAI and explanations in education and professional training through active video watching. This research also aims to explore the potential of XAI as a way to increase user engagement and learning when using AI-supported features of active video watching systems. A second goal is to look at currently implemented AI models and identify potential points of improvement in the AI / ML models used in active video watching.

Keywords: Explainable Artificial Intelligence, Active Video Watching, Video-based Learning

1. Introduction

Rapid advancements in the field of Artificial Intelligence (AI) (Mullins & Conati, 2020) have dramatically increased the interest in AI and the use of AI applications and tools in diverse domains over the past decade (Fiok et al., 2022). With this surge of interest in AI come questions related to the Fairness, Accountability, Transparency, and Ethics (FATE) of AI. As AI is also being used to support high-stake and critical human decisions, such as in the medical field. Hence, there is a clear need for FATE in AI systems, mainly as AI models are used to make important predictions and decisions. These concerns propelled the interest in explanations in AI systems, which in turn increased the interest in the field of Explainable Artificial Intelligence (XAI). Explainable Artificial Intelligence uses different methods to "enable end users to understand, appropriate trust, and effectively manage the emerging generation of artificially intelligent partners" (Gunning & Aha, 2019, p.45).

The use of XAI can also be beneficial in providing explanations in educational systems (Khosravi et al., 2022). Despite the increasing use of AI in educational systems (AIED), the integration of XAI has been particularly low in Intelligent Tutoring Systems (ITS) as compared to other areas, such as recommender systems, office assistants, and interactive systems (Conati et al., 2020). The same is true with video-based learning and active video watching.

This need for explanations has become apparent in Active Video Watching (AVW)-Space, an online video-based learning platform developed at the University of Canterbury. AVW-Space supports engagement in video-based learning and is aimed at learning soft skills. In recent surveys done on AVW-Space, a number of users have indicated the need for explanations, particularly in features that supports student engagement through the use of AI. One of the features that use Machine Learning (ML) models assesses the quality of comments students write while watching videos. The use of AI and ML models has increased student

engagement (Mohammadhassan et al., 2022). With this increase in engagement, we observed students wondering how AI is used in the system, particularly how AI decides on the comment quality.

This research will focus on three different areas in integrating XAI to active video watching. The first area focuses on determining the XAI desiderata and identifying the various needs, interests, goals, demands, and expectations of different AVW users. The second focus area of the research is on how XAI can be utilized to identify potential improvements or changes in implemented machine learning models in AVW. The third focus area of the research is on integrating XAI into active video watching by designing explanations suitable for end users of AVW. This research aims to answer the following research questions:

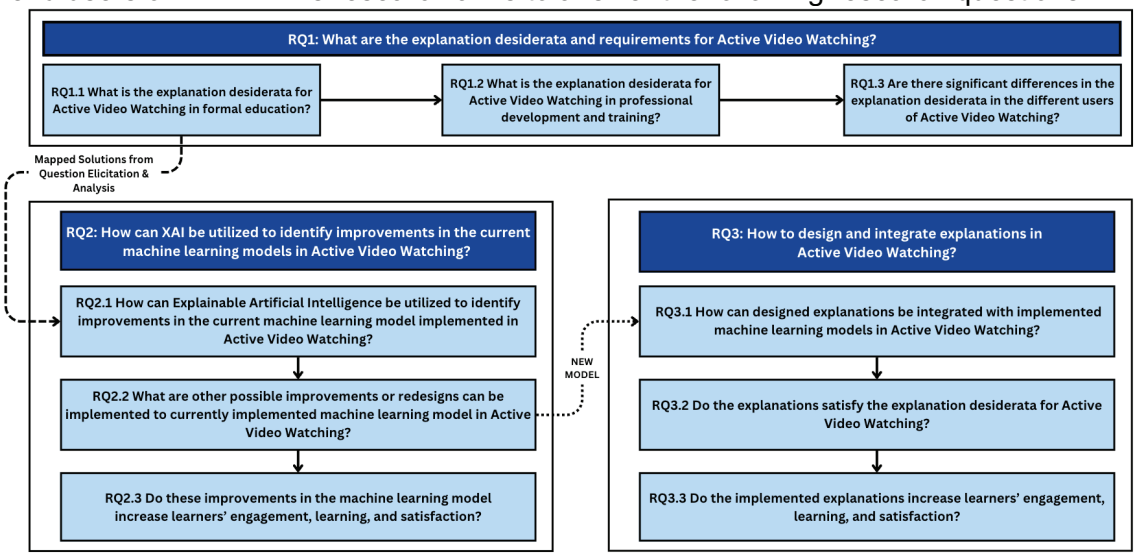

Figure 1. Project Framework and Research Questions

2. Literature Review

2.1 Active Video Watching

Video-based learning provides positive effects on students' learning experiences, such as flexibility and opportunities for self-regulated learning, increased student attention, and increased motivation to learn (Chatti et al., 2016; Dimitrova & Mitrovic, 2022; Sablić et al., 2021). The use of video-based learning has also shown promise in learning soft skills, as it allows the contextualization of personal experiences and shows real-life experiences (Cronin & Cronin, 1992; Dimitrova & Mitrovic, 2022). However, despite these benefits and potential, the lack of interaction between students and teachers in video-based learning, which may result in passive learning and a low level of engagement, becomes a challenge. A way to address this challenge is to support student engagement through active video watching here learners conduct activities while watching videos. One example platform that implements active video watching is AVW-Space.

This VBL platform supports engagement in video-based learning and is aimed at learning soft skills. AVW-Space allows teachers to create a space and integrate videos sourced from YouTube. Using the space created by their teacher, students can watch videos, write comments, and anonymously rate their peers' comments. Students can only review or rate their peers' anonymous comments once the teacher enables rating on the platform. AVW-Space contains different features, such as personalized prompts called Nudges and Visualizations. For example, as soon as a student writes a comment, AVW-Space automatically analyses it and displays the comment quality. The comment quality is determined by an AI model developed in previous research (Mohammadhassan, 2022). Student feedback from previous studies shows that there is a demand on explaining how the AI works in AVW-Space, for example how the comment quality is determined. Mohammadhassan et al. also proposed that the AI models used can be improved further and potentially improve users' engagement with the system by explaining the decisions made.

2.2 Explainable Artificial Intelligence in Education (XAI-ED)

Building trust with stakeholders in educational systems is important, given their distinct needs and the nature of data. Furthermore, the need for trust and accountability in educational systems has increased due to challenges arising from the use of AI. Issues related to accountability, learner autonomy and agency, support for learner metacognitive processes and reflective processes, and broader issues related to authentic assessment, credentialing, and academic integrity highlight has highlighted the need for explanations (Khosravi et al., 2022). This shows the necessity and importance of XAI in education systems.

In recent years, there has been an increase in research towards XAI in Education or XAI-ED. Khosravi et al. (2022) provided a framework that characterizes the nature of XAI in education in terms of questions about these six key aspects: *(1) the people involved (stakeholders); (2) the benefits to each group; (3) how to deliver the explanation; (4) the widely used classes of models used in education; (5) the human-centered design of the AI and interfaces to support explanation; and (6) the potential pitfalls of providing explanations*. This framework can help and guide researchers in AIED in studying, designing, and developing XAI systems for education and answer important questions related to the key aspects of XAI-ED. Some work has been done in the area of XAI-ED. This has been highlighted in the case studies investigated by Khosravi et al. (2022) illustrating the use of XAI-ED in a range of AIED systems. The case analysis showed the potential of XAI in different forms of AIED systems.

Utilizing XAI can help explain AI's behavior and achievements in educational systems (Fiok et al., 2022). However, there is still a great need to explore explanations of AI in education, given the increasing use of AI in the domain. Moreover, Fiok et al. indicate that XAI can also be designed in a way that the system allows to achieve goals essential from the professional training perspective. The use of XAI has been echoed by Khosravi et al. (2022) as well, explaining that the benefits of XAI is not just applicable in education systems but also in human capital development as well. Given the potential of XAI in education and professional development systems, the present research investigates its application in learning soft skills using active video watching.

3. Proposed Work

This research focuses on the integration of XAI in active video watching. AVW-Space will be used as the platform to implement this research. As indicated, there will be three different focus areas for this research with each part having different research activities and studies. The first focus area will be on determining the XAI desiderata for active video watching. Insights from this area will motivate and guide the implementation of studies related to the other two succeeding focus areas. Given the possible complexity of explanations, understandable and timely explanations are needed to help learners understand how the system uses AI and its decisions. As there are different needs and demands by AVW users, it is important to determine the XAI desiderata. An important part of this research is to look at the needs and demands of AVW users, in particular formal education users and professional development and training users.

The second focus area will explore possible improvements to the currently implemented models, potentially integrating explanation elements to pinpoint gaps or issues in the models or features used for the models. The goal is to further improve the currently used models or identify other ways of integrating AI in AVW. In the case of AVW-Space, the models used in assessing the quality of comments were shown to be effective in enhancing engagement and in nudging users to write more high-quality comments (Mohammadhassan, 2022). However, the performance of the models can be enhanced further (Mohammadhassan et al., 2022). Given the complexity of the various features used to assess comment quality, integrating explanations would benefit platform users. Using XAI can potentially help identify ways to improve or redesign the currently implemented ML models or can help in identifying the potential need to integrate and implement new AI methods or models. XAI can be utilized

to to look at currently implemented AI models and identify potential points of improvement in the AI / ML models used in active video watching systems.

The third focus area will be on designing and integrating explanations for users of AVW. Results from studies on the first focus area will serve as a guide in designing explanations in the system. Careful investigation of the explanation designed out of the explanation desiderata and requirements will be investigated. The appropriate XAI techniques and tools will then be used in providing explanations for the AI-features in the system. Furthermore, these explanations will be designed or presented in a way that is understandable by users of the system.

Improvements from the implementing the XAI design and improvements in the ML models will then be integrated into the AVW-Space platform. The improved AVW platform will then be tested with formal education and professional development and training users. This test will evaluate improvements in user engagement, learning, and satisfaction. Other potential metrics will also be used to identify improvements in the use of AVW, such as user trust and confidence in the system.

We did some initial work for the first part of the research, particularly in determining the XAI desiderata for Active Video Watching. We have also integrated some improvement in the ML models in AVW-Space. We conducted a study to help in setting the XAI desiderata for active video watching through a question-driven process for XAI. Users of AVW-Space were asked questions they have regarding the AI features of AVW-Space. A paper on this entitled *"Question-Driven Design Process for Explainable AI in Active Video Watching"* has been submitted as a Work-in-Progress paper in the International Conference on Computers in Education (ICCE). Another study has also been conducted to discuss the changes in the ML models for the Communication Skills space. This paper on the ML models entitled *"Evaluating the Assessment of Comment Quality in Learning Communication Skills in AVW-Space"* is also submitted as an Extended Summary for ICCE 2023.

To summarize, the ultimate goal of the research is for software engineering practitioners to learn soft skills (such as Communication and Presentation skills) using active video watching that utilizes AI features and integrates explainability using XAI. Further work will be done to identify how explanations can be implemented to support the learning of different types of users, in this case students and software engineering professionals, and how XAI can further help in improving active video watching systems.

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