


A Dialogue-Like Video Created From a Monologue Lecture Video Provides Better Learning Experience

Ari Nugraha, University of Tsukuba, Japan

 <https://orcid.org/0000-0002-5793-3157>

Tomoo Inoue, University of Tsukuba, Japan*

Tamara Adriani Salim, Universitas Indonesia, Indonesia

Muhammad Hanif Inamullah, Universitas Indonesia, Indonesia

ABSTRACT

Video is the most widely used format to deliver a lecture by the tutor/lecturer in electronic distance learning. One of the video presentation styles is a dialogue style where the learning material is presented with a dialogue between a tutor/teacher and a tutee student. The presence of the tutee and dialogues provide cues that enable the observer student to pay more attention to the video. However, most video lectures available are in a monologue style. The authors developed a system that transforms a monologue-style lecture video into a dialogue-like video style by adding a synthetic tutee agent. They conducted a within-subject design experiment involving first-year undergraduate students comparing this dialogue-like video style with other two traditional video lecture styles, the monologue, and dialogue styles. The evaluation found that students perceived the dialogues in the dialogue and dialogue-like style supported them to have a better learning experience. The finding indicates that this dialogue-like video style has a comparable effect on the traditional dialogue video.

KEYWORDS

Agent, Dialogue, Dialogue Video, Online Learning, Tutee, Tutee Agent, Tutor, Vicarious Learning, Video Lecture

INTRODUCTION

Many massive open online courses (MOOCs) have emerged on the World Wide Web. MOOCs bring disruptive changes to the process of learning and teaching. With high-speed Internet connection becoming ubiquitous and with the advancement of video compression techniques, the primary multimedia format in learning and teaching in these MOOC environments is video, streamed in a web browser.

Watching lecture videos in a MOOC provides greater accessibility than the traditional classroom and time convenience for learners. However, there are several problems faced by learners when watching long lecture videos: high cognitive load caused by information overload faced by learners,

DOI: 10.4018/IJDET.334012

*Corresponding Author

This article published as an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>) which permits unrestricted use, distribution, and production in any medium, provided the author of the original work and original publication source are properly credited.

especially for persons with low working memory capacity, and high dropout rates caused by misleading titles, course navigation structure, and longer video duration, which makes students feel bored due to short attention spans or experiencing more interruption (Kim et al., 2014).

A study by Chi et al. (2017) found that college students who observed dialogue between a tutor and a tutee have better learning gains with the tutee students at answering transfer-type questions which implies that they can learn as well as the tutees in the dialogue videos. The study showed that a tutee in the video plays an essential role in the video and, from the observer student's point of view, the tutee becomes a role model for them. Even though the dialogue-style video is proven to have more benefits to learning than monologue-style videos, the majority of lecture videos provided in MOOCs, Open Courseware, and also popular video sharing platforms such as YouTube are delivered in monologue style where one lecture/tutor presents learning material. A past study also found that most MOOCs use recorded video lectures (Hew & Cheung, 2014).

A recent study investigating the effect of a dialogue-style video lecture versus a monologue-style video lecture on a programming topic also found no differences in the students' learning performance and attention (Lee & Muldner, 2020). We saw this as an opportunity to enhance the existing monologue video into a dialogue-like video by adding a synthetic agent. The agent can act as a tutee which ignites a dialogue with the tutor or the lecturer in the monologue video. To add the synthetic or the tutee agent inside an existing video lecture, we developed an online tool that enables a course designer to transform an existing monologue video into a dialogue-like video so it could gain the same benefits as the dialogue video. To evaluate how our dialogue-like style video affects student learning performance and their perception, we experimented by comparing it to two other traditional video styles, the monologue and dialogue style.

In this paper, we present our study with the following structure. First, we discuss previous studies on learning from a dialogue video, pedagogical agents, and the effects of learning with a pedagogical agent. We started with the dialogue video which has its root in vicarious learning. Second, we describe the study's purpose, our research questions, and the methodology we used to evaluate the dialogue-like video. Third, we present the results of our quantitative and qualitative data analysis. Fourth, we discuss the results in detail and how they answer our research questions. Finally, we conclude this paper by presenting our study's limitations and the improvements that can be made for future research. The contributions of our study include:

- Evidence of the comparable learning effect between a traditional dialogue video and a dialogue-like video with a pedagogical agent.
- Evidence of student preference and their opinion in regard to their learning experience with a dialogue, a dialogue-like, and a monologue video lecture.

LITERATURES REVIEW

Learning From Dialogue Video

Learning through video proved to be more effective than a combination of text and static images or photographs, especially for novice or first-time learners studying manual techniques such as medical procedures (Ganier & de Vries, 2016). Lectures using video also became popular in the flipped classroom, a recent pedagogical model in which the video becomes a tool for direct instruction from lecturer to students before face-to-face classroom meetings (Blau & Shamir-Inbal, 2017).

To improve the experience of learning with a video lecture, several approaches related to the enhancement of video lecture exist, such as using segmentation to break the lecture content into several segments (Biard et al., 2018; Mayer, 2014). Using segmentation in multimedia learning has proven to have a positive effect on students' performance; however, perceiving too much segmentation did not facilitate students' learning and they found it to be annoying and inappropriate (Doolittle et al.,

2015). Another method for enhancing video lectures includes synchronously integrating the tutor/lecture' slides side by side with the video (Renz et al., 2015).

Aside from the enhancement of the video lecture, the presentation style also could affect learning engagement (Guo et al., 2014). A dialogue video is one of the styles that has proven to benefit the learner. The concepts underlying the dialogue video style include one-on-one human tutoring and vicarious learning. One-on-one human tutoring has proven to be a powerful method of promoting knowledge construction compared to classroom instruction (Craig et al., 2004). One of the advantages of this method is that it does not need to be conducted with professional tutors; a meta-analysis study found that people with untrained tutoring skills and moderate domain knowledge could become tutors (Cohen et al., 1982).

Learning from observing or learning vicariously can be described as learning by watching someone else learn or overhearing dialogues between a learner and an instructor (Chi et al., 2008). By observing activities carried out by others, such as dialogue between tutor and tutee, an observer student can master how to perform the activities without overt practice or direct incentives (Driscoll et al., 2005). It was also found that overhearing dialogue can benefit students in learning gain because they were able to write better propositions in free recall tests (Driscoll et al., 2005). Chi et al. (2017) note several reasons why dialogue videos are more effective, including: a) observing students show better constructive and interactive behaviors when watching dialogue videos compared to watching monologue videos; b) students pay more attention to what the tutees said than to what the tutors said; c) tutees can serve as a model of learning; and d) tutees tend to make errors and struggle, which is followed by tutor feedback, and these cycles of errors followed by the feedback are called "conflict episodes." However, when the similar procedure was applied to middle school students, no differences were found between observing dialogue, tutoring, and observing monologue (Muldner et al., 2014).

Learning by Observing Pedagogical Agents

Pedagogical agents are commonly represented as lifelike characters presented on a computer screen that guide or talk to students when they are engaged in multimedia learning environments (Martha & Santoso, 2018). A pedagogical agent's primary purpose or goal is to introduce more instructional support and motivational elements into multimedia learning (Clark & Choi, 2005). The social agency theory argues that a pedagogical agent's voice and representation will produce social signals that trigger social responses from students. The social response of students will then improve the student's motivation to learn when they are using the electronic learning system (Utomo & Santoso, 2015).

There are already many studies related to the implementation of a pedagogical agent in a learning environment. One example in regard to the usage of dialogues is AutoTutor, a natural language dialog (NLD) tutor learning environment, which implements strategies such as filling in missing pieces of information and fixing any detected bugs and misconceptions (Graesser et al., 2004). The AutoTutor improves the learner's answer to the question given by the system using turn-taking dialogue. In the end, it draws out more of the learner's knowledge that is relevant to the answer. This dialogue between a pedagogical agent and a learner aligns with constructivism theory, where learners actively create meaning and knowledge by interacting with people and other objects (Craig et al., 2004).

Learning with a pedagogical agent is not only effective when there are interactions between the agent and the student. Vicarious learning by observing interactions between a virtual tutor and a virtual agent during tutoring sessions also proved to be effective. Several studies found that overhearing dialogue between a virtual tutor and a virtual tutee in virtual tutoring sessions has positive effects on observer students, such as students asking significantly more deep-level reasoning questions (Craig et al., 2000) and producing more relevant propositions in free recall questions (Driscoll et al., 2005). The positive effect of conversational/dialogue style is not only limited to improvement in retention and transfer, but also on learners' perceived difficulty, friendliness, helpfulness, and physical presence (Jaques et al., 2002).

Effects of Learning With Pedagogical Agent

Many studies address the effects of learning with a pedagogical agent (PA), focusing not only on how it impacts students' learning performance but also how it affects students' cognitive load (Park, 2015; Yung & Paas, 2015) and metacognitive awareness (Baylor, 2002; Daradoumis & Arguedas, 2020; Karaođlan Yilmaz et al., 2018).

Cognitive load theory states that a human's working memory can only handle a limited amount of information at one time (Sweller, 1988). Lowering the cognitive load can have a beneficial impact on the learning process. As the role of PA is to enhance an interactive/multimedia learning environment by facilitating cognitive processes of learning (Kim & Baylor, 2016), it is important to examine how it will affect the cognitive load of a student. Studies on the effect of learning with pedagogical agents on student's cognitive load came up with mixed results, particularly related to the social cue from PA. According to Feine et al. (2019), a social cue from PA can be defined as "a cue that triggers a social reaction towards the emitter (agent) of the cue." The social reaction of the user can be emotional, cognitive, or behavioral which are similar to the reactions during interaction with other human beings. The forms of a social cue from a PA can be verbal or non-verbal. Verbal cues include descriptive verbal messages of spoken communication. Non-verbal cues are cues expressed through temporal changes in neuromuscular and physiological activities such as gesture (Akhtar & Falk, 2018).

Park (2015) investigated how social cues from PA on cognitive load dimension. It was found that perceived cognitive load was significantly lower when multimedia instructional material was narrated by the PA than when the narration was not presented. A meta-analysis of the literatures related to the impact of the pedagogical agents by Davis (2018) showed that the gesturing of PA did not increase cognitive load. The study found that a significantly lower cognitive load was perceived when the human narration was presented by a PA than voice-only narration was presented. Social cues in the form of pointing to an important concept in a video lecture from the PA were also found to have a more positive effect on learning comprehension compared to learning material without an agent; a significant difference was not found in terms of cognitive load (Yung & Paas, 2015). The social cues from the PA can also harm the students' learning. A previous study revealed that the agent's conversational gestures decreased students' comprehension of text and increased their cognitive load (Moon & Ryu, 2021). According to the study by Moreno et al. (2000), the conversational style of learning with a PA promotes deep learning; thus we investigate how the dialogue-like conversation between the tutee agent and the tutor affects students' cognitive load.

Another dimension of learning with a PA is how it affects metacognitive awareness. Metacognition is defined as knowledge about and regulation of one's own cognitive activities (Flavell, 1979 as cited in Molenaar et al., 2011). Metacognitive awareness can be defined as an individual's awareness and control of their learning processes (Altiok et al., 2019). A study with 102 university students experimented with a PA providing metacognitive support and found that the students have significantly higher level of self-regulation skills when supported by the PA (Karaođlan Yilmaz et al., 2018). A PA providing affective feedback is also proven to promote students' self-reflection process and enhance students' conceptual change (Daradoumis & Arguedas, 2020). The impact of the PA on metacognitive awareness can even be applied to a teacher. Teachers' metacognitive awareness was affected by PA support when they were developing instructional planning (Baylor, 2002). Based on the premises from the aforementioned studies, we investigate how the dialogue could improve students' metacognitive awareness.

STUDY PURPOSE AND METHOD

Study Purpose

As we mentioned in the preceding sections, studies from Chi et al. (2008, 2017) and Muldner et al. (2014) found benefits of learning by observing dialogue. However, these studies contain limitations

in that the length and the content of videos used in their experiments were different between dialogue and monologue videos, thus giving an advantage to the dialogue video. A recent study conducted by Lee and Muldner (2020) found no significant effect of dialogue style over monologue video style on factors such as learning gain and students' attention. Another eye-tracker study that compared the monologue and dialogue-like styles with a tutee agent showed a marginally significant difference in student attention to the learning material (Nugraha et al., 2020). Since the studies are inconclusive, we developed a software tool to add a tutee agent into a monologue video and turn it into a dialogue-like video, to enhance the monologue and capture the benefit of dialogue video. We want to explore how the dialogue-like video produced by the tool performs in comparison to the traditional monologue and dialogue video. With this in mind, the purpose of this study is to answer several research questions, the first of which is:

RQ1: Are there any differences in student learning performance between the monologue, the dialogue, and the dialogue-like video style?

The studies mentioned in the previous section measure the impact of PA not only in terms of learning performance/gain but also in terms of cognitive load and metacognitive awareness. The second question that we seek to answer related to these aspects is:

RQ2: How does the video style affect student's perceived cognitive load and metacognitive awareness?

Since the tutee agent in this study uttered spoken questions to the human tutor that form a dialogue-like interaction, we seek to investigate the effect of the dialogue on the student learning experience. Thus, our third research question is:

RQ3: How do students perceive the effect of dialogue in the videos on their learning experience?

What students perceived in terms of cognitive load, metacognitive awareness, and dialogue effect might not fully capture students' subjective preferences and opinions of their learning experience with all video styles in this study. We asked students to write their subjective opinion to answer our fourth research question:

RQ4: How does the video style affect students' preferences and subjective opinions of their learning experience?

Experiment Design

In this study, we conducted a within-subject experiment involving first-year undergraduate students from library science majors at Universitas Indonesia. The experiment session was conducted individually for each student. Each student watched video lectures under three conditions in a different order:

- **Monologue style (MON):** In this condition, students watch a monologue lecture video, where only a human tutor is present in the video.
- **Dialogue style with a human tutee (DIA):** Students watch a traditional dialogue lecture video with a human tutee and a human tutor.
- **Dialogue-like style with a tutee agent (AGN):** A dialogue-like style, where students watch a dialogue-like lecture video with a tutee agent. This video style is produced using our tutee agent tool based on the monologue-style version of the videos.

Each condition has three videos of different content, which we describe more in the learning material section. In total, we have nine video lectures in this experiment. There were no differences in learning content between styles and all videos have approximately the same 10-minute duration. We counter-balanced the order of video styles presented to the students using the Latin square design. The experiment was conducted under the approval of our university ethics review board (#20-127).

Learning Material

We used three different video lecture topics under the “Preservation & Conservation” theme for learning material. We used a question-and-answer interaction where in the monologue style, these interactions were performed by the lecturer (the tutor) herself, while in dialogue and dialogue-like style, the interactions are performed between the tutor and the tutee/tutee agent. The lines used were exactly the same in all styles. The tutee agent’s speeches in our tool are generated from a neural network-based text-to-speech service from Google Cloud, which produces natural-sounding speech. An example of three video lecture styles used in this study can be seen in Figure 1.

For the video lecture, we used a talking-head style in which both the tutor and tutee agent appeared on the presentation slide. This is the commonly used video lecture style in the MOOC platforms and has proven to have better learning performance than other lecture video styles such as Khan style (Guo et al., 2014; Ilioudi et al., 2013). The three video topics we used for this experiment were:

LS1: Introduction to Preservation of Information Object

LS2: Introduction to Treatment & Collection Repairment

LS3: Introduction to Environment Control for Preservation

All of the video topics are introductory and, although they are under the same theme, they are independent of each other. Each video contains eleven presentation slides (the first slide is the title slide) and the slides only contain textual content in the middle. The videos did not contain a subtitle. The duration of all videos was approximately 10 minutes. The learning content on all videos is adapted from “The Preservation Management Handbook” by Harvey and Mahard (2014) and narrated in English by the main instructor of the Information Preservation and Conservation course.

Participant

Thirty-four first-year undergraduate students from Universitas Indonesia unfamiliar with the video lecture themes were recruited for this study. All students were from Library Science majors and were non-native English speakers.

Figure 1. Comparison of video styles from the LS1 theme (Note: In the monologue style (MON), the tutor narrated the content and stated the question by herself. In the dialogue (DIA) and dialogue-like style (AGN), the questions were asked by the tutee and the tutee agent. The AGN video was based on the MON version)



Procedure

We conducted the experiment session online using the Zoom video conferencing app, and every student was given a consent form and an explanation of the procedure for the experiment before the session started. The experimenter assigned an alias name for each student to maintain their anonymity. The experimenter recorded the sessions using a desktop recorder application to capture the student's behavior in this experiment. Students watched three videos with different styles sequentially based on the counter-balanced order. The detailed procedure for each student and each video lecture was as follows:

1. Before watching each video, students answered the pre-test quiz in 10 minutes (Figure 2A). The quiz was distributed online using an online questionnaire tool.
2. We asked the student to share their desktop screens and make two separate browser windows side by side. The left-side window was for watching the video and the right-side window was for notetaking as can be seen in Figure 3.
3. We shared the URL for the video lecture, hosted on YouTube.
4. The student opened the URL and watched the video from the beginning to the end and was not allowed to use video controls like pause or seek. We asked the student to write down their notes, separating by points while watching the video. The notes were written using an online spreadsheet app (Figure 2B).
5. The student was then given 15 minutes to review and interact with the video lecture. We asked the student to continue the notetaking activity while reviewing the video (Figure 2C). We called this phase the Review phase.
6. The student answered the post-test quiz in 10 minutes, not allowed to watch the video nor reads their notes (Figure 2D).
7. The student filled a questionnaire related to their experience when watching the video (Figure 2E).
8. We gave the student a 5-minute break before continuing to the next video.
9. At the end of the experiment session, we distributed an exit questionnaire asking the student to rate their preference for video style from the most to the least along with their reasons and opinions.

Data and Measurement

Learning Gain

To measure the learning gain, we calculated the number of correct answers from the pre-test and post-test quizzes. All questions are a free recall type where pre-test and post-test contain the same questions but in a different order. Each question is designed to match the

Figure 2. Overview of the procedure for each video

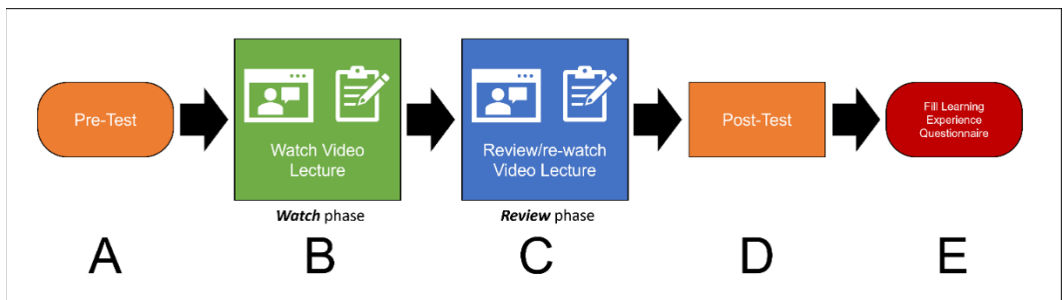
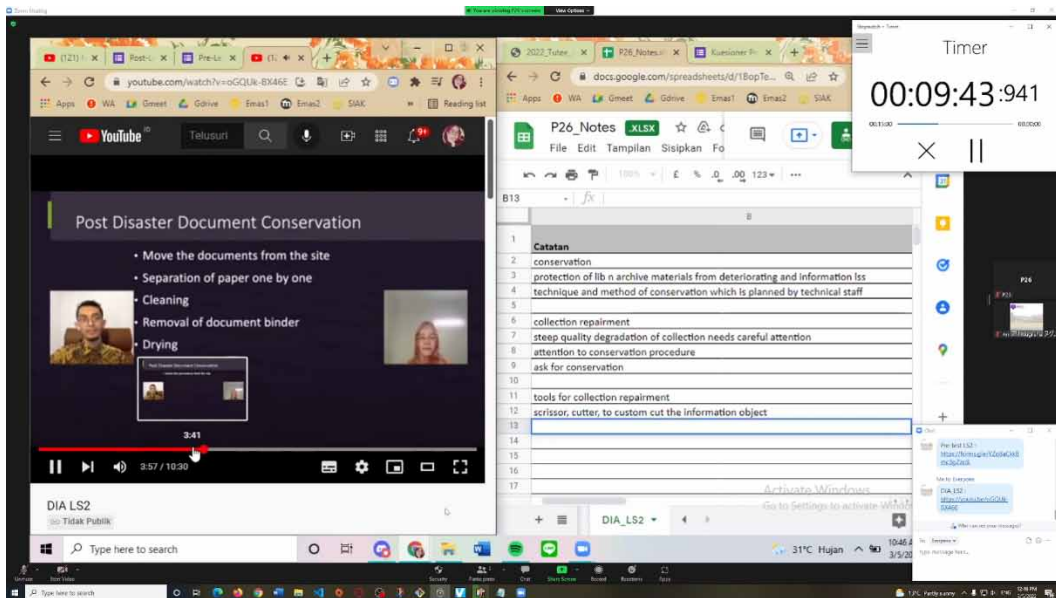


Figure 3. Screenshot of one student's screen (Note: On the left window is the video lecture being watched and on the right window is the student's note)



dialogue interaction that occurred in the learning content. This means that the questions are similar to what the tutee/the tutee agent prompted in the video. The reason for this is to observe if the dialogue as a social cue in the video could affect the student's performance and engagement. The quiz contains 10 questions where each correct answer was scored 10, the partially correct was scored 5, and the incorrect answer was scored 0. The total score of correct answers is 100.

Perception of Cognitive Load, Metacognitive Awareness, and Dialogue Effect

To measure students' perception of cognitive load, metacognitive awareness, and the dialogues, we designed a questionnaire modified from previous studies. For cognitive load, we took the items from Leppink et al.'s (2013) study and, for metacognitive awareness, we took the items from Mokhtari and Reichard (2002). To measure the effect of dialogues, we took inspiration from the items for pedagogical agent persona (Ryu & Baylor, 2005) and adjusted them to better reflect the impact of dialogues than the agent persona. In total, the questionnaire contains 24 items, and each item is rated using a 7-point Likert scale, from strongly disagree (1) to strongly agree (7). The Cronbach's alpha for our self-report questionnaire was 0.783 which can be considered good. The complete 24 items for the questionnaire can be seen in Appendix A.

Video Style Preference and Learning Experience Opinion

To collect opinions from the students regarding their learning experience for each video style, we asked the students to complete a learning experience opinion questionnaire at the end of the experiment session. The questionnaire was distributed online using an online questionnaire form. In the questionnaire we asked the students to choose their preference of video style starting from the most- to the least-preferred style. We also asked them to write the reason for each preference.

RESULTS

Learning Gain

The learning gain was measured based on the post-test score conducted at the end of each video. We gathered a total of 102 pre-test and 102 post-test scores from 34 students in this study. To measure how the video style affected the learning gain, we conducted ANCOVA with the pre-test score as a covariate. Figure 4 shows the comparison of score mean between the pre-test and the post-test. Before calculating the ANCOVA, we conducted a statistical test to check if the pre-test score and the video style are independent of each other. It yielded an insignificant effect of video style, $p = 0.69$, which means no effect of the video style on the pre-test score. We also conducted a statistical test to check the homogeneity of variance of the data, and the result of Levene's test showed we had an equal group variance with $p = 0.70$. The ANCOVA yielded insignificant effect of video style to the post-test score with $F(1,98) = 1.16$, $p = 0.32$, $\eta^2 = 0.02$.

Students' Perception of the Pedagogical Agent Effects

To measure the students' perception of cognitive load, metacognitive awareness, and dialogue effect, we calculated the sum of score for each aspect's items and divided it by the number of items in that aspect. We conducted MANOVA on the scores of these three aspects and a significant difference was found, $F(2, 99) = 3.49$, $p = 0.004$. Further pairing the non-parametric Friedman test with each aspect revealed there was a significant difference in the dialogue effect, $\chi^2(2) = 19.42$, $p < 0.0001$. We then conducted post-hoc Wilcoxon signed-rank test within the dialogue effect to see the difference between video styles. As we can see in Figure 5, with p -value adjusted using the Benjamini-Hochberg (FDR) method revealed significant differences between DIA and MON ($p < 0.0001$), and between AGN and MON ($p = 0.028$). Students perceived the dialogues occurred in DIA and AGN more effective than those in MON. No difference was found between DIA and AGN.

Based on the questionnaire for the dialogue effect aspect, a significant difference was found between video styles. Breakdown of the dialogue effect self-rated items (Appendix B) confirms students' opinion related to the impact of the dialogue to their learning experience. In DE4 "*I could feel the learning material presented in this video was interactive*", students perceived DIA video to be more interactive than MON video. Students could also recognize the occurrence of dialogue clearer (DE5) in DIA and AGN than MON. DIA and AGN video appeared to help students focus on relevant information (DE6) more than MON video. The dialogue occurred in DIA was perceived to

Figure 4. Scores of pre-test and post-test for all video styles

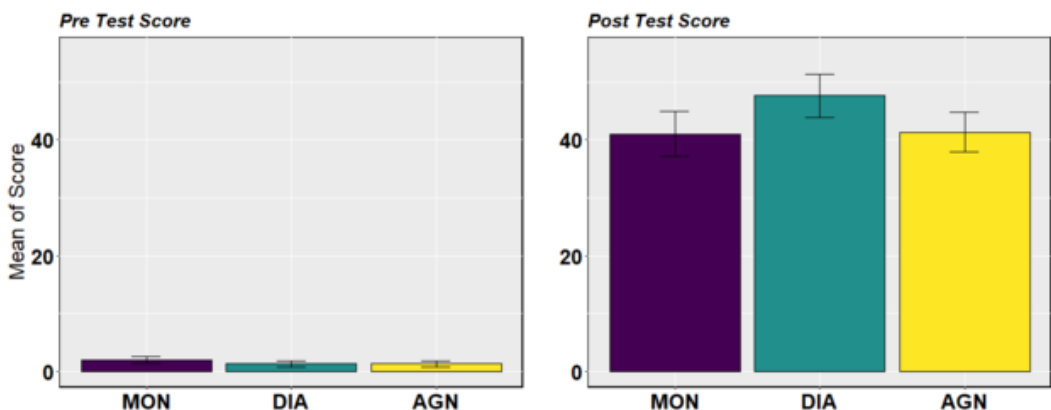
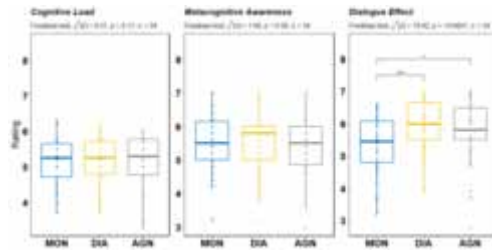


Figure 5. Student's rating in three aspects of cognitive load, metacognitive awareness, and dialogue effect



help presentation make sense (DE8) more than in MON, although no difference was found between DIA and AGN, and AGN and MON.

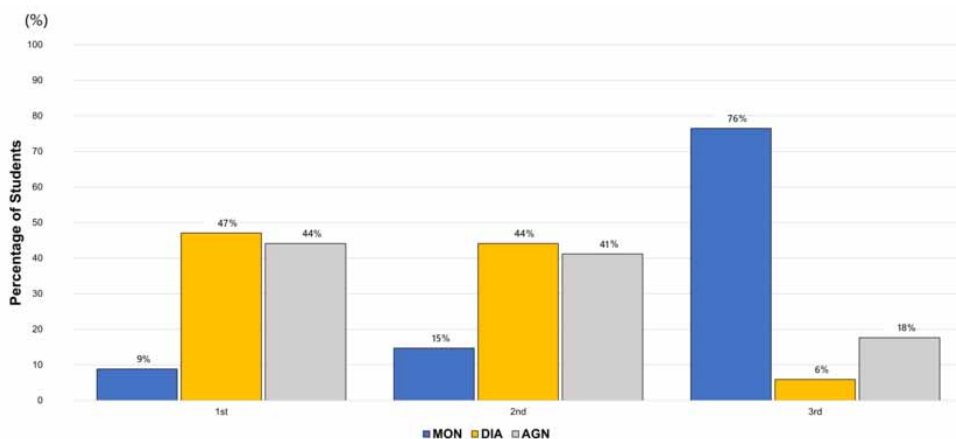
DIA video was also perceived significantly better than MON in DE9, DE10, and DE11. Significant difference was found in how the students perceive the dialogue effect in terms of keeping their attention on the video (DE9), leading them to think more deeply about the learning material (DE10), and making the video more interesting to watch (DE11). AGN had a marginal significant difference to keep the student's attention on the learning material compared to MON ($p = 0.092$).

Most students perceived that they could identify the questions that were uttered in the video (DE3) regardless of the video style. However, AGN almost reached a statistically significant difference against MON ($p = 0.055$) and no significant difference with DIA. Based on these results we can see that the students perceived the dialogue in DIA and AGN to have several benefits over MON such as making the video more interactive, helping them to focus on relevant information, keeping their attention on the video, making the video more interesting to watch, and helping them think deeply.

Students' Preference and Opinions on Learning Experience

To complement our students' perception questionnaire and gain deeper understanding of the student's learning experience, we asked about their video style preferences. From Figure 6, we can see that students in this study preferred DIA and AGN than MON. Students who chose the dialogue-like style as their first preference chose the dialogue style as their second preference. The same thing occurred for students who preferred the dialogue style as their first choice. They chose the dialogue-like video as their second preference. The monologue video style was the least preferred video style by most

Figure 6. Students' preferences for video style



students. We classified student opinions for each video style into several categories: clear voice, interactivity, concentration, and social cue, which are described in the following sections.

Clear Voice

Students who preferred AGN as their first or second preference expressed the tutee agent had a clear voice when it uttered the questions. Students who preferred the dialogue-like style video expressed their opinions as follows:

P8: “Because the pronunciation was clearer, more interactive, it (the agent) makes me understand the content faster and fun.”

P15: “The robot’s pronunciation was clearer.”

P19: “In my opinion the AGN was more interesting because it is combining picture and the voice was clearer.”

P23: “In my opinion because English pronunciation through tutees/synthetic students/robots is clearer... The question and material sections can be easily distinguished.”

The clear voice of the tutee agent comes from the fact that it was computer-generated synthesized voice which has less noise compared to recorded human tutee voice. However, studies related to the agent voice in the education field found a small effect of various kinds of pedagogical agent voices on recall performance (Morris & Chen, 2021), whether modern synthesized voice or the classic synthesized voice.

Interactivity of Dialogue

Most of the students who chose AGN and DIA as their first or second preference thought that the dialogue between the tutee/tutee agent and the tutor made the video feel interactive. Students expressed their opinions as follows:

P4: “It makes more sense and feels more interactive because it feels like there are representatives from students.”

P7: “I think watching learning videos in the form of dialogues with tutees/students like this feels more interactive. With variations in dialogue with the tutee/student, the video doesn’t feel bored. The questions asked by the tutee/student also made me gain a deeper understanding of the learning material.”

P9: “the interactions presented can encourage interest in learning.”

P29: “Because of the interactivity, make it (learning material) easier to remember.”

P32: “This (MON) video seems less interesting and effective for learning because there is no interaction or reciprocity between the presenters of the material so it looks boring. We are not motivated to think critically because it is only one-way communication.”

Students who felt interaction (dialogue) between the tutee/tutee agent and the tutor stated that the benefits of interactivity included showing what you should pay attention to, making it easier to digest the learning content, and making the video less boring. The term interactive in video-based learning usually refers to a student having some kind of activity such as answering in-video quizzes (Cummins et al., 2016; Kovacs, 2016). However, the feel of interactivity can also be achieved if the video lecture contains some form of interactive learning activity (Hung et al., 2018). The dialogue between a tutee and a tutor is one of the interactive learning activities. One of the problems when watching videos in distance learning is that students feel bored when watching (Schacter & Szpunar, 2015). Students expressed their opinions that the dialogue-like style video made them not feel bored.

Concentration

Students who preferred AGN expressed their opinions on how the video styles helped them more effectively concentrated on the learning material as follows:

- P10:** “Although I don’t like the presence of many people, I find it very difficult to focus when the video is just a self-narrative like a monologue (MON). My concentration is more divided and tends to be boring, this also makes me unable to think critically because there is no question expression.”
- P13:** “I can focus more on the material presented through interactive videos because I am used to this kind of method.”
- P24:** “Because the teacher has a dialogue with the robot, I can focus more on paying attention to the material, not being distracted by the tutee gimmick.”
- P25:** “The AGN videos give the impression of a more interactive learning environment and more interesting to watch. The presence of the agent in the video made me pay more attention to the dialogue that occurred between him and the teacher, so it was easy to note the points that could be highlighted.”

Students who chose MON as their first preference expressed their opinions as follows:

- P11:** “Because I can focus more on explanation when there is only one voice.”
- P14:** “Personally, I prefer the monologue one because the learning presentation is not messy.”
- P33:** “Makes me focus on one specific topic. The type of presentations (DIA & AGN) splits my focus”

We can see that students who preferred MON felt that DIA or AGN made them distracted from the learning content. They preferred to listen from one source as it makes them more focused. However, students who preferred AGN and DIA also expressed the same reason that the video styles help them concentrate more.

Social Cue in the Dialogue

Students who felt that the question and answer uttered by the teacher in MON made it difficult to distinguish important things in the learning material said:

- P15:** “rather difficult to detect the answer to the previous question because there is no point that states if it is the answer to the question.”
- P23:** “In my opinion, the (MON) video is quite clear and interesting. It’s just that I took a little time to grasp which part is the material and which part is the question being explained.”
- P31:** “If the teacher talks to himself (questioning and answering) for important things, the students will not hear clearly because it will be the same as the explanation of the material.”

From these opinions about MON video, it is implied that the social cue provided by the dialogue between the tutee/tutee agent and the tutor has some benefits to the students. Students thought that the presence of the dialogue between the tutee and the teacher in DIA or AGN made it easier to grasp important points in the video.

DISCUSSION

In this section, we discuss the results described in the previous sections in regard to our research questions.

RQ1: Are there any differences in student learning performance between the monologue, the dialogue, and the dialogue-like video style?

In terms of learning performance, we found no difference in learning gain between video styles. This result again follows the result from a previous study which also found no difference between dialogue and monologue video style in terms of learning gain (Lee & Muldner, 2020). Our study also confirms results from Carlotto and Jaques's (2016) study in which they experimented with various kinds of pedagogical agents (no agent, voice-only agent, static image agent, and full animated agent) and found no significant differences in learning outcomes among those different groups.

Driscoll et al.'s (2005) study with a virtual tutee and a virtual tutor found that students wrote significantly more content and significantly more relevant content in the post-test answer for deep questions when they overheard the learning content with dialogue format, where the virtual tutee and the virtual tutor engage in question and answer dialogue, than when the same content was overheard in a monologue-like (only virtual tutor talking) format. In a recent study comparing a monologue style and a dialogue-like style with a pedagogical agent, there was no significant difference in relevant content written by the students (Nugraha et al., 2020).

RQ2: How does the video style affect student's perceived cognitive load and metacognitive awareness?

Students' perception of the cognitive load and metacognitive awareness between video styles was not significantly different. Students expressed that AGN and DIA helped in their metacognition, particularly when they are writing notes as we can read from the following statements:

P24: "I find it easier to take notes on the first (AGN) and second (DIA) videos because the main points conveyed by the teacher are emphasized through interaction with the tutee."

P25: "The MON video sounded very confusing when the teacher interacted/questioned himself because of the same voice so that it made it quite difficult for me to write down important notes. The MON videos also make me lose focus quickly when I'm in the middle of the video."

P32: "For the DIA and AGN videos that use interactive methods (dialogue), it makes it easier for me to find important information and critical questions and answers related to the material. It also makes it easier for me to note the important points of the material in the video. Meanwhile, for the MON video, it's a bit difficult to find important information."

The presence of dialogue can be an anchor for the student to write important points in their notes. The statement from student P9 showed a distinction in the learning strategy between the monologue and the dialogue/dialogue-like style:

P9: "...the difference between videos is how to learn and understand the material presented, as in the monologue video I also did a monologue on myself, in the video with dialogues I try to capture the meaning of the questions and conversations between students and teachers."

Student P15 expressed how the dialogues in AGN video help in remembering test questions:

P15: "... in the third video (AGN), I tried to remember the questions (pre-test questions) and immediately write down if there are (same) questions uttered in the video, the robot (the tutee agent) also helps me remember the questions..."

It showed that the dialogue supported the student's metacognitive awareness particularly in how they answer the post-test.

RQ3: How do students perceive the effect of dialogue in the videos on their learning experience?

According to the questionnaire results in the dialogue effect aspect described in the previous section, we can see that students perceived DIA and AGN provide a better learning experience, particularly in the question-and-answer dialogue parts. This is also supported by the students' opinions.

RQ4: How does the video style affect students' preferences and subjective opinions of their learning experience?

AGN and DIA share similar percentage as the student's first preference and second preference. The reasons for their preferences are expressed in the students' opinions described in the previous section. Students preferred AGN and DIA because they thought that the videos were more interesting, more interactive, less boring, and help them concentrate on the learning material. Particularly with AGN, students preferred AGN over DIA because of the clear voice from the tutee agent. Students who preferred MON thought that the dialogue split their attention and that they have better concentration when there is only one person talking in the video.

Specifically, with the concentration theme, students who preferred AGN and DIA thought that the interaction between the tutee and the teacher help them to focus despite there being many channels of information (from the tutee, the teacher, and the learning material). Processing all the information from these channels while learning might incur an extraneous load that will burden students' cognitive load. However, McKendree et al. (1998) stated that observing dialogues actually lowers the emotional and cognitive load. The reason for this is that there is less of a cognitive load when student concentrate on the content and process of what is being said. Research on the impact of a visual cue from the pedagogical agent showed that the cue provided by the pedagogical agent to the learning material has proven to reduce extraneous load when students are looking for relevant information (Johnson et al., 2015). In particular, students favored the question uttered by the tutee agent and its clear voice. This might be an indication that the clear voice of the tutee agent could help students to concentrate. The impact of the tutee agent's clear voice was also supported by the claim about the importance of the agent's voice in improving learning (Mayer et al., 2003).

Another theme that needs to be highlighted in this study is the role of social cues from the dialogue. Concerning the question-and-answer format that we used in this experiment, students expressed their opinion that the question uttered by the tutee or the tutee agent not only allows them to concentrate but also think more critically. Even though the dialogue in AGN is considered less natural than DIA, students still perceived the dialogue between the human tutor and the tutee agent to be useful and comparable to the human tutee.

Study Limitation and Future Studies

This study contains some limitations that we believe can be improved in future iterations of such studies. The first limitation is that the experiments were conducted once for each student and thus may not reflect the long-term effect of the learning, such as long-term memory retention. A future study may improve this by incorporating our method in an actual classroom situation for an entire semester.

The second limitation is that the total duration of each experiment with three video lectures and break time between each video took quite a long time (3.5 hours in average), which might saturate the students' attention over time and cause fatigue. Future studies may improve on this by breaking the activity up into smaller activities and spreading them out over a longer period of time.

The third limitation is that the participants in this experiment were only first-year undergraduate students. The results may not be generalized to other populations or levels of education. A future study should include students of various educational levels to investigate the difference between educational levels for this dialogue-like video style.

Another limitation that we think needs to be improved for future study is the type of interaction between the tutor and the tutee agent, which was limited to only question and answer in this study. How other types of interaction in a dialogue such as backchanneling, repetitions, making mistakes, and summarization from the tutee agent could affect learning engagement and learning gain need to be investigated. In regard to the benefit of the tutee agent's clear voice, future research may also consider how the speaking style of the tutee agent can be implemented, particularly if the speaking style resembles a very well-known person. A recent study indicated that it can affect student performance in terms of perceived competence, self-confidence, and passion (Fischer et al., 2021).

Scalability and Future Development of Dialogue-Like Video Tool

As mentioned in the earlier section, we developed a software tool for this study to create a dialogue-like video between a tutee agent and a tutor. Although a teacher or course creator needs to be trained to design a good dialogue interaction with the provided features before using the tool, it allows the user to add a tutee agent inside a video to produce not only a dialogue-like interaction using a question and answer but also other types of interaction such as backchanneling, repetition, making a mistake, and summarization of explanation, which may help students improve their video learning experience and metacognitive strategy. Future studies may also include investigating the teachers' experience in using the tool. Regarding scalability, since the tool is a web-based application, it can be easily accessed through the internet or intranet using a web browser. The web-based platform also makes the tool easily incorporated/integrated into existing e-learning in an educational institution or a MOOC system in the market to provide additional teaching tools. With the tool integrated into an existing system, the user could enhance or improve their existing monologue videos with the tutee agent interactions. In the current stage, the tool allows a user to manually add tutee agent interactions in a specific video time one by one. As the use of AI becomes more common due to its rapid advancement, we believe that AI can be incorporated into the tool to enhance the user experience by, for example, giving automatic suggestions in the specific time points to add the tutee agent interactions.

CONCLUSION

In this study, we investigated how the dialogue-like video produced from our tool performed compared to the traditional monologue video and the dialogue video. No difference was found in terms of learning gain, but some differences were found in the students' perception of the dialogue's effect on their learning experience. Most students preferred the dialogue and dialogue-like styles over the monologue style, finding them to be more interesting to watch, to be more interactive, and to provoke critical thinking. The results indicated that the dialogue-like style with a tutee agent can achieve effects comparable to the traditional dialogue style.

The study has several limitations that can be improved in the future. Although one of them was that the interaction between the tutor and the tutee was limited only in the form of question and answer, it was due to the adequately controlled lab experiment. Also, though the developed tool to make a dialogue-like video from a monologue video was only a prototype for conducting this study and there remains points to be improved, it is scalable as it is web-based and it allows types of interactions other than just question and answer. Thus, with the findings of this study, there is a possibility of providing many dialogue-like videos that offer a better learning experience, including ones transferred from monologue videos.

REFERENCES

- Akhtar, Z., & Falk, T. H. (2018). Visual nonverbal behavior analysis: The path forward. *IEEE MultiMedia*, 25(2), 47–60. doi:10.1109/MMUL.2017.265091158
- Altrok, S., Başer, Z., & Yükseltürk, E. (2019). Enhancing metacognitive awareness of undergraduates through using an e-educational video environment. *Computers & Education*, 139, 129–145. doi:10.1016/j.compedu.2019.05.010
- Baylor, A. L. (2002). Expanding preservice teachers' metacognitive awareness of instructional planning through pedagogical agents. *Educational Technology Research and Development*, 50(2), 5–22. doi:10.1007/BF02504991
- Biard, N., Cojean, S., & Jamet, E. (2018). Effects of segmentation and pacing on procedural learning by video. *Computers in Human Behavior*, 89, 411–417. Advance online publication. doi:10.1016/j.chb.2017.12.002
- Blau, I., & Shamir-Inbal, T. (2017). Re-designed flipped learning model in an academic course: The role of co-creation and co-regulation. *Computers & Education*, 115, 69–81. doi:10.1016/j.compedu.2017.07.014
- Carlotto, T., & Jaques, P. A. (2016). The effects of animated pedagogical agents in an English-as-a-foreign-language learning environment. *International Journal of Human-Computer Studies*, 95, 15–26. doi:10.1016/j.ijhcs.2016.06.001
- Chi, M. T. H., Kang, S., & Yaghmourian, D. L. (2017). Why students learn more from dialogue- than monologue-videos: Analyses of peer interactions. *Journal of the Learning Sciences*, 26(1), 10–50. doi:10.1080/10508406.2016.1204546
- Chi, M. T. H., Roy, M., & Hausmann, R. G. M. (2008). Observing tutorial dialogues collaboratively: Insights about human tutoring effectiveness from vicarious learning. *Cognitive Science*, 32(2), 301–341. doi:10.1080/03640210701863396 PMID:21635338
- Clark, R. E., & Choi, S. (2005). Five design principles for experiments on the effects of animated pedagogical agents. *Journal of Educational Computing Research*, 32(3), 209–225. doi:10.2190/7LRM-3BR2-44GW-9QQY
- Cohen, P. A., Kulik, J. A., Kulik, C. C., & Cohen, P. A. (1982). Educational outcomes of tutoring: A meta-analysis of findings. *American Educational Research Journal*, 19(2), 237–248. doi:10.3102/00028312019002237
- Craig, S., Driscoll, D., & Gholson, B. (2004). Constructing knowledge from dialog in an intelligent tutoring system: Interactive learning, vicarious learning, and pedagogical agents. *Journal of Educational Multimedia and Hypermedia*, 13(2), 163.
- Craig, S. D., Gholson, B., Ventura, M., & Graesser, A. C. (2000). Overhearing dialogues and monologues in virtual tutoring sessions: Effects on questioning and vicarious learning. *International Journal of Artificial Intelligence in Education*, 11, 242–253.
- Cummins, S., Beresford, A. R., & Rice, A. (2016). Investigating engagement with in-video quiz questions in a programming course. *IEEE Transactions on Learning Technologies*, 9(1), 57–66. doi:10.1109/TLT.2015.2444374
- Daradoumis, T., & Arguedas, M. (2020). Cultivating students' reflective learning in metacognitive activities through an affective pedagogical agent. *Journal of Educational Technology & Society*, 23(2), 19–31.
- Davis, R. O. (2018). The impact of pedagogical agent gesturing in multimedia learning environments: A meta-analysis. *Educational Research Review*, 24, 193–209. doi:10.1016/j.edurev.2018.05.002
- Doolittle, P. E., Bryant, L. H., & Chittum, J. R. (2015). Effects of degree of segmentation and learner disposition on multimedia learning. *British Journal of Educational Technology*, 46(6), 1333–1343. doi:10.1111/bjet.12203
- Driscoll, D. M., Craig, S. D., Gholson, B., Ventura, M., Hu, X., & Graesser, A. C. (2005). Vicarious learning: Effects of overhearing dialog and monologue-like discourse in a virtual tutoring session. *Journal of Educational Computing Research*, 29(4), 431–450. doi:10.2190/Q8CM-FH7L-6HJU-DT9W
- Feine, J., Gnewuch, U., Morana, S., & Maedche, A. (2019). A taxonomy of social cues for conversational agents. *International Journal of Human-Computer Studies*, 132, 138–161. doi:10.1016/j.ijhcs.2019.07.009
- Fischer, K., Niebuhr, O., & Alm, M. (2021). Robots for foreign language learning: Speaking style influences student performance. *Frontiers in Robotics and AI*, 8, 680509. doi:10.3389/frobt.2021.680509 PMID:34540905

- Ganier, F., & de Vries, P. (2016). Are instructions in video format always better than photographs when learning manual techniques? The case of learning how to do sutures. *Learning and Instruction*, *44*, 87–96. doi:10.1016/j.learninstruc.2016.03.004
- Graesser, A. C., Lu, S., Jackson, G. T., Mitchell, H. H., Ventura, M., Olney, A., & Louwerse, M. M. (2004). AutoTutor: A tutor with dialogue in natural language. *Behavior Research Methods, Instruments, & Computers*, *36*(2), 180–192. doi:10.3758/BF03195563 PMID:15354683
- Guo, P. J., Kim, J., & Rubin, R. (2014). How video production affects student engagement. *Proceedings of the First ACM Conference on Learning @ Scale Conference - L@S '14*, (pp. 41–50). ACM. doi:10.1145/2556325.2566239
- Harvey, D. R., & Mahard, M. R. (2014). *The preservation management handbook: A 21st-century guide for libraries, archives, and museums*. z-wcorg.
- Hew, K. F., & Cheung, W. S. (2014). Students' and instructors' use of massive open online courses (MOOCs): Motivations and challenges. *Educational Research Review*, *12*, 45–58. 10.1016/j.edurev.2014.05.001
- Hung, I. C., Kinshuk, , & Chen, N.-S. (2018, February). Kinshuk, & Chen, N. S. (2018). Embodied interactive video lectures for improving learning comprehension and retention. *Computers & Education*, *117*, 116–131. doi:10.1016/j.compedu.2017.10.005
- Ilioudi, C., Giannakos, M. N., & Chorianopoulos, K. (2013). Investigating differences among the commonly used video lecture styles. *CEUR Workshop Proceedings*, *983*, 21–26.
- Jaques, P., Andrade, A., Jung, J., Bordini, R., & Vicari, R. (2002). Using pedagogical agents to support collaborative distance learning. *Proceedings of the Conference on Computer Support for Collaborative Learning Foundations for a CSCL Community - CSCL '02*. ACM. doi:10.3115/1658616.1658713
- Johnson, A. M., Ozogul, G., & Reisslein, M. (2015). Supporting multimedia learning with visual signalling and animated pedagogical agent: Moderating effects of prior knowledge: Learning with signalling and APA. *Journal of Computer Assisted Learning*, *31*(2), 97–115. doi:10.1111/jcal.12078
- Karaođlan Yilmaz, F. G., Olpak, Y. Z., & Yilmaz, R. (2018). The effect of the metacognitive support via pedagogical agent on self-regulation skills. *Journal of Educational Computing Research*, *56*(2), 159–180. doi:10.1177/0735633117707696
- Kim, J., & Li, S.-W., Cai, C. J., Gajos, K. Z., & Miller, R. C. (2014). Leveraging video interaction data and content analysis to improve video learning. *CHI '14 Workshop on Learning Innovation at Scale*, 1–6.
- Kim, Y., & Baylor, A. L. (2016). Research-based design of pedagogical agent roles: A review, progress, and recommendations. *International Journal of Artificial Intelligence in Education*, *26*(1), 160–169. doi:10.1007/s40593-015-0055-y
- Kovacs, G. (2016). Effects of in-video quizzes on MOOC lecture viewing. *Proceedings of the Third (2016) ACM Conference on Learning @ Scale*, (pp. 31–40). ACM. doi:10.1145/2876034.2876041
- Lee, B., & Muldner, K. (2020). Instructional video design: Investigating the impact of monologue- and dialogue-style presentations. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, (pp. 1–12). ACM. doi:10.1145/3313831.3376845
- Leppink, J., Paas, F., Van der Vleuten, C. P. M., Van Gog, T., & Van Merriënboer, J. J. G. (2013). Development of an instrument for measuring different types of cognitive load. *Behavior Research Methods*, *45*(4), 1058–1072. doi:10.3758/s13428-013-0334-1 PMID:23572251
- Martha, A. S. D., & Santoso, H. B. (2018). Investigation of motivation theory on pedagogical agents design in the online learning environment. *Proceedings of the 10th International Conference on Education Technology and Computers - ICETC '18*, (pp. 217–222). ACM. doi:10.1145/3290511.3290530
- Mayer, R. (Ed.). (2014). *The Cambridge handbook of multimedia learning*. Cambridge University Press., doi:10.1017/CBO9781139547369
- Mayer, R. E., Dow, G. T., & Mayer, S. (2003). Multimedia learning in an interactive self-explaining environment: What works in the design of agent-based microworlds? *Journal of Educational Psychology*, *95*(4), 806–812. doi:10.1037/0022-0663.95.4.806

- McKendree, J., Stenning, K., Mayes, T., Lee, J., & Cox, R. (1998). Why observing a dialogue may benefit learning. *Journal of Computer Assisted Learning*, *14*(2), 110–119. doi:10.1046/j.1365-2729.1998.1420110.x
- Mokhtari, K., & Reichard, C. A. (2002). Assessing students' metacognitive awareness of reading strategies. *Journal of Educational Psychology*, *94*(2), 249–259. doi:10.1037/0022-0663.94.2.249
- Molenaar, I., van Boxtel, C. A. M., & Slegers, P. J. C. (2011). Metacognitive scaffolding in an innovative learning arrangement. *Instructional Science*, *39*(6), 785–803. doi:10.1007/s11251-010-9154-1
- Moon, J., & Ryu, J. (2021). The effects of social and cognitive cues on learning comprehension, eye-gaze pattern, and cognitive load in video instruction. *Journal of Computing in Higher Education*, *33*(1), 39–63. doi:10.1007/s12528-020-09255-x
- Moreno, R., Mayer, R., & Lester, J. (2000). Life-like pedagogical agents in constructivist multimedia environments: Cognitive consequences of their interaction. In J. Bourdeau & R. Heller (Eds.), *Proceedings of EdMedia + Innovate Learning 2000* (pp. 776–781). Association for the Advancement of Computing in Education (AACE). <https://www.learnlib.org/p/16160>
- Morris, T. W., & Chen, H.-T. M. (2021). Voice's effect on student effort ratings and recall performance while under cognitive stress. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *65*(1), 576–580. doi:10.1177/1071181321651070
- Muldner, K., Lam, R., & Chi, M. T. H. (2014). Comparing learning from observing and from human tutoring. *Journal of Educational Psychology*, *106*(1), 69–85. doi:10.1037/a0034448
- Nugraha, A., Wahono, I. A., Zhanghe, J., Harada, T., & Inoue, T. (2020). Creating dialogue between a tutee agent and a tutor in a lecture video improves students' attention. In A. Nolte, C. Alvarez, R. Hishiyama, I.-A. Chounta, M. J. Rodríguez-Triana, & T. Inoue (Eds.), *Collaboration technologies and social computing* (Vol. 12324, pp. 96–111). Springer International Publishing. doi:10.1007/978-3-030-58157-2_7
- Park, S. (2015). The effects of social cue principles on cognitive load, situational interest, motivation, and achievement in pedagogical agent multimedia learning. *Journal of Educational Technology & Society*, *18*(4), 211–229.
- Renz, J., Bauer, M., Malchow, M., Staubitz, T., & Meinel, C. (2015). Optimizing the video experience in MOOCS. *EDULEARN15 Proceedings*, (pp. 5150–5158). ACM.
- Ryu, J., & Baylor, A. L. (2005). The psychometric structure of pedagogical agent persona. *Technology, Instruction [TICL]. Cognition & Learning*, *2*(4), 291–315.
- Schacter, D. L., & Szpunar, K. K. (2015). Enhancing attention and memory during video-recorded lectures. *Scholarship of Teaching and Learning in Psychology*, *1*(1), 60–71. doi:10.1037/stl0000011
- Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, *12*(2), 29. doi:10.1207/s15516709cog1202_4
- Utomo, A. Y., & Santoso, H. B. (2015). Development of gamification-enriched pedagogical agent for e-Learning system based on community of inquiry. *Proceedings of the International HCI and UX Conference in Indonesia on - CHIUXiD '15*, (pp. 1–9). doi:10.1145/2742032.2742033
- Yung, H. I., & Paas, F. (2015). Effects of cueing by a pedagogical agent in an instructional animation: A cognitive load approach. *Journal of Educational Technology & Society*, *18*(3), 153–160.

APPENDIX A

Table 1. Questionnaire design

| CODE | ITEMS | ASPECT | REASON |
|---------------------------------------|--|-------------------------|--|
| COGNITIVE LOAD ASPECT | | | |
| CL1 | The explanations of the learning material in the video were clear. | Cognitive Load | Observe the effect of the vide style to the student's perceived clearness of explanation |
| CL2 | Explanations of learning material were very effective in terms of learning. | Cognitive Load | Observe the effects of the video style to the student's perception of learning effectiveness. |
| CL3 | Watching this video enhanced my understanding of concepts and definitions. | Cognitive Load | Observe the effect of the video style to the student's understanding of important information in the video. |
| CL4 | Many things needed to be kept in my mind simultaneously when watching the video. | Cognitive Load | Observe the effect of the video style to the student's cognitive load. |
| CL5 | The video consisted of elements supporting my comprehension of learning. | Cognitive Load | Observe the effect of the video style to the student's learning comprehension. |
| CL6 | It was easy to recognize and link crucial information when watching this video. | Cognitive Load | Observe the effect of the video style on how a student could recognize and link important information in the video. |
| METACOGNITIVE AWARENESS ASPECT | | | |
| MA1 | It was easy to find important information when watching this video. | Metacognitive Awareness | Observe the effect of the video style in helping student to find important information in the video. |
| MA2 | It was easy to take notes to help understanding while watching this video. | Metacognitive Awareness | Observe the effect of the video style in helping student take their notes. |
| MA3 | It was easy to write important things in my notes while watching this video. | Metacognitive Awareness | Observe the effect of the video style in helping student write important information in their notes. |
| MA4 | The cues or signals in the video helped me to better understand the learning material. | Metacognitive Awareness | Observe the effect of social cue in the video style in helping student understand the learning material. |
| MA5 | It was easy to analyze and evaluate the information presented in the video. | Metacognitive Awareness | Observe the effect of the video style in helping student to recognize crucial concepts, thus making them easy to analyze and evaluate information in the video |
| DIALOGUE EFFECT ASPECT | | | |
| DE1 | Learning with this video was enjoyable for me. | Dialogue Effect | Observe the dialogue effect to student's learning enjoyment. |
| DE2 | I felt my questions about the learning material were represented in the video. | Dialogue Effect | Observe the dialogue effect in student's feeling of their questions represented. |
| DE3 | I could identify the questions asked in the video. | Dialogue Effect | Observe the dialogue effect to help student identify the questions uttered in the video. |
| DE4 | I could feel the learning material presented in this video was interactive. | Dialogue Effect | Observe the dialogue effect to make student feel the learning material interactive. |
| DE5 | I could see there were interactions (dialogue or question & answer) in this video. | Dialogue Effect | Observe the dialogue effect to make student identify the dialogues in the video. |
| DE6 | The interaction that occurred in this video focused me on relevant information. | Dialogue Effect | Observe the dialogue effect to help student focus on relevant information. |
| DE7 | The interaction that occurred in this video helped me to concentrate on the learning material. | Dialogue Effect | Observe the dialogue effect to help student concentrate on the video. |
| DE8 | The interaction that occurred in this video helped its presentation make sense. | Dialogue Effect | Observe the dialogue effect in making sense of the video. |
| DE9 | The interaction that occurred in this video kept my attention. | Dialogue Effect | Observe the dialogue effect to help student keep their attention to the video. |
| DE10 | The interaction that occurred in this video made me think deeply about the learning material. | Dialogue Effect | Observe the dialogue effect to help student have deep/critical thinking. |
| DE11 | The interaction that occurred made this video interesting to watch. | Dialogue Effect | Observe the dialogue effect to make the video interesting to watch. |
| DE12 | The interaction that occurred in this video encouraged me to reflect on what I learned. | Dialogue Effect | Observe the dialogue to help student reflect what they learned from the video. |
| DE13 | The interaction that occurred in this video encouraged me to think by myself. | Dialogue Effect | Observe the dialogue effect to help student think by themselves. |

APPENDIX B

Table 2. Questionnaire result in the dialogue effect aspect

| Code | Items | Mean (SD) | | | $\chi^2(2)$ | p | Pairwise comparison |
|------|--|------------|------------|------------|-------------|---------------|---|
| | | MON | DIA | AGN | | | |
| DE1 | Learning with this video was enjoyable for me. | 5.68(1.15) | 5.85(1.02) | 5.65(1.23) | 1.10 | 0.58 | ns |
| DE2 | I felt my questions about the learning material were represented in the video. | 5.35(0.92) | 5.47(1.21) | 5.62(1.07) | 0.83 | 0.66 | ns |
| DE3 | I could identify the questions asked in the video. | 5.59(1.08) | 5.97(1.11) | 5.82(1.14) | 4.77 | 0.09 | ns |
| DE4 | I could feel the learning material presented in this video was interactive. | 5.18(1.40) | 5.94(0.92) | 5.71(1.03) | 9.28 | **0.00 | <i>DIA > MON</i> |
| DE5 | I could see there were interactions (dialog or question & answer) in this video. | 4.53(1.52) | 6.21(0.98) | 5.97(1.19) | 23.2 | **0.00 | <i>DIA > MON;</i> <i>AGN > MON</i> |
| DE6 | The interaction that occurred in this video made me focus on relevant information. | 5.03(1.42) | 5.97(0.97) | 5.79(1.23) | 9.14 | *0.01 | <i>DIA > MON;</i> <i>AGN > MON</i> |
| DE7 | The interaction that occurred in this video helped me to concentrate on the learning material. | 5.35(1.18) | 5.76(1.05) | 5.53(1.28) | 2.92 | 0.23 | ns |
| DE8 | The interaction that occurred in this video helped its presentation make sense. | 5.41(1.18) | 6.03(0.83) | 5.79(1.23) | 7.83 | *0.02 | <i>DIA > MON</i> |
| DE9 | The interaction that occurred in this video kept my attention. | 5.44(1.21) | 6.18(0.83) | 5.85(1.10) | 15.5 | **0.00 | <i>DIA > AGN;</i> <i>DIA > MON</i> |
| DE10 | The interaction that occurred in this video made me think deeply about the learning material. | 5.59(1.18) | 6.21(0.84) | 5.94(1.13) | 7.54 | *0.02 | <i>DIA > MON</i> |
| DE11 | The interaction that occurred made this video interesting to watch. | 5.24(1.13) | 5.97(0.87) | 5.71(1.14) | 10.9 | **0.00 | <i>DIA > MON</i> |
| DE12 | The interaction that occurred in this video encouraged me to reflect on what I learned. | 5.71(1.17) | 6.03(0.83) | 5.79(1.09) | 3.31 | 0.19 | ns |
| DE13 | The interaction that occurred in this video encouraged me to think by myself. | 5.47(1.13) | 5.68(0.97) | 5.5(1.21) | 3.23 | 0.20 | ns |

Note: All tests are using the Friedman test, followed by pairwise comparisons using Wilcoxon signed-rank test with p-value adjusted using FDR.

* p < 0.05

** p < 0.001

Ari Nugraha is a doctoral student at the Graduate School of Library, Information, and Media Studies at the University of Tsukuba, Japan. His research field is in educational technology, particularly multimedia and electronic distance learning, through enhancement of the learning experience with a video lecture and active learning such as student-generated questioning and question improvement.

Tomoo Inoue is Professor of the Faculty of Library, Information and Media Science of University of Tsukuba, Japan. His research interests include Computer-Supported Cooperative Work, Human-Computer Interaction and Educational Technology. He is a recipient of awards including Outstanding Paper Award, Activity Contribution Award and SIG Research Award from Information Processing Society of Japan (IPSJ). He has served on a number of academic committees, including IPSJ Journal Group Editor-in-Chief, IPSJ Transactions on Digital Content Editor-in-Chief, IEICE Technical Committee on Human Communication Science Chair, IPSJ SIG Groupware and Network Services Steering Committee Chair, ACM CSCW Papers Associate Chair, CollabTech Steering Committee, and IEEE TC CSCWD.

Tamara Adriani Salim, is senior lecturer in the Department of Library and Information Science, Faculty of Humanities, Universitas Indonesia. She has been appointed as Head Department of Library and Information Science, Faculty of Humanities, Universitas Indonesia, since 2015-2022; was appointed as Manager of Human Resources, Faculty of Humanities for 2022-2025. She graduated from Department of Literature Roman Section French Program Studies, Faculty of Humanities, Universitas Indonesia in 1987; she completed her Master's Degree in Department of Library and Information Studies, Faculty of Information Management, Loughborough University of Technology, United Kingdom in 1992; and she earned her doctoral degree from Department of Archaeology, Faculty of Humanities, Universitas Indonesia in 2011. Her research focuses on preservation and conservation of heritage manuscripts, digital preservation, indigenous knowledge preservation, information resource service. She has several multidiscipline research studies with Department of Microbiology, Faculty of Mathematic and Natural Science, Universitas Indonesia.

Muhammad Hanif Inamullah is a teaching staff at the Department of Library and Information Science, Faculty of Humanities, Universitas Indonesia. His field of work and interest is digital literacy and its related topics including information literacy, information behavior, social media, data management, online learning and education, and information ethics.