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An investigation of using elaborated and metacognitive feedback strategies in interactive instructional videos

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Highlights

- This study investigated the use of elaborated and metacognitive feedback strategies in interactive instructional videos.
- The quantitative analysis of data showed no statistically significant difference between the two types of feedback in terms of students' engagement and metacognitive awareness levels.
- However, the qualitative findings indicated that students viewed the two types of feedback as serving different purposes.
- The learning experience in interactive instructional videos could be improved by selecting to use elaborated or metacognitive feedback according to students' mastery level of the subject or by thoughtfully integrating both types of feedback.

Article Info: Research Article

Keywords: *Interactive Instructional Videos, Feedback, Metacognitive Feedback, Elaborated Feedback, Video-Based Learning*

Abstract

The purpose of this study is to compare the use of elaborated and metacognitive feedback strategies in interactive instructional videos in terms of undergraduate students' engagement and metacognitive awareness levels. This study also aims to investigate undergraduate students' evaluations of elaborated and metacognitive feedback in these instructional videos based on qualitative data. This study used a basic randomized post-test-only experimental design comparing two treatments supported by qualitative data. The participants were 52 preservice teachers who registered for an undergraduate educational technology course offered by a faculty of education. They were randomly assigned to the metacognitive and the elaborated feedback groups. The data were collected with the Short Form of the User Engagement Scale and the Metacognitive Awareness Inventory. In addition, qualitative data were collected through interviews and used to examine students' evaluations of the elaborated and metacognitive feedback used in the interactive instructional videos. The results showed that there was no statistically significant difference between the two types of feedback in terms of students' engagement and metacognitive awareness levels. The qualitative findings indicated that while the two types of feedback did not provide a significant superiority over each other, students viewed the two types of feedback as serving different purposes. Our findings suggest that customizing the type of feedback based on students' answers and subject mastery level, or a thoughtful integration of both types of feedback, could enhance the learning experience in interactive instructional videos.

1. Introduction

While video-based learning has become increasingly popular since the 2010s (Kolas, 2015), the COVID-19 pandemic has further underscored the importance of instructional videos in the realm of online education (Eidenberger & Nowotny, 2022). However, given that students may easily become inactive in video-based

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learning, interactive videos that can support user engagement and learning have gained popularity to promote active engagement and counteract the negative effects of passive learning (Sebille et al., 2018).

Interactive instructional videos are typically characterized by the inclusion of test questions shown to users at certain points in an instructional video (Kovacs, 2016). With these, students can have the opportunity to receive feedback after answering test questions (Cummins et al., 2016). Different types of feedback could be used in video-based instruction to support student learning. Some of the widely used feedback types are called simple outcome feedback because they do not provide extra information about the task or strategy other than simply stating correct (or false) answers. In contrast, certain types of feedback, such as elaborated and metacognitive feedback, can provide students with more comprehensive information and self-regulation strategies. These types of feedback can greatly enhance students' engagement and metacognitive awareness, which are crucial elements in any distance learning environment (Coates, 2005; Golke et al., 2015; Karaoğlan Yılmaz & Yılmaz, 2021; Mevarech & Fridkin, 2006; Schraw & Dennison, 1994; Wanga et al., 2019). Research has also shown that the correct use of feedback has positive effects on student engagement (Hepplestone et al., 2011), and offering immediate feedback can further lead to improved metacognitive awareness (Lee et al., 2015; Molin et al., 2020). However, to the best of our knowledge, there have not been any studies comparing the effectiveness of elaborated and metacognitive feedback embedded into instructional videos, which has important implications for designing better video learning materials (Coates, 2005; Ostafichuk et al., 2020; Schraw & Dennison, 1994).

The purpose of this study is to examine the use of elaborated and metacognitive feedback strategies in interactive instructional videos in terms of undergraduate students' engagement and metacognitive awareness. This study also intends to explore undergraduate students' evaluations of elaborated and metacognitive feedback in these videos based on qualitative data.

2. Background

2.1. *Types of Feedback in Computer-Based Learning Environments*

Feedback can be broadly defined as any post-response information regarding students' state of performance or learning in instructional contexts (Narciss, 2014). Feedback is an important instructional strategy to support learning because empirical evidence demonstrates that when students receive feedback, more effective learning can take place (Guo et al., 2014). Narciss (2014) identified several feedback types used in computer-based learning environments. Among these, the widely used feedback types are knowledge of response, knowledge of correct response, answer-until-correct, multiple-try feedback, and elaborated feedback (see Table 1).

Table 1.

Commonly Used Feedback Types in Computer-Based Learning Environments (Narciss, 2014)

Feedback Type	Explanation
Knowledge of response	Offers information about the truth of the answer (e.g., true/false)
Knowledge of the correct response	Provides the true answer
Answer-until-correct	Includes knowledge of response and provides the chance for more tries on the same task until the task is answered correctly
Multiple-try feedback	Consists of knowledge of response and the chance for limited tries on the same task
Elaborated feedback	Includes further information in addition to knowledge of the response or knowledge of the correct response

Research suggests that, in comparison to the other types, elaborated feedback is found to be the most effective for student learning (Gilman, 1969; Kleij et al., 2012; Jaehnig & Miller, 2007; Pridemore & Klein, 1995). Researchers have proposed various forms of information that can be effectively conveyed to students through elaborated feedback. According to Narciss (2012), elaborated feedback should include additional

information helping to reduce differences between the students' current states and the desired state of understanding, and providing effective strategies for solving a problem. For Shute (2008), elaborated feedback can include a discussion of errors, additional examples, or general guidance, along with the right answer. Similarly, elaborated feedback can further be provided in such forms as explaining why a specific response is correct, giving cognitive or metacognitive hints, and providing additional background or related information (Golke et al., 2015). The most important feature of this type of feedback is that, with all these components and forms, students are supported to exhibit a deeper cognitive engagement with learning topics (Wanga et al., 2019).

2.2 Metacognitive Awareness and Metacognitive Feedback Strategies

According to Flavell (1976), *metacognition* is the monitoring and regulation of one's cognitive processes. Metacognitive awareness is the ability to regulate an individual's cognition or thinking processes (Schraw & Dennison, 1994). It is commonly accepted that metacognitive awareness is positively correlated with higher learning gains (Ostafichuk et al., 2020).

Three essential metacognitive strategies, which help students become aware of their learning processes, have been widely discussed in the literature: planning, monitoring, and evaluation. Planning refers to strategy selection and allocation. Monitoring involves controlling self-comprehension, awareness, and performance. Evaluating is about the assessment of goals or products (Schraw, 1998).

A set of self-questions under these strategies (a regulatory checklist) is provided by King (1991) (see Figure 1).

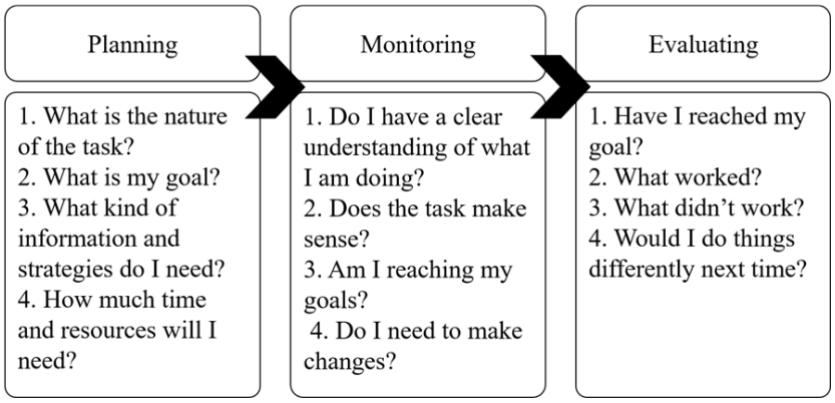

Fig. 1. A regulatory checklist, Source: [King, 1991]

King (1991) found that students who used a checklist similar to Figure 1 outperformed those who did not on problem-solving and asking strategic questions. Tanner (2012) prepared a set of self-questions for planning, monitoring, and evaluating steps in the context of one class session, an assignment, an exam, or a whole course (see Table 2). While these questions might be shared directly with learners, they can also be embedded in different activities such as exams, tests, assignments, or feedback. These types of questions can further be used to develop metacognitive awareness (Altıok et al., 2019) and metacognitive awareness, which in turn supports students in becoming more independent learners (Asha et al., 2022; Kim, 2018).

Immediate feedback, in the form of metacognitive feedback, can also be used to increase user engagement. Karaoğlan Yılmaz and Yılmaz (2021) examined the effect of metacognitive feedback on students' engagement in a computing course. While the experimental group received metacognitive feedback (self-questioning e.g., "How could I relate what I have learned with real life?"), the control group didn't receive any feedback. The results show that the engagement of students, who received metacognitive feedback, was higher than the engagement of students, who didn't receive it (Karaoğlan Yılmaz & Yılmaz, 2021).

Table 2.

Self-Questions for Planning, Monitoring, and Evaluating (Tanner, 2012)

Activity	Planning	Monitoring	Evaluating
Class session	What are the goals of the class session going to be? What do I already know about this topic? What questions do I already have about this topic that I want to find out more about?	Do I find this interesting? Why or why not? How could I make this material personally relevant? Can I distinguish important information from details?	What did I hear today that is in conflict with my prior understanding? How did the ideas of today's class session relate to previous class sessions? What did I find most interesting about class today?
Active-learning task and/or homework assignment	What are all the things I need to do to successfully accomplish this task? What resources do I need to complete the task?	What strategies am I using that are working well or not working well to help me learn? What action should I take to get these?	When I do an assignment or task like this again, what do I want to remember to do differently? What worked well for me that I should use next time?
Test or exam	What strategies will I use to study? Which aspects of the course material should I spend more or less time on, based on my current understanding?	Which of my confusions have I clarified? How was I able to get them clarified? Which confusions remain and how am I going to get them clarified?	What did not work so well that I should not do next time or that I should change? How did my answer compare with the suggested correct answer?
Overall course	What do I most want to learn in this course? What do I want to be able to do by the end of this course?	In what ways is the teaching in this course supportive of my learning? How could I maximize this?	What advice would I give a friend about how to learn the most in this course? If I were to teach this course, how would I change it?

Source: [Tanner, 2012, p. 115]

In summary, previous research suggests that employing appropriate feedback strategies can positively affect students' engagement and metacognitive awareness (Hepplestone et al., 2011; Lee et al., 2015; Molin et al., 2020). This could offer a potential solution to address the issue of passive learning typically associated with video-based learning. However, the existing literature lacks sufficient research comparing the effectiveness of different types of feedback in instructional videos concerning student engagement and metacognitive awareness, the two constructs closely associated with self-regulated learning (Chung & Yuen, 2011; Sebille et al., 2018; Paris & Paris, 2001; Zimmerman, 2008).

2.3 Purpose and Research Questions

The primary purpose of this study is to conduct a comparative analysis of elaborated and metacognitive feedback strategies used in interactive instructional videos in terms of undergraduate students' levels of engagement and metacognitive awareness.

In addition, this study also aims to investigate undergraduate students' evaluations of elaborated and metacognitive feedback in interactive instructional videos based on qualitative data. Thus, the following research questions are asked:

(1) Is there any statistically significant difference between the engagement scores of students who watch interactive instructional videos with elaborated feedback and those who watch the same videos with metacognitive feedback?

(2) Is there any statistically significant difference between the metacognitive awareness scores of students who watch interactive instructional videos with elaborated feedback and those who watch the same videos with metacognitive feedback?

(3) How do the students evaluate elaborated and metacognitive feedback in interactive instructional videos?

3. Method

3.1. *Research Design*

This study used a basic randomized post-test-only experimental design comparing two treatments (Shadish et al., 2002), supported with qualitative data. Participants were randomly assigned to the comparison groups, which are the elaborated feedback group and the metacognitive feedback group. For both groups, measurements were made after the implementation. In addition, qualitative data were collected through interviews and used to examine students' evaluations of the elaborated and metacognitive feedback used in the interactive instructional videos.

The independent variable of the study is the two types of feedback embedded into a set of interactive instructional videos. The dependent variables of the study are students' engagement and metacognitive awareness levels.

3.2. *The Participants*

The participants were undergraduate students who took an educational technology course at the Faculty of Education in a public research university in Istanbul, Turkey. More specifically, there were 52 (45 female) preservice teachers from a variety of teaching majors registered for the course, which was offered completely online due to the COVID-19 pandemic in the spring of 2021. The age range of the students was 20-25. The participants were selected using a purposeful sampling strategy (Creswell, 2012) based on the following criteria: (a) being an undergraduate student, (b) having basic computer skills, especially in using Moodle and Panopto.

3.3. *Data Collecting Tools*

The short form of the User Engagement Scale and the planning, comprehension monitoring, and evaluation subcomponent items of the Metacognitive Awareness Inventory were used as the quantitative data collection scales. Additionally, an interview protocol that was prepared by the researchers was used to collect qualitative data.

3.2.1. The Short Form of the User Engagement Scale

The Short Form of the User Engagement Scale (UES-SF) consists of 12 items, including six negative and six positive items, and has a four-factor structure. This 5-point Likert scale aims to evaluate user engagement in a particular application. The factors are focused attention, perceived usability, aesthetic appeal, and reward. Cronbach's alpha values for these factors are calculated as 0.92, 0.92, 0.90, and 0.87, respectively, and 0.88 for the overall score (O'Brien et al., 2018).

3.2.2. The Metacognitive Awareness Inventory

The Metacognitive Awareness Inventory (MAI) is one of the most frequently used self-report instruments to measure metacognitive awareness (Harrison & Vallin, 2018). This inventory was created by Schraw and Dennison (1994) to assess the two theoretical dimensions of metacognition: 17 items for knowledge about cognition and 35 items for regulation of cognition. These dimensions also have subcomponents. The components of knowledge about cognition are declarative knowledge, procedural knowledge, and

conditional knowledge. The regulation of cognition involves planning, information management strategies, comprehension monitoring, debugging strategies, and evaluation components (Schraw & Dennison, 1994).

Because the metacognitive feedback used in the present study was constructed considering the planning, monitoring, and evaluation components, only the 20 items related to these three components were used to collect the data.

In the MAI, the original response format is true-false options, but researchers have used various scale formats, especially Likert-types (Harrison & Vallin, 2018). In this research, the 5-point Likert type is used as the answer option of the MAI. The Cronbach's α for the knowledge factor was reported as .88, and the regulation factor was reported as .91 (Teo & Lee, 2012).

3.2.3. The Interviews

Semi-structured one-on-one interviews were conducted with three volunteering students from the sample five months after collecting the quantitative data. The purpose of collecting the interview data was to obtain more detailed information about students' evaluations of in-video feedback and to interpret the study's quantitative findings. In the interview, the participants watched one of the instructional videos with the first author in a recorded Zoom session. After they responded to each test question, both types of feedback were shown to them on the screen. And they were asked three main questions: (1) Which feedback type would you prefer, and why? (2) Which feedback type would you choose to enhance your metacognitive awareness? (3) Which feedback type would you choose for better engagement? The interview duration varied from 13 to 18 minutes.

3.4. *The Context and Research Procedures*

The study was conducted in an educational technology course offered during the COVID-19 pandemic period. This course has both lecture and lab sections. The lecture section covers the theoretical background of technology-supported learning environments, while the lab sections focus on hands-on experiences of developing instructional materials using different software tools. Since the course was fully offered online due to the COVID-19 pandemic, both the lab and lecture parts were carried out through Moodle, the learning management system of the university.

One of the major assignments of this course is to create an Articulate Storyline-based project. Articulate Storyline is an interactive multimedia software used to design interactive technology-based learning materials (Nabilah et al., 2020). The course has been utilizing some instructional videos in the lab section of the course to enhance students' technical and design skills related to Articulate Storyline. These videos were screen-cast tutorials created and recorded by the course lab assistant. They showcased how different interactive learning media could be developed using articulate storyline features. These instructional videos were being shared with the students through the Panopto video service, which was integrated into Moodle.

For the present study, six of these instructional videos were made interactive by inserting test questions and feedback using the Panopto test feature. While the videos were in English, the test questions and the associated feedback were prepared in the students' native language, Turkish, given that using students' native language in feedback sessions can significantly enhance their active engagement (Aktaş, 2021). The authors and the course lab assistant worked together to determine the types of questions and their specific timing within the videos. Except for the last one, each video had three knowledge- or comprehension-level questions based on Bloom's taxonomy about the topic of the video in a multiple-choice format. The site articulate.bilgikurdu.net (2021) provided the content information for constructing the test questions and the feedback. Each video had two versions: one with elaborated feedback and one with metacognitive feedback (explained below).

We randomly assigned the participants to one of the two groups: elaborated feedback or metacognitive feedback. During the semester, all participants watched the same videos with the same set of embedded test questions. The only difference was the type of feedback they received after answering the test questions. Students in the elaborated feedback group only received elaborated feedback, while students in the

metacognitive feedback group received metacognitive feedback. Further information about the videos is presented in Table 3.

Table 3.

Video and Question Information

The Topic of The Video	Video Duration	Number of Test Questions Embedded into the Video	Timing of the Test Questions and Feedback
1- Introduction to Interface: Meeting with Boo	23:58	3	03:03, 12:33, 19:13
2- Presenting Content: Multiple Intelligence Theory	11:46	3	00:50, 05:45, 10:22
3- Presenting Content: The Four Stages of Cognitive Development	13:04	3	00:48, 06:08, 11:22
4- Presenting Content: The Four Stages of Cognitive Development	10:17	3	02:02, 05:47, 08:15
5- Presenting Content: The Four Stages of Cognitive Development	14:08	3	01:15, 07:21, 12:44
6-Final Project Layout	45:40	7	00:54, 03:29, 08:06, 18:30, 35:56, 39:50, 45:06

3.4.1. Metacognitive Feedback

In the metacognitive feedback group, the feedback provided to the students consisted of the correct answer and metacognitive feedback that was prepared based on the suggestions in the literature (King, 1991; Tanner, 2012). The goal was to provide feedback that was consistent with the essential metacognitive strategies of planning, monitoring, and evaluation, which are the three major metacognitive strategies widely discussed in the literature (Schraw, 1998). The feedback was specifically tailored to the content covered in the videos. Table 4 provides some examples of the metacognitive feedback used in the study with the corresponding metacognitive strategies, based on the suggestions in the literature.

Table 4.

Examples of Metacognitive Feedback

Metacognitive Feedback Types from the Literature	Example Metacognitive Feedback Used in the Study	Corresponding Metacognitive Strategy
What do I already know about this topic? (Tanner, 2012)	What do I already know about the purpose of using "the timeline"?	Planning
Do I find this interesting? Why or why not? How could I make this material personally relevant? (Tanner, 2012)	Did I find this feature interesting? Can I use it in my own project?	Monitoring
Would I do things differently next time? (King, 1991)	What would I do differently if I used "variables" in my own project?	Evaluating

An example of a metacognitive feedback screen can be seen in Figure 2. Here, students were asked about "Operator/Value Features of Articulate Storyline." The metacognitive feedback provided was: "*What should I pay attention to use the Operator/Value concepts used for variables?*" that corresponded to the metacognitive strategy of monitoring.

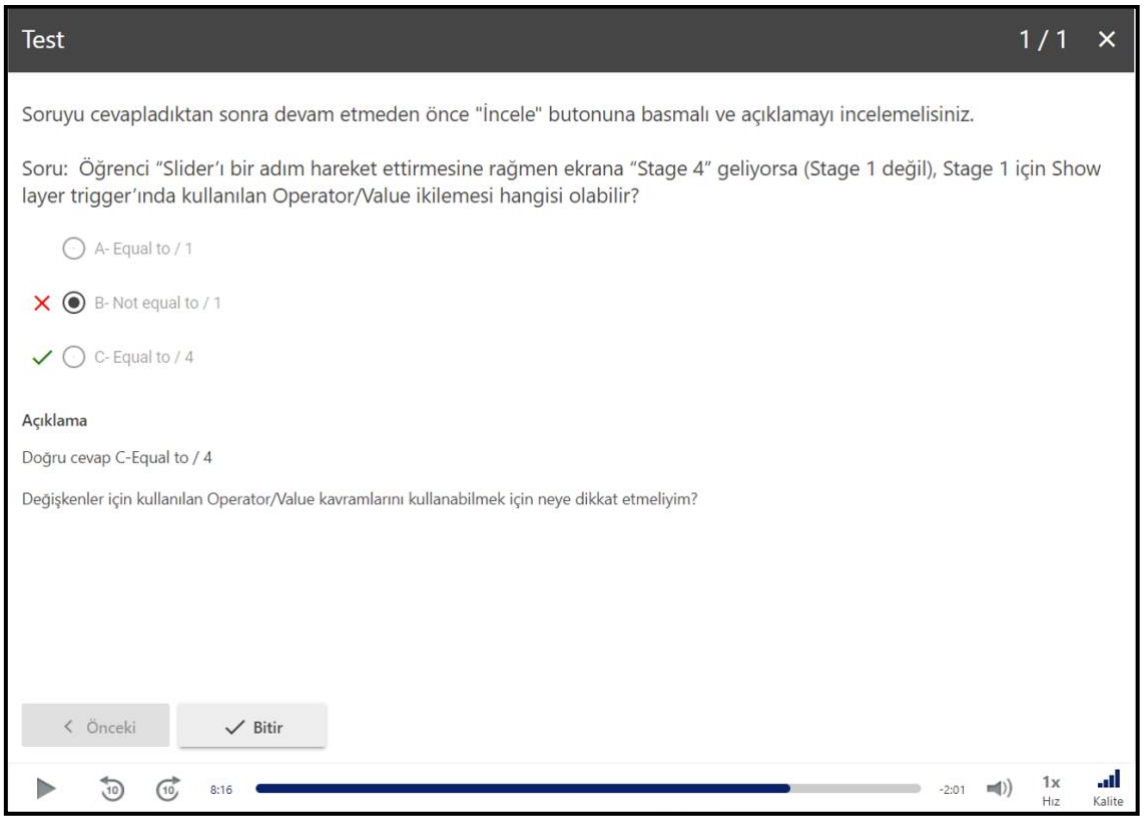

Fig. 2. Sample metacognitive feedback screenshot

3.4.2. Elaborated Feedback

In the elaborated feedback group, students were provided with the correct answer and received elaborated feedback. Based on the literature, we used additional information and essential hints tailored to the specific content to provide elaborated feedback (Chung & Yuen, 2011).

An example of an elaborated feedback screen can be seen in Figure 3. In the same example where students were asked about "Operator/Value Features of Articulate Storyline," the elaborated feedback provided was: "*If Stage 4 information is visible despite going to Stage 1, there is an error in the Show layer trigger's variables and values. Therefore, this happens when the value is equal to 4.*"

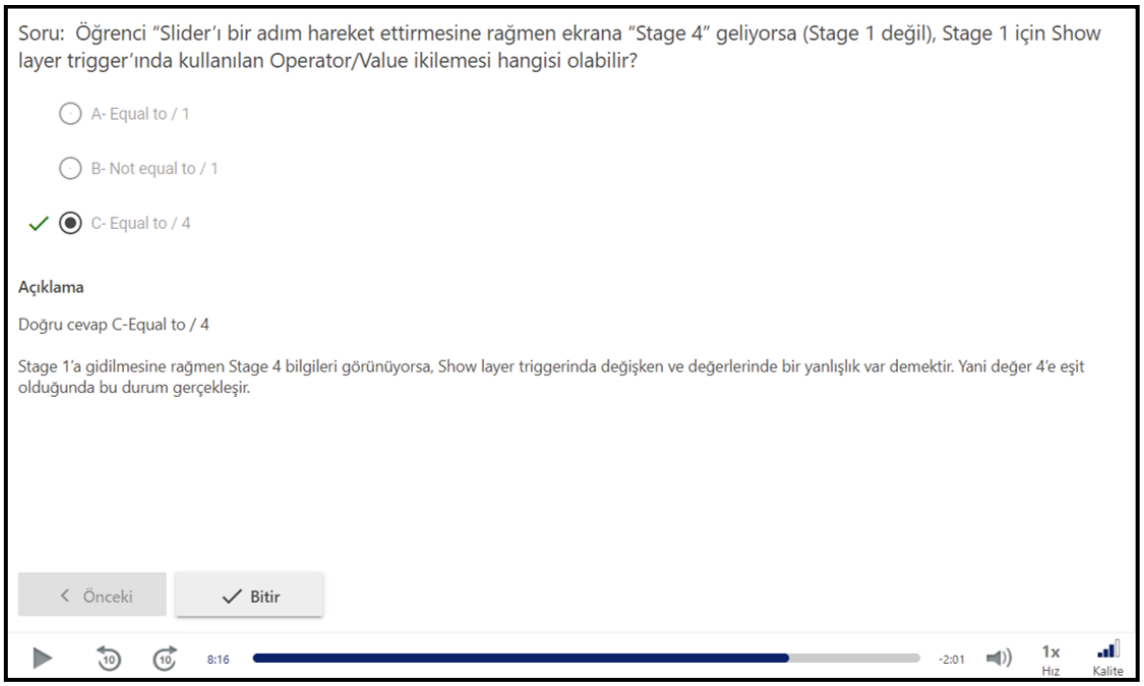

Fig. 3. Sample elaborated feedback screenshot

Table 5 contains the elaborated feedback used on this sample screen and more examples.

Table 5.

Examples of Elaborated Feedback

Example Elaborated Feedback		
The correct answer is C -Equal to /4 If Stage 4 information is visible despite going to Stage 1, there is an error in the Show layer trigger's variables and values. So, this happens when the value is equal to 4.	**Additional Information Part** If Stage 4 information is visible despite going to Stage 1, there is an error in the Show layer trigger's variables and values.	**Hints Part** Therefore, this happens when the value is equal to 4.
The correct answer is A -States With the states property, we can change any object depending on the student's action. We can set something to resize after being clicked or put an x on that object when the user clicks on the wrong object.	**Additional Information Part** With the states property, we can change any object depending on the student's action.	**Hints Part** We can set something to resize after being clicked or put an x on that object when the user clicks on the wrong object.
The correct answer is D -All of them We can add triggers to anything (buttons, images, text, whatever you want) and we can also use multiple triggers together to create a more complex structure.	**Additional Information Part** We can add triggers to anything (buttons, images, text, whatever you want)	**Hints Part** We can also use multiple triggers together to create a more complex structure.

Students were allowed to answer the in-video questions only once since the correct answers were provided as part of the feedback in both the metacognitive and elaborated feedback groups. After completing the six video tutorials with their respective feedback types over a four-week period, students in both groups were asked to complete the UES-SF (User Engagement Scale-Short Form) and the MAI (Metacognitive Awareness Inventory) scales through Google Forms. The links to these data collection tools were provided at the end of the final video and sent to the students via a message on the Moodle platform during the fourth

week of the implementation. The students had a 15-day period to fill out the scales and submit their responses.

Five months later, three volunteer students from the sample were interviewed one-on-one. During the interview, the first author and the participants watched one of the videos together in a Zoom meeting. When the test questions came on the screen, the participants were instructed to respond. Following their responses, the participants were shown both types of feedback. After examining each type of feedback, they were asked about their preferences and the type of feedback they would choose for improved engagement and metacognitive awareness.

3.5. *Data Analysis*

To answer the first and second research questions, students' UES-SF and MAI total scores were calculated. The maximum possible score for the 12-item UES-SF was 60, whereas the 20-item MAI test could produce a maximum score of 100. For each data set, descriptive statistics were computed, and the parametric test assumptions were controlled. When the parametric test assumptions were violated, the Mann-Whitney U test was used instead of a *t*-test to determine the statistical significance between the UES-SF and MAI scores of the two groups.

The qualitative data analysis started with transcribing the Zoom meetings conducted with the three students. The researchers carefully read through the complete transcripts to gain a comprehensive understanding of how the participants evaluated the elaborated and metacognitive feedback in terms of their preference, metacognitive awareness, and engagement.

Descriptive explanations were then written for each student in terms of their preferences, level of metacognitive awareness, and engagement with each type of feedback. By examining these descriptions collectively, the researchers were able to draw inferences and identify some common patterns or themes. This analysis led to a deeper understanding of how the students perceived and interacted with elaborated and metacognitive feedback, thereby informing further interpretations and conclusions.

4. Findings and Discussion

4.1. *Engagement*

The descriptive statistics related to the UES-SF scale showed that the engagement mean score of students in the elaborated feedback group (40.58) was higher than the engagement mean score of students in the metacognitive feedback group (38.85) (see Table 6).

Table 6.

Descriptive Statistics of the UES-SF Scores

	N	Min	Max	Mean	Median	SD
Metacognitive Feedback Group	26	25	50	38.85	40.50	6.583
Elaborated Feedback Group	26	25	48	40.58	42.00	5.573

To examine if the mean difference in engagement scores between the two groups is statistically significant, the parametric test assumptions were considered (i.e., normally distributed data, interval data, homogeneity of variances, and independence) (Field, 2009).

A Shapiro-Wilk's test for normality was conducted to check the normal distribution of data and the skewness and kurtosis *z*-values were calculated. Shapiro-Wilk's test results showed that the UES-SF scores of the metacognitive feedback group were normally distributed ($p > .05$) (see Table 7), with a skewness of -0.486 (SE = 0.456) and a kurtosis of -0.375 (SE = 0.887) (see Table 8). However, the UES-SF scores of students in the elaborated feedback group were not normally distributed ($p < .05$) with a skewness of -1.217 (SE = 0.456) and a kurtosis of 1.330 (SE = 0.887) (see Tables 7 and 8). In addition, while the *z*-values values of the metacognitive feedback group were in the acceptable range (between -1.96 and 1.96), the *z*-value of the skewness of the elaborated feedback group was not (see Table 7).

Table 7.

Shapiro-Wilk Test Results of the UES-SF Scores for the Elaborated and Metacognitive Feedback Group

	Statistics	df	Sig.
Metacognitive Feedback Group	0.961	26	.415
Elaborated Feedback Group	0.893	26	.011

Table 8.

Skewness, Kurtosis, and *z*-values of the UES-SF Scores

	Skewness	SE	*z*-value	Kurtosis	SE	*z*-value
Metacognitive Feedback Group	-0.468	0.456	-1.026	-0.375	0.887	-0.422
Elaborated Feedback Group	-1.217	0.456	-2.668	1.330	0.887	1.499

Therefore, we used a Mann-Whitney U test to examine if the mean difference regarding the engagement scores between the two groups is statistically significant. The analysis showed that there was no statistically significant difference between the mean engagement scores, $z = -1.184$, $p > .05$ (see Tables 9 and 10).

Table 9.

Mann-Whitney U Rank Test of the UES-SF Scores

	N	Mean	Sum of Ranks
Metacognitive Feedback Group	26	24.02	624.50
Elaborated Feedback Group	26	28.98	753.50
Total	52		

Table 10.

Mann-Whitney U Test Statistics of the UES-SF

	UES-SF Score
Mann-Whitney U	273.500
Wilcoxon W	624.500
Z	-1.184
Asymp. Sig. (2-tailed)	.237

4.2. *Metacognitive Awareness*

The descriptive statistics associated with the MAI scale showed that the mean score of students in the metacognitive feedback group (72.23) was higher than the mean score of students in the elaborated feedback group (70.23) (see Table 11).

Table 11.

Descriptive Statistics of the MAI Scores

	N	Min	Max	Mean	Median	SD
Metacognitive Feedback Group	26	58	91	72.23	71.50	8.373
Elaborated Feedback Group	26	40	87	70.23	72.50	10.297

Based on the Shapiro-Wilk test, the MAI scores were normally distributed ($p > .05$) for both the metacognitive and elaborated feedback groups (Table 12). While the skewness z-value of the elaborated feedback group was not in the acceptable range (Table 13), given that the sample size is not very large, we assumed a normal distribution of the MAI scores in each group (Field, 2009). Thus, we used the independent samples *t*-test to test for significance between the mean differences. The analysis showed that there was no statistically significant difference between the groups' MAI scores, $t(50) = .768$, $p > .05$ (see Table 14).

Table 12.

Shapiro-Wilk Test Results of the MAI Scores for Both Groups

	Statistics	df	Sig.
Metacognitive Feedback Group	.977	26	.811
Elaborated Feedback Group	.938	26	.118

Table 13.

Skewness, Kurtosis, and *z*-values of the MAI Scores

	Skewness	SE	z-value	Kurtosis	SE	z-value
Metacognitive Feedback Group	0.400	0.456	0.877	-0.108	0.887	-1.249
Elaborated Feedback Group	-1.073	0.456	-2.353	1.652	0.887	1.862

Table 14.

Independent Samples *t*-test for the MAI Scores

	Levene's Test for Equality of Variances		t-test for Equality of Means					
							95% Confidence Interval of the Difference	
	F	Sig.	t	df	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	.767	.385	.768	50	2.000	2.603	-3.228	7.228
Equal variances not assumed			.768	48.003	2.000	2.603	-3.233	7.233

4.3. *Students' Evaluations of Feedback Strategies*

Based on the qualitative data, we saw that the elaborated feedback was preferred five times and the metacognitive feedback was preferred four times (Table 15). While all students preferred the elaborated feedback for the first test question, for the second and third test questions, only two students preferred the elaborated feedback type. The students who favored the elaborated feedback mentioned that it was explanatory, summative, and descriptive. They particularly valued this type of feedback when they answered the test question incorrectly, as it helped them better understand the subject matter (see Table 15). On the other hand, the students who preferred the metacognitive feedback type stated that it enabled them to reflect and engage in deeper thinking. In summary, while both types of feedback were almost equally favored by the students, the reasons for preference varied.

Table 15.

Students' Preferences for the Type of Feedback

Test Question	Preferred Type of Feedback
First Test Question	Student 1 (Wrong answer) – The Elaborated Feedback Student 2 (Wrong answer) – The Elaborated Feedback Student 3 (Right answer) – The Elaborated Feedback
Second Test Question	Student 1 (Right answer) – The Metacognitive Feedback Student 2 (Wrong answer) – The Elaborated Feedback Student 3 (Right answer) – The Metacognitive Feedback
Third Test Question	Student 1 (Right answer) – The Elaborated Feedback Student 2 (Right answer) – The Metacognitive Feedback Student 3 (Right answer) – The Metacognitive Feedback

Students who preferred elaborated feedback said it was explanatory and informative. These descriptions align with the descriptions provided in the literature. Golke et al. (2015) state that elaborated feedback can involve explanations of why a specific response is correct and provide additional background or related information. Therefore, students were able to identify the function of elaborated feedback as described in the literature.

On the other hand, students who favored metacognitive feedback generally mentioned that it facilitated deeper thinking about the subject. Most importantly, students noted that they would choose metacognitive feedback if they already had a good understanding of the topic and answered test questions correctly. This suggests that benefitting from metacognitive feedback may require some prior knowledge or a certain level

of mastery of the topic. These observations are consistent with the literature. According to Taub and Azevedo (2018), students with high prior knowledge can be involved in processes including metacognitive strategies more than students with low prior knowledge.

Furthermore, all three students emphasized the importance of integrating these two types of feedback and receiving them simultaneously. They understood that the two types of feedback served different purposes, and both had value. Consequently, they expressed a wish to receive both types of feedback. The following words of a student can be given as an example.

> I think the two feedback types are very different from each other. It felt like these two feedbacks didn't serve the same purpose. That's why both of them are very beautiful separately, in fact, the first one [metacognitive feedback] was very effective for me. I guess if I had to choose one, I think I would choose the first. But still, I would like both together. (Student 2 / Interview)

Similarly, another student said:

> The second type [elaborated feedback] again, for example, gave this [additional] information. For example, a question can be added to make you think about what else it can be used for. It can give information. For instance, we can give information and use the layer for a lot of things for this study after all. Perhaps, a question can be added that will make them [students] think about what else it can be used for. (Student 3 / Interview)

For some researchers, elaborated feedback can incorporate metacognitive hints (Golke et al., 2015). This implies that metacognitive feedback can be integrated into elaborated feedback, allowing for the use of both types of feedback at the same time. Students asserted that such combined feedback would be both informative and beneficial for promoting deeper thinking.

5. Discussion and Conclusions

The present study aimed to compare the effectiveness of elaborated and metacognitive feedback strategies in interactive instructional videos among undergraduate students in terms of their engagement and metacognitive awareness levels. Additionally, the study sought to investigate students' evaluations of these feedback types based on qualitative data. The results indicated no statistically significant differences between the two groups' engagement and metacognitive awareness scores. However, students' evaluations of these feedback types based on qualitative data provided some important insights.

5.1. *Comparing elaborated and metacognitive feedback in terms of engagement and metacognitive awareness based on quantitative data*

The first two questions of this research focused on analyzing quantitative data aiming to determine any statistically significant differences between engagement and metacognitive awareness scores of students who received elaborated feedback and those who received metacognitive feedback when viewing instructional videos.

Elaborated feedback, which has been identified as an important form of feedback for supporting self-regulation in computer-based educational settings (Butler & Winne, 1995), has been found to increase student engagement (Wanga et al., 2019). Past research has also shown that metacognitive feedback improves engagement (Karaoğlan Yilmaz & Yilmaz, 2021). Thus, the literature suggests that both elaborated and metacognitive feedback can affect engagement, while there has been no direct comparison between them.

Similarly, metacognitive awareness is valued in educational settings since it is linked to student achievement (Abdelrahman, 2020; Khan & Seemab, 2019; Khodaei et al., 2022; Ostafichuk et al., 2020). Providing immediate feedback can allow students to develop metacognitive awareness (Molin et al., 2020).

More specifically, the use of self-questioning as a metacognitive feedback strategy has been shown to improve students' metacognitive awareness (Altok et al., 2019).

Furthermore, both elaborated and metacognitive feedback can support students' self-regulation. Elaborated feedback that incorporates the strategies mentioned in the literature review has been shown to improve students' self-regulation (Butler & Winne, 1995; Chung & Yuen, 2011), and self-regulated students can more easily learn to use metacognitive strategies to improve their achievement (Lee et al., 2016; Zimmerman, 2008; Delen et al., 2014). In that sense, one could expect that both the use of elaborated and metacognitive feedback could be equally effective in instructional videos.

Our analysis showed that while the mean engagement score of the elaborated feedback group was descriptively higher than the mean engagement score of the metacognitive feedback group, the difference was not statistically significant. Similarly, the difference in mean MAI scores between the two groups was not statistically significant, even though the mean MAI score of the metacognitive group was descriptively higher than the mean MAI score of the elaborated feedback group.

One could explain these findings regarding the variations in how the feedback was prepared in this study. Elaborated feedback can involve general guidance (Shute, 2008) as well as cognitive or metacognitive hints (Golke et al., 2015). Similarly, metacognitive feedback strategies could include self-questions for planning, monitoring, and evaluation (Tanner, 2012), or self-questions for comprehension, connection, strategy, and reflection (Mevarech & Fridkin, 2006). In this study, metacognitive feedback was prepared based on self-questioning strategies suggested by King (1991) and Tanner (2012). Elaborated feedback was constructed so that it involved further information or essential hints about the topic (Chung & Yuen, 2011). However, different strategies are suggested in the literature to prepare each feedback type (Golke et al., 2015; Narciss, 2012; Shute 2018). Thus, the results could have differed if alternative strategies were employed for the specific feedback prepared in the present study.

Another factor that could have led to the present findings could be related to the cognitive level of the test questions embedded into the instructional videos. The literature suggests that when feedback includes information about the problem-solving strategy employed, it tends to enhance students' self-regulation (Dignath & Büttner, 2008). This aspect is significant as self-regulation has a positive impact on students' engagement (Cho & Shen, 2013). Also, with problem-solving tasks, students' metacognitive abilities can be supported (Adagideli & Ader, 2017). Therefore, using higher cognitive level questions in terms of Bloom's taxonomy, such as application, analysis, or synthesis, could have produced different results.

5.2. *Students' evaluations of different types of feedback based on qualitative data*

While the quantitative analysis revealed no significant differences between the groups, the qualitative findings of the study offered important insight into the use of different types of feedback strategies in instructional videos.

The interview participants in the study recognized the importance of subject mastery in utilizing metacognitive feedback effectively. They tended to opt for metacognitive feedback when they believed they had a certain level of understanding of the subject and answered test questions correctly. On the other hand, when they had beginner-level knowledge about the topic, they preferred to receive elaborated feedback to enhance their understanding. These insights are consistent with the literature. According to Taub and Azevedo (2018), learners with high prior knowledge can use metacognitive strategies more than students with low prior knowledge. According to this inference, when designing interactive instructional videos, in-video feedback can be customized according to students' answers, with metacognitive feedback provided for correct answers and elaborated feedback offered for incorrect answers.

Moreover, all three participants offered suggestions for integrating the two types of feedback. They proposed a feedback format that included "a brief explanation" (elaborated feedback) followed by a "reflection question" (metacognitive feedback). During the interviews, this suggestion stood out as a new strategy that has not been fully examined in the literature. Only using elaborated feedback, including metacognitive hints, can be seen as an example in literature (Golke et al., 2015). Thus, another effective

feedback strategy could be to combine topic-specific, elaborated, and metacognitive feedback in interactive instructional videos.

The qualitative findings suggest that providing feedback based on students' answers and subject mastery level, or a thoughtful integration of both types of feedback, could enhance the learning experience. Future research could investigate the most effective ways of providing such feedback for different subject matters in different contexts.

6. Limitations

This study took place during the COVID-19 pandemic when most students were experiencing low motivation for schooling, which could be a factor affecting the results. It was also conducted within the scope of only one course with preservice teachers focusing on only one topic. As the topic of the videos could be an important factor for feedback preferences, the research can be repeated within the scope of different subjects and courses. To generalize the research findings to a larger population, further research can investigate the role of feedback types on student motivation and metacognitive awareness with different groups and grade levels. In addition, researchers should pay close attention to the qualitative findings when conducting comparison studies on different feedback types.

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