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Instructor Presence in Video Lectures: Preliminary Findings From an Online Experiment

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ABSTRACT **Motivation.** Despite the widespread use of video lectures in online and blended learning environments, there is still debate whether the presence of an instructor in the video helps or hinders learning. According to *social agency theory*, seeing the instructor makes learners believe that s/he is personally teaching them, which leads to deeper cognitive processing and, in turn, better learning outcomes. Conversely, according to *cognitive load theory*, adding an image of the instructor may hinder attention engagement with lecture content due to split-attention effect. Not only are theoretical propositions conflicting, but so is the empirical evidence as well. **Objective.** This study investigates the effects of the presence of the instructor's face in the corner of an educational video on learning outcomes, perceived cognitive load, and perceived social presence in the context of foreign language vocabulary learning. **Method.** In an online quasi-controlled experiment with between-subject design, 112 participants were randomly assigned to view a 10-min-long educational video in one of two conditions: instructor-present or instructor-absent. As for the latter condition, the face was shown only at the introduction of the presentation. Afterwards, participants completed a retention test as well as a cognitive load and social presence questionnaire. **Results.** No significant differences were found for any dependent variable. **Conclusion.** Individuals differ so much in their language aptitude as well as motivation to perform well that random assignment is probably not enough to ensure balanced groups in this particular study context. Besides, the approach that we used to measure cognitive load as well as social presence is not suited for between-subject design, even though it was previously used in such settings.

INDEX TERMS Multimedia learning, instructional video, image principle, online lectures, instructional design, distance education.

I. INTRODUCTION

In March 2020, the world changed. In just a few months, the pandemic has transformed our lives on an unprecedented scale, impacting individuals, communities, organizations and countries [1]–[5]. Universities and other educational institutes have begun closing campuses and shifting to online learning [6], [7]. This has presented unique challenges for educators, as they have had to adapt their courses in a very short time to meet the moment. Although video lectures had been widely used in blended and online learning environments (e.g., Coursera, EdX, Udacity, and Khan Academy) even before the COVID-19 outbreak [8]–[12], specific guidelines for designing such videos have been scarce [11], [13]. Yet video lectures can take diverse forms and the video lecture style might have effects on learning outcomes as well as enjoyment [14], [15].

One of the fundamental design aspects concerns the presence of the instructor in the video [9], [14], [15]. Besides, if an instructor is present, s/he may be either fully visible, standing next to a screen on which the slides are presented, or only a ''talking head'' may be shown by using a picture-in-picture overlaid on the lecture slide [11]. While intuition suggests recording at least talking-head lectures to mitigate the lack of physical instructor presence, theoretical propositions are conflicting. According to social agency theory, the presence of the instructor in the video promotes a sense of interaction between the instructor and learners, which in turn increases cognitive processing and learning performance [16]. Conversely, according to cognitive load theory,

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instructor presence impedes learning as students have heavier cognitive load, which is defined as the amount of information being stored and manipulated in working memory [17], when they split their attention between the learning materials and the instructor [14]. Likewise, the empirical findings are inconclusive, which may suggest that the instructor's on-screen presence has different effects depending on the type of knowledge being taught, cultural distance, content difficulty, individual learning preference and so on. Besides, in some contexts such as foreign language learning, which has not been investigated yet, the presence of the instructor's face may increase comprehension by supplementing the instructor's narration with a nonverbal communication channel that allows for lip reading [18].

In this paper, we start to fill in the identified gap in the existing literature by investigating the effects of instructor presence in the corner of a lecture video on learning outcomes, perceived cognitive load, and perceived social presence in the context of foreign language vocabulary learning. We decided to investigate a ''talking head'' version instead of a ''lecture-style'' form showing the instructor entirely because the former can be easily recorded on a laptop using Microsoft PowerPoint, while producing the latter requires a recording studio and video editing skills, which are not available for most of the educators impacted by COVID-19.

The rest of this paper is structured as follows. In the next section, we introduce the theoretical background on multimedia learning as well as the theoretical propositions for the support and opposition of incorporating an instructors' image into instructional videos. In Section III, related work is presented. The research method and the experimental design are explained in Section IV. This is followed by Section V, which contains the results of the statistical analysis on the raw data, and an interpretation of the results. In Section VI, we discuss our findings while their implications are considered in Section VII. In Section VIII, we elaborate on threats to validity that are relevant for our study and how we addressed them. Finally, we summarize the key findings and suggest directions for future research.

II. THEORETICAL BACKGROUND

The term ''multimedia'' is defined by Mayer [19] as presenting both words and pictures. Words can be presented in verbal form such as written text or narration, while pictures are in pictorial form, for example, static or dynamic graphics [19]. Hence, one can infer that multimedia instruction means, in the light of the concise definition mentioned, the presentation of words and pictures concurrently that aims to foster learning [20]. It includes a broad range of scenarios, ranging from conventional textbook lessons to prevalent online educational videos. More precisely, what makes them a multimedia instructional presentation is that words and graphics are employed regardless of the medium [21].

In line with this, multimedia learning is perceived as a knowledge construction activity in which cognitively active learners build coherent mental representations from words and pictures. According to this view, knowledge is not an entity that can be transferred from one place to another and received passively by students. On the contrary, one needs to select, organize, and integrate the relevant verbal and nonverbal information presented so as to construct new knowledge that can be thoroughly understood and remembered [20]. Research on learning has demonstrated that meaningful learning necessitates appropriate cognitive processing on the learners' part, and it is feasible to prime cognitively active learning through a well-designed multimedia instructional message [20]. For this reason, it is crucial to determine how to design multimedia presentations that foster learning in conjunction with how people learn from words and pictures.

The proponents of multimedia learning believe that people can learn better from verbal material and effective graphics than from words alone [20]. This affirmation can be referred as the multimedia principle, which is the basis for using multimedia instruction [21]. With a view to contributing to the science of instruction, Mayer [21], together with other researchers, have identified 12 research-based principles for designing multimedia. Nevertheless, they are not solely interested in pinpointing these multimedia instructional methods, which are the practical knowledge for designing effectual multimedia instructions. Understanding how the human mind works during multimedia learning and how instructional manipulations influence the cognitive processing of learners also intrigued them. It is speculated that learning effectiveness can be maximized when multimedia messages are designed to support the functioning of human brains [20]. To account for this, Mayer proposed the cognitive theory of multimedia learning (CTML) that is primarily founded on several well-known cognitive theories [22]. In short, the design principles for multimedia instruction determined by Mayer are both research-based and theory-grounded. One prominent rationale for apprehending these fundamental theories is that instructional designers can devise a multimedia material based on their extensive knowledge of how the multimedia instructional principles work and maximize their effectiveness instead of simply following them rigidly [20].

A. THE COGNITIVE THEORY OF MULTIMEDIA LEARNING (CTML)

As mentioned above, the cognitive theory of multimedia learning (CTML) is a research-based theory propounded by Mayer to shed new light on how people learn from words and pictures. Furthermore, it contends that one should take account of how the human mind works as well as how information is being processed during learning when designing a multimedia message [23]. This theory is based on three underlying assumptions: dual channels, limited capacity, and active processing [24]. These assumptions do not contradict one another but focus on elucidating different aspects of multimedia learning.

1) DUAL-CHANNEL ASSUMPTION

The dual channel assumption in CTML hypothesized that visual and verbal materials are processed by separate information processing channels in working memory [24]. This notion has a very close association with Paivio's dual coding theory [25] and the working memory model [26], [27]. According to the dual coding theory, verbal and image representations are encoded by the verbal and pictorial system respectively. Each of the two independent memory codes can result in recall; hence, having two memory codes for an item is considered as superior because dual coding may prompt better memory [28]. Similarly, the working memory model, which is a robust model for short-term memory, also consists of subcomponents that process visual and verbal information separately. They are the visuo-spatial sketchpad which is in charge of maintaining and manipulating visual images, whereas the phonological loop is assumed to keep and rehearse speech-based information [29]. The two cognitive theories mentioned are considered useful as they can provide valuable insights when one examines the independent contributions of verbal and visual codes [28].

2) LIMITED-CAPACITY ASSUMPTION

The limited-capacity assumption states that both verbal and visual channels have severely limited capacity to process information at one time [16]. One of its elementary tenets is Baddeley's assumption, which assumes that working memory has finite cognitive resources. This instructional implication is then further developed in Sweller's cognitive load theory [17] that delineates the finite capacity of working memory in terms of selecting relevant information and the processing of incoming data from each channel [28], [29]. The theory distinguishes between three kinds of cognitive load during learning, which are as follows: intrinsic, extraneous, and germane [29].

Intrinsic cognitive load depends on the inherent nature of the materials being learned. The more complex the information learners must process, the higher the intrinsic cognitive load they experience [30]. This is due to the level of element interactivity. Materials with high element interactivity are difficult to understand and thus impose high intrinsic cognitive load. The second category is *extraneous cognitive load*, which is unnecessary and consumes limited cognitive processing capacity due to improper instructional design [31]. Lastly, *germane cognitive load* develops when a motivated student is endeavoring to process and integrate new information [30]. It may be primed by an engaging learning task [20].

Both intrinsic and extraneous loads could impede learning while germane load may facilitate learning. These three kinds of cognitive load would compete for the limited resources of working memory, and cognitive overload happens when the information overwhelms the working memory capacity [30]. As a consequence, learning is somewhat thwarted due to the fact that information is not selected and processed optimally. To attenuate the problem, three types of instructional design principles for multimedia learning are proposed to reduce extraneous load, manage intrinsic load, and foster germane load [21]. Intrinsic load is considered to be invariant whereas it is possible to manipulate extraneous and germane load [29]. Hence, one should restrain from designing an instruction that will overtax the mind with irrelevant information [29] so that more working memory resources will be dedicated to germane load [30].

3) ACTIVE PROCESSING ASSUMPTION

Finally, active processing assumes that meaningful learning occurs through selecting appropriate incoming information, organizing the selected material, and then integrating it with existing knowledge [21]. Focusing on the relevant words and pictures in the presented material, learners select relevant information and bring it into working memory. Here, a coherent mental structure can be built. The knowledge in long-term memory is then activated and brought into working memory so that integration of the selected material with the prior knowledge can occur [20]. Mayer and Moreno [32] took the idea from constructivist learning theory. This assumption rejects the common notion that learning is a passive processing activity. On the contrary, multimedia learning requires people to be cognitively active in order to understand the multimedia presentations [20].

B. INSTRUCTIONAL VIDEOS

Instructional videos have been increasingly popular in educational context [33]. For instance, they are the prominent form of instructional strategy in MOOCs and flipped classrooms; and act as an aid to self-study [34]–[37]. Besides the growth of video lectures' popularity and ubiquity, the types of video lessons also varied.

There are different types of video lectures, including: lecture capture format, voice-over presentation, picture-in-picture video, and pen-cast style [38]. Among them, the lecture capture and picture-in-picture video generally incorporate the talking head or full body of the instructor. Although video lectures have been created and made available by many educational institutions, there are no general guidelines for designing and presenting them [38].

One of the issues which intrigue many educators and researchers is whether incorporating an instructor or an instructor's face into a video will affect learning [14]. The theoretical propositions for the support and opposing of incorporating instructors' images into instructional videos will be discussed below.

1) SPLIT-ATTENTION EFFECT

According to cognitive load theory and the cognitive theory of multimedia learning, incorporating redundant information into a multimedia instructional message will bring extraneous load to learners and subsequently results in subpar learning. These irrelevant messages can be either in visual or verbal form [30]. Thus, in the context of instructional videos, an instructor's image can be considered redundant as

it carries no pedagogically relevant information but occupies the limited working memory capacity [39]. In other words, the very presence of an instructor's face can cause learners to engage in extraneous processing that is not beneficial to learning effectiveness. Moreover, based on the working memory model [26], [27], an instructor's image would compete for the limited visual working memory capacity with the other relevant visual information on the screen and then results in visual channel overload [40].

When instructors, especially their faces, are visible on the screen, they may serve as a visual distractor that takes learners' attention away from the instructional content in the graphic [30]. This statement is supported by findings from several empirical researches. For example, Kizilcec *et al.* [41] found out that participants spent, on average, 41% of time staring at the instructor's face while watching a video lecture. Van Wermeskerken *et al.* [11] also observed that students looked at the instructor's face during the video lesson, which was about 30% of the time. The observation obtained by Zhongling Pi and Jianzhong Hong [42] showed that Chinese participants spent more than half of the time looking at the face of the instructor. All of these make it reasonable to hypothesize that showing the image of the instructor in a video lecture may be distracting.

It is speculated that when an instructor's face is visible to students, they have to divide their visual attention between the face and the relevant content of the lesson shown on the screen. This situation will create a split-attention effect [20]. If learners focus more on the instructor and fail to attend to the relevant visual content of the lesson, learning might be impeded. Moreover, taking into account the transient nature of a video lesson, learning may be hampered when one does not timely attend to the relevant information being addressed [11].

The split-attention effect suggests that the instructor's face is extraneous; videos that include the instructor's face may not be ideal for learning. Nevertheless, it is possible that this type of presentation can indeed enhance learning [30]. A more positive view sees multimedia learning as a social event, and social cues elicited from instructors can affect the learners' motivation during learning [20]. Details will be discussed in the following subsection.

2) SOCIAL PRESENCE AND SOCIAL AGENCY THEORY

The concept of *social presence* was initially studied in the field of telecommunications and was defined by Gunawardena [43] as ''the degree to which a person is perceived as a 'real person' in mediated communication''. A general research finding from this field concerning the effect of social presence shows that learner engagement and learning outcomes are fostered when information is delivered in a way that heightens social presence [30]. Hence, it is reasonable to suggest that social presence can positively affect learning outcomes. In line with this, it is speculated that an instructor's image presented in a video can somehow help to create a sense of social presence. That is, learners would feel that they are interacting with a ''real'' person while watching a video lesson that incorporates an instructor's face [30]. If a sense of social presence is promoted by making an instructor's face visible to learners, better learning outcomes should be fostered.

In order to promote a sense of social presence, social cues can be employed [20]. According to the social agency theory, social cues used by instructors would prime a social response in learners and subsequently develop a social rapport between them. This sense of partnership can motivate learners to engage in active processing and foster learning outcomes [20]. When an instructor's face is shown in a video lesson, they provide nonverbal communication cues such as eye-gaze, gestures, and facial expressions to learners. As these cues replicate the social aspect of human face-to-face interaction, they should be able to activate social response in learners [9], which in turn encourage them to put in more effort during learning and produce better learning outcomes. Besides, based on the dual coding theory [25], it is likely that these nonverbal cues can enhance one's understanding of the lesson by complementing the verbal information; they are processed by visual working memory and hence, will not burden the verbal working memory that is in charge of auditory information [9].

3) THE IMAGE PRINCIPLE

Based on inconsistent evidence from several studies analyzing the impact of adding a humanoid or a cartoon-like pedagogical agent in multimedia instructional presentations, Mayer [20] suggested that ''people do not necessarily learn better when the speaker's image is added to the screen''. It is hypothesized that the extraneous visual processing caused by an image of the speaker on the screen would offset the potential positive effect of social responses [20]. Although some of the findings show that students who had learnt from a multimedia lesson with a pedagogical agent performed slightly better on a subsequent transfer test, the median effect size is small [20]. Note that this principle was not tested with a human instructor in videos but with animated pedagogical agents in simulation games, interactive lessons, narrated animations, and so on [20], so the effects of the presence of human instructor in instructional videos are not well informed [9].

III. RELATED WORK

So far, several studies have been conducted to find out the effect of instructor presence in video lessons on learning outcomes, perceptions, or attention allocation. Nonetheless, the findings are inconsistent; that is, some suggest a positive effect while others find negative or no effect.

One of the studies which found instructor presence effectual was conducted by Pi and Hong [42]. They investigated the effect of four different presenting modes of educational video on learning process and learning outcomes. All videos were about attachment theory in psychology, and the stimuli were the following: PPT slides with only voice-over,

PPT slides with instructor presence, video showing only the instructor, and lecture capture video which includes the instructor, students and synchronized PPT slides. The results showed that the students who watched the video with PPT slides and instructor obtained the best learning outcomes. Besides, eye-tracking evidence from participants from this group revealed that they allocated a lot more attention to the instructor (about 62% of the total fixation time) than to the PPT slides. This suggested that although the instructor's face may impose cognitive load on students, the sense of social presence produces high learning engagement and thereby facilitates learning. At least this was found for Chinese students. In contrast, some studies on Western populations produced different results, which led Pi and Hong to conclude that it is attributable to cultural differences. Note that even though the other two videos also included the image of the instructor, they did not render better learning, which implies that the sense of social presence and cognitive load may need to be well-balanced.

Another empirical evidence that substantiated the claim about the positive impact of instructor presence was provided by Ilioudi *et al.* [44]. The study explored the effects of instructor presence in instructional videos on learning outcomes and perceptions. The subject studied was mathematics in secondary education and consisted of three modules. Students were assigned into three groups: the control group which learnt from books; one group that watched the instructor present video; while the last group watched the pen-cast video. Learning performance tests showed that there was no significant difference between the three groups during the first two modules; however, students from the instructor-present video group performed significantly better than the other two groups in the third module, which was the most difficult module of the three. Hence, Ilioudi *et al.* [44] speculated that instructor-present videos could be superior for learning complex topics. Although students were in favor of learning from books, this might have been due to students' familiarity with the conventional learning style.

The study conducted by Hong *et al.* [12] provided insights into the implications of the type of knowledge being taught and instructor visibility on perceived cognitive load and learning outcomes. The two categories of knowledge being taught were declarative knowledge, which focused on the topic of educational technology, and procedural knowledge, which taught about image processing in Photoshop. Declarative knowledge involves knowing and remembering the factual information while procedural knowledge is knowing the associated information and then practicing how to do something. A mixed method design was used in this study. Participants were randomly assigned either to the group that watched the video teaching declarative knowledge without the instructor and then learning procedural knowledge with the instructor visible in the video; or to the other group which watched the declarative lecture showing the instructor and the procedural lecture without showing the instructor. The results from the self-reported cognitive load questionnaire revealed that the video teaching procedural knowledge with instructor presence induced significantly more cognitive load, but not when learning declarative knowledge. Furthermore, the declarative knowledge video with embedded instructor's image produced better learning outcomes than the video without the instructor, whereas there was no significant difference in learning outcomes for procedural knowledge videos. The preliminary evidence from this study indicates that learning outcomes varied owning to the influence of the type of knowledge and instructor visibility. Therefore, it is advisable to consider these two factors while designing a pedagogical video.

Wang and Antonenko [9] investigated the impact of instructor presence on visual attention allocation, learning outcomes, and perceptions in the context of mathematics learning of varying content difficulty. Participants were asked to watch both easy and difficult topic videos and they were randomly assigned to either one of the two conditions: the easy topic without an instructor and the difficult topic with an instructor; and vice versa. The findings showed that instructor presence enhanced knowledge recall for the easy topic, but no effect was found for the difficult topic. Besides, there were no significant effects on learning transfer for either topic. Based on these, Wang and Antonenko [9] speculated that, due to lower inherent complexity of the material, participants watching the easy topic with instructor presence had more cognitive resources available to process the nonverbal cues provided by the instructor. These nonverbal cues might have helped to direct and maintain participant attention throughout the lesson, thus resulting in better knowledge recall. Eye-tracking data revealed that the instructor was an attention magnet for both topics; participants spent 26% of the time looking at the instructor while watching the easy topic video, whereas 22% of the time was spent attending to the instructor in the difficult topic video. Moreover, participants were found strongly in favor of seeing the instructor with substantially higher ratings on perceived learning and satisfaction for both easy and difficult topic videos. Interestingly, instructor presence significantly decreased perceived cognitive load for the difficult topic video; nonetheless, as mentioned before, instructor presence did not improve learning performance for difficult topic. This indicates that people might not be able to provide reliable data when it comes to subjective reporting. It is important to note, however, the two instructor-present videos and the other two instructor-absent videos were designed by two different MOOC platforms. Thus, the number and nature of concepts covered in the videos were not the same.

Wang *et al.* [15] conducted another experiment to disentangle how instructor presence in an instructional video impacts learning, perceptions, and visual attention allocation. They also aimed to discover whether visual attention pattern can predict learning and perceptions. Similar to the previous research, students were asked to watch two videos on mathematics learning of varying content difficulty in either one of the two conditions: the easy topic without an instructor and the difficult topic with an instructor; and

vice versa. Contrary to the previous findings on learning outcomes, this study found instructor presence did not influence participants' retention of information for both easy and difficult topics. Nevertheless, instructor presence significantly improved learning transfer for the difficult topic only. Wang *et al.* [15] attributed this inconsistency to the differences in the nature of materials and the topics presented. Note that the topic used in the study by Wang and Antonenko [9] was geometry, while statistics was the topic of discussion in Wang *et al.* study [15]. The results of learner perceptions revealed that instructor presence was particularly beneficial to participants watching the difficult topic video. While there were no significant differences on self-reported cognitive loads for the videos on easy topic, perceived intrinsic and extraneous loads were reported significantly lower for the video with an instructor on the difficult topic. Wang *et al.* [15] explained that this could have been due to the nonverbal cues used by the instructor, which helped the participants to focus on the most crucial information efficiently, as well as aided in the comprehension of the concepts being taught. Besides, participants from both topics were strongly in favor of seeing the instructor and rated significantly higher situational interest. Similar to the previous study, the instructor's face was found to attract a considerable amount of visual attention, regardless of material complexity. Lastly, Wang *et al.* [15] found out that visual attention paid to the instructor positively predicted participants' satisfaction with the videos for both easy and difficult topics. Nevertheless, the visual attention paid to the instructor did not predict learning and other perception variables.

Van Gog *et al.* [45] explored the effects of showing the model's face in a video modeling example on attention allocation and learning outcomes. Participants were presented with a video example showing how to solve a puzzle that either included or excluded the instructor's face. They were shown the video twice. Eye-tracking data indicated that participants spent an average of 23% and 17% of all fixations on first viewing and second viewing respectively. Although the model's face attracted some attention, participants who saw it performed better in solving the puzzle than those who did not, at least after the second viewing. Based on these findings, van Gog *et al.* [45] suggest that the instructor's face may not be distracting; on the contrary, an instructor's gaze direction might guide learners to pay attention to the relevant area of an instructional material efficiently and in a timely manner.

In an attempt to replicate the findings of the foregoing experiment by van Gog *et al.* [45], van Wermeskerken and van Gog [14] investigated the effects of seeing the model's face and gaze in a demonstration video example about organic chemistry on attention allocation and learning outcomes. The design was rather similar to the previous study, except that a different task was used and an exploratory condition, which showed the model's face but did not provide gaze guidance was added. Instead of just solving a puzzle, participants were asked to build an organic molecule and then took a knowledge test. Eye-tracking data revealed that the model's face did attract attention, but it only constituted around 13–17% of the total dwell time. In contrast to the aforementioned study, this study found no significant difference in learning outcomes between the group that saw the instructor's face and the group that did not. Based on these, Van Wermeskerken and van Gog [14] speculated that the results from the previous study could be an anomaly. That was because their findings corresponded with other related studies, which also found that showing an instructor's face did not influence learning outcomes.

Another study that revealed neither beneficial nor detrimental effects of displaying an instructor's image in an instructional video on learning outcomes was conducted by Homer *et al.* [30]. In this study, the effects of instructor visibility on learning outcomes, perceived cognitive load, and social presence were investigated. Undergraduate students were randomly assigned to view a video about child development that either involved PPT slides with voice-over or a video involved PPT slides, voice-over, and an instructor's face. Results revealed that no significant differences were found for learning outcomes and perceived social presence. Homer *et al.* [30] surmised that individual differences in learning preference might have caused the students who saw the instructor's face to not report a greater sense of social presence. In terms of perceived cognitive load, participants who watched the video embedded with the instructor's image reported higher cognitive load than those who did not. This supported the assumption that an instructor's face can act as a distractor and creates a split attention effect, which increases one's cognitive load.

Kizilcec *et al.* [41] explored how showing an instructor's face in a video lesson about organizational sociology could affect learning outcomes, visual attention, and affective response. This study used a 2 x 7 repeated measures design. It means that the video is divided into 7 segments and the instructor's face was shown in alternate segments; one version showed the face in segments 1, 3, 5, and 7, while another version displayed the face in segments 2, 4, and 6. Students were randomly assigned to either version. Results from affective response questionnaire revealed that students strongly favored seeing the instructor's face, which implied that social cues could have induced the participants' positive perception of the instructor. Besides, the instructor's face also attracted a significant amount of visual attention; participants spent, on average, 41% of the time looking at it. Therefore, Kizilcec *et al.* [41] concluded that showing an instructor's face would change learners' watching behavior and learner fondness for instructors may stimulate learning motivation. However, results from both short-term and medium-term recall tests revealed that the instructor's face had no effect on learning outcomes.

The impact of instructor presence in learning from a video modeling example showing step-by-step calculations of probability problems were examined by van Wermeskerken *et al.* [11]. Participants were randomly

TABLE 1. Summary of the related work.

Work	Subject	Retention	Transfer	Cognitive load	Social presence
Pi & Hong, 2016	psychology	P[a]		-	-
Ilioudi et al., 2013	mathematics	P[b]		-	-
Hong et al., 2018	declarative knowledge	P[b]		?	-
	procedural knowledge	?[b]		A	-
Wang & Antonenko, 2017	geometry; easy topic	P	?	?	-
	geometry; difficult topic	?	?	P	-
Wang et al., 2020	statistics; easy topic	?	?	?	-
	statistics; difficult topic	?	P	P	-
van Gog et al., 2014	problem-solving task	P	?	-	-
van Wermeskerken & van Gog, 2017	building organic molecule	?[a]		-	-
Homer et al., 2008	child development	?	?	A	?
Kizilcec et al., 2014	sociology	?	-	-	-
van Wermeskerken et al., 2018	probability	?	?	-	-
Wilson et al., 2018	experiment 1: biology	A	-	-	-
	experiment 2: history	?	-	-	-
	combined experiment 1 and 2 analysis	A	-	-	-

A – instructor-absent group performed better, **P** – instructor-present group performed better, **?** – the difference was not statistically significant

[a] the combination of both retention and transfer test

[b] it is not specified whether the test is retention, transfer, or the combination of both

assigned to watch either the instructor-present or the instructor-absent video. Their visual attention was also recorded throughout the process in order to explore the connection between viewing behavior and learning achievement. The data collected revealed that participants allocated a considerable amount of attention to the instructor's face, which took up an average of 30% of the time. What is more, their attention to the instructor did not decrease as the lesson went on. These suggested that faces are potential attention magnets and act as a salient and seductive distractor. Even though students spent much time focused on the instructor, their learning outcomes were not statistically significantly different from those who viewed the instructor-absent video.

A set of experiments conducted by Wilson *et al.* [10] found that adding visuals of an instructor to video lectures has deleterious effects on learning outcomes. Only the first two experiments will be discussed here as they are more relevant. The aim of the studies was to investigate how instructor visibility in online video lectures may affect attention, learning outcomes, and subjective preferences and beliefs about learning. In the first experiment, a topic about global population growth in biology was used. Participants were randomly assigned to three lecture conditions, which are as follows: audio-only, audio with text, and instructor-present. Wilson *et al.* [10] found no differences across the three groups in terms of attention and interest in the lesson; but the comprehension test results indicated that participant comprehension of the topic was significantly lower in the instructor-present group, which implied that seeing an instructor's image would impact learning outcomes negatively. The second experiment replicated and extended the results of the first experiment. Participants were either randomly assigned to the audio-only or to the instructor-present condition. Results from this experiment showed that, again, there was no significant difference in participant attention paid to the lesson between the two modalities. However, those from the audio-only group had significantly higher beliefs about learning. Although the difference in comprehension between the two groups did not reach significance in this experiment, a combined analysis of comprehension across the two experiments revealed a significance comprehension cost for the instructor-present condition relative to the audio-only condition. Based on these, Wilson *et al.* [10] thereby concluded that incorporating an instructor's image into a video lecture would impact learning outcomes negatively.

The main findings of the related work discussed above are summarized in Table 1. Initials "P" and "A" refer to the condition (instructor presence or instructor absence) that resulted in a significantly better performance (i.e. higher posttest scores, lower cognitive load, or higher social presence), while "?" means that the difference was not statistically significant. Table 1 reveals that the instructor presence effect still remains a research gap, even though numerous studies have investigated this issue. Furthermore, Table 1 also shows that the instructor presence effect has not been explored yet in the context of foreign language learning.

IV. METHOD

A. RESEARCH DESIGN

Several issues must be considered before choosing the appropriate experimental design [46]. As for our experiment, we chose a between-subjects design to avoid the learning effect. Furthermore, due to the COVID-19 pandemic, the experiment was conducted in an online environment rather than in a laboratory. Nevertheless, we implemented policies to have control over the experimental environment (e.g., we traced whether someone refreshed the page to watch the video again).

B. PARTICIPANTS

One hundred and twelve voluntary participants, who are recruited from two universities in Poland, participated in our online experiment. They were both full-time graduate and undergraduate students majoring in computer science or related fields, and all were fluent in English. Nevertheless, the records of 17 participants were removed after applying exclusion criteria to ensure high data quality (see Section IV-F). As a result, 95 participants remained in the analysis (77 males; 18 females). Their age distribution is presented in Figure 1.

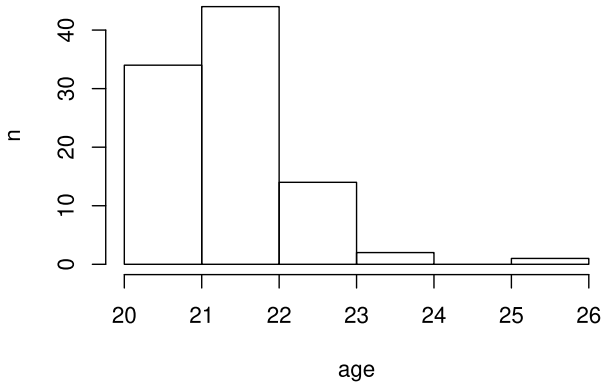

FIGURE 1. Participants' age distribution after applying exclusion criteria.

C. MATERIALS

1) STIMULI

We produced two videos using Microsoft PowerPoint. Both videos have identical slides and audio narration; the only difference is that in the instructor-present video, the instructor's face is shown in a frame at the bottom right-hand corner of the video (see Figure 2). Whereas in the instructor-absent video, the talking head is not included. Both videos last approximately ten minutes.

The videos were designed to introduce basic Mandarin Chinese vocabulary to novice learners. The fifteen vocabularies being taught were chosen from the Chinese Proficiency Test level one (HSK level one) vocabulary list, while the pictures presented in the slides were taken from two free stock image websites (www.pexels.com, pixabay.com).

FIGURE 2. Screenshot from the instructor-present video.

2) DEMOGRAPHIC QUESTIONNAIRE

The demographic questionnaire on the webpage was implemented using HTML forms. It contained questions on age, gender, native language, and level of Mandarin Chinese proficiency. This data was collected as controlling factors in the study.

3) POSTTEST

Posttest was constructed by using the JMatch application in the Hot Potatoes software suite (hotpot.uvic.ca). This test was a fifteen-question drag-and-drop test. There were fifteen short audio clips on the left, each containing one vocabulary taught in the videos; while there were fifteen corresponding pictures on the right, which participants could drag to match with the audios.

4) LEARNER PERCEPTION QUESTIONNAIRE

Two perception questionnaires were created by using Google Forms. The first consisted of five questions and corresponded to the instructor-absent condition; whereas the second included one more extra question and corresponded to the instructor-present condition (see Appendix IX). The first question in both questionnaires assesses the overall cognitive load participants experienced during the learning process. Questions two to five evaluate the instructor's social presence. The extra question in the second questionnaire determines participants' affective response to seeing the instructor.

5) WEBSITE

All materials were orchestrated using HTML and PHP. The resulting website was hosted at a NCU server.

D. MEASURES

1) LEARNING OUTCOMES

Learning outcomes were measured using recall assessment. In other words, participants' ability to recall vocabularies presented in the video was measured. This knowledge test was mentioned in Section IV-C3. The total score was computed

by giving 1 point for each correct matching. Hence, the maximum score was 15.

2) COGNITIVE LOAD

Cognitive load was assessed by asking participants to self-report the perceived amount of mental effort invested in learning on a 9-point Likert scale. The scale ranged from *very, very low mental effort* (1) to *very, very high mental effort* (9). This subjective measure of cognitive load was proposed by Paas [47], and has been validated in many prior studies (for review, see [9]) and has been used in related work [9], [12], [15].

3) SOCIAL PRESENCE

Social presence was self-reported using a Likert scale composed of four 5-point items (varying from 1 = *Strongly disagree* to 5 = *Strongly agree*) adopted from the social presence questionnaire by Kizilcec *et al.* [18]. Our participants indicated the degree to which they agreed with the following statements:

- I felt that the instructor was present;
- I felt that the instructor was very detached in her interactions with me (reversed);
- I felt that the instructor was aware of my presence;
- I felt that the instructor remained focused on me throughout our interaction.

One item from the original questionnaire (i.e., "I felt like the instructor was in the same room as me") was not included in our study because of close similarity to item 1. Social presence scores were computed by summing the four items. Thereby, social presence scores range from 4 to 20, with higher scores indicating more subjective experiences of social connection with the instructor (item 2 is reverse scored).

4) FEELINGS TOWARD SEEING THE INSTRUCTOR

Participants who watched the instructor-present video responded to one additional question to provide information regarding their subjective feelings toward seeing the instructor. They reported it by choosing at least one suitable adjective from six adjectives (i.e., useful, helpful, engaging, distracting, annoying, frustrating) that characterized their perceptions of the instructor. The approach was adopted from Wang *et al.* [15].

E. PROCEDURE

Firstly, a participant invitation letter which consisted of information including study procedures and general purposes as well as the link to the online experiment were sent to potential participants via email. All of them were enrolled in academic courses taught by the author and his colleague. They were encouraged (but not coerced) to participate in the experiment. Those who participated were awarded extra course credit.

Since participants could choose to ignore the invitation or withdraw from the experiment at any time, those who took part in the study were considered giving their consent. Participants were provided more detailed information about the experiment in written form on the first page of the website. Following it, they were randomly assigned to one of the two conditions: instructor-present or instructor-absent, and presented with the corresponding video. It is important to note that participants watched the video linearly and were not able to use the pause button for breaks or replay the video. Once the instructional video had finished, they were automatically directed to a roughly one-minute video which briefed on what to fill in for the demographic form as well as how to do the matching test. Participants were again automatically directed to another page, which included the demographic questionnaire at the top of the page and the posttest located below it. No time limit was imposed on participants for completing the assessments. After they had filled in their demographic data and did the knowledge test, they had to click the "Send Answer" button to save the data in MySQL database. Immediately after that, participants responded to a short questionnaire on Google Forms that evaluated their perceptions. These self-reported measurements were optional and hence, after applying the exclusion criteria, there were, in total, seventy-three participants (39 in the instructor-absent group and 34 in the instructor-present group) responded to it. The experiment lasted about twenty minutes.

F. EXCLUSION CRITERIA

After the experiment, we removed the records of some participants to reduce threats to internal validity. Since the experiment was conducted online, we could not guarantee a controlled and undisturbed environment. Therefore, we excluded participants who failed to conform to the instructions (e.g., some participants attempted to watch the video twice) as well as those who encountered technical problems during the experiment. Moreover, participants were expected to have no prior contact with Mandarin Chinese or any related languages. Those who reported their prior contact with Mandarin Chinese were excluded. Furthermore, we decided to exclude those who are not Polish native speakers to have a homogenous group of participants.

TABLE 2. Exclusion Criteria (criteria are not mutually exclusive).

Exclusion criterion	#participants
First language other than Polish	7
Prior contact with Chinese Mandarin or related languages	2
Violation of instructions	6
Technical problems	2

All exclusion criteria and the number of affected records are listed in Table 2. When at least one criterion applied to a participant, their record set was excluded from further analyses.

V. RESULTS

Descriptive statistics for learning outcomes, cognitive load and social presence are presented in Table 3, while the

TABLE 3. Descriptive statistics for learning outcomes, cognitive load and social presence.

	Learning outcomes			Cognitive load			Social presence		
Condition	Median	Mean	Std. dev.	Median	Mean	Std. dev.	Median	Mean	Std. dev.
instructor-absent	12	11.7	3.0	6	5.4	2.0	15	14.6	2.1
instructor-present	13	12.3	2.7	6	6.0	1.3	14	14.0	2.9

distributions of these variables are shown in Figure 3. All collected data is available at a supplementary Web site: https://github.com/przybylek/talkingHead.

As for learning outcomes, the statistics suggest that participants in both groups did not have great difficulty in recognizing vocabularies learnt from the videos. Nevertheless, the mean as well as the median score in the instructor-absent condition are slightly lower than in the instructor-present condition. Besides, the boxplots show that the distributions of scores for both groups are skewed to the left and there is a slight ceiling effect.

When it comes to cognitive load, the mean score in the instructor-present condition is slightly higher than in the instructor-absent condition, which is in line with the expectation, whereas the median score is identical.

Surprisingly, the instructor-absent group reported slightly higher social presence. The social presence scale has a Cronbach's alpha of 0.7 for the instructor-present group, which is in line with the previous studies [18], [30]. However, as for the instructor-absent group, the value of this coefficient is not only unacceptably low (0.24), but is also negatively correlated with item Q3 that was reversed.

To determine whether the observed differences were statistically significant, we followed the procedure presented in our prior research [46]. Since the box plots revealed that neither variable was normally distributed in both groups, we utilized a non-parametric Mann-Whitney U test. We tested the null hypothesis (the use of instructor-present or instructor-absent video has no effect on the results) against the alternative hypothesis (there is a difference between the two alternatives) at a significance level of 0.05. No significant differences were found for any variable, while the resulting p-values are reported in Table 4. The analysis was performed using R studio.

TABLE 4. Results of Mann-Whitney U test.

Variable	W	p-value
learning outcomes	1010.5	0.3723
cognitive load	561	0.2525
social presence	745.5	0.3593

Finally, we examined the perception of instructor presence among learners who watched the instructor-present video. Note that one participant did not respond to this question and another two participants were excluded because of incongruent response, leaving $n = 31$ in the analysis. In general, participants were strongly in favor of seeing the instructor in the video (Fig. 4), with 87% of them rating instructor presence as helpful, useful, or engaging. Only 13% of participants responded negatively towards instructor presence and reported seeing the instructor as distracting, annoying, or frustrating.

VI. DISCUSSION

This study explored how instructor presence in a foreign language learning video influences learning outcomes, perceived cognitive load, the sense of social presence and students' affective reactions towards seeing the instructor.

The retention test results show that although participants in the instructor-present group scored slightly higher than their counterparts in the instructor-absent group, the difference is not statistically significant. In other words, this study found no evidence that supports the claims about instructor presence would either impede or enhance information recall. This finding is aligned with the results of several previous studies [11], [14], [30], [41]. One possible explanation for the current result is that there were other factors that moderated the effects of instructor presence, such as language aptitude, motivation to perform well, learning style, personality and so on. Moreover, our finding should be treated with caution because the data revealed a ceiling effect. Participant scores from the instructor-present group clustered towards the high end of the measure probably due to the fact that the test was relatively easy for the participants. Therefore, the ceiling effect may have censored the possible effects of instructor presence on learning outcomes.

Besides, seeing the instructor neither increased nor decreased self-reported cognitive load. This may have pertained to the fact that participants watched only one version of the videos. Since judgments are made relatively [48], participants in this experiment could not provide reliable evaluations. In order to vindicate this possible source of problem, we conducted a follow-up interview with some of the participants and they confirmed that it was rather hard for them to assess their perceptions of the video shown.

As for social presence, the results must be interpreted with caution, because the value of Cronbach's alpha for the instructor-absent group was unacceptably low and, what is more, one item was negatively correlated with the total scale. Taking into account that the internal reliability of the scale was previously validated in multiple studies (e.g. [18], [30]), our results suggest that participants in the instructor-absent

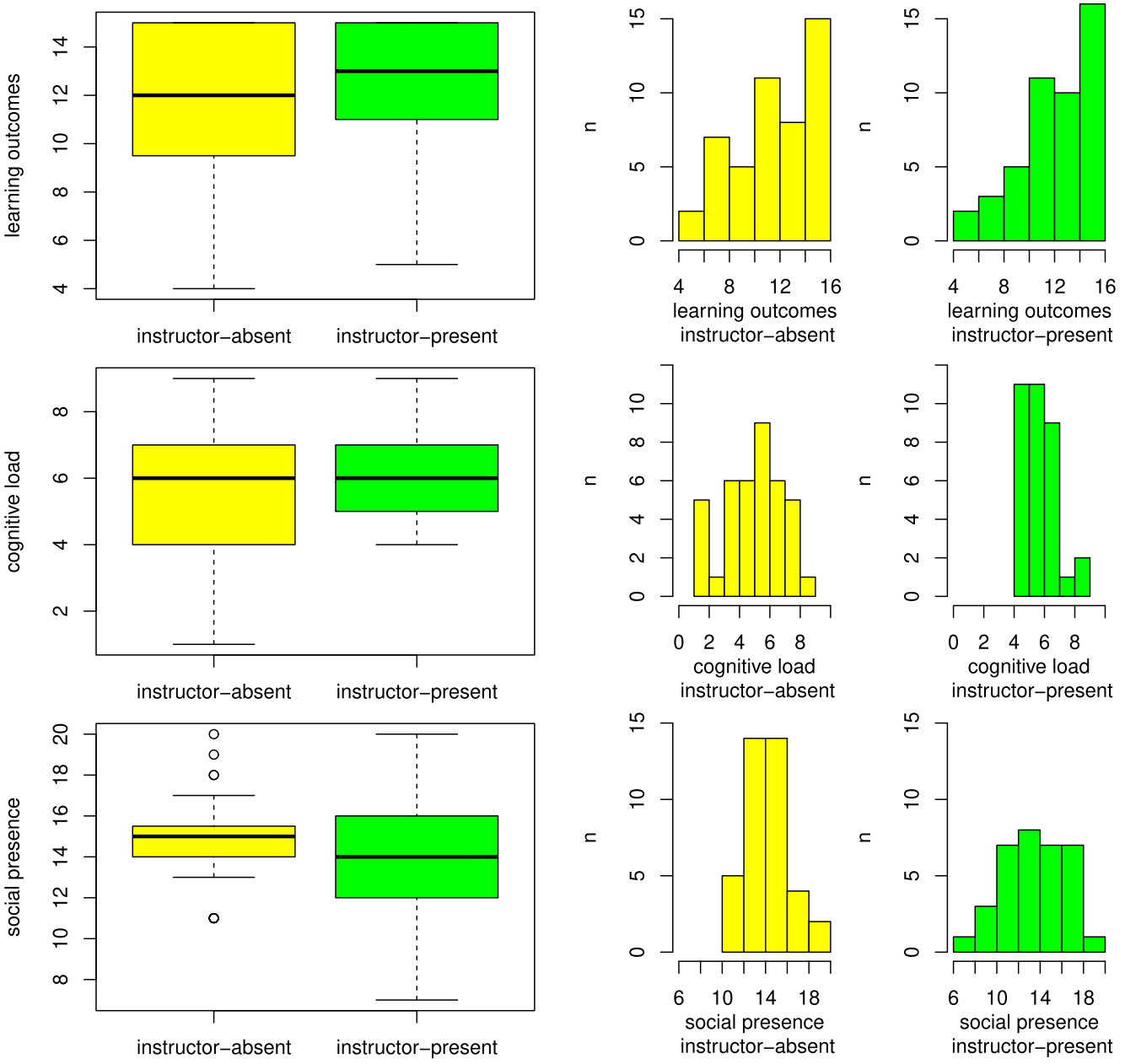

FIGURE 3. **Distributions of the dependent variables.**

group simply did not put much effort into giving thoughtful feedback. A possible explanation is that they were fed up with questions about social presence since they had not felt the presence of the instructor.

Interestingly, although no positive effect on social presence was found, participants seeing the instructor reported positive affective responses. This strong effect of instructor presence corresponds to the empirical findings of several previous studies [9], [15], [41]. One interpretation of the current finding could be that participants found out that extra articulatory information provided by the instructor's mouth movement was beneficial for language comprehension. Under normal circumstances, auditory information alone is sufficient for a competent adult listener to understand; nonetheless, people would seek more linguistic information conveyed by the speaker's mouth movement when intelligibility is low, for example, talking in noisy environments, listening to a non-native language, and so on [49]. The similar situation might have happened when participants were watching the instructor-present video. Accordingly, it could have been the availability of the additional visual information provided by mouth movement that caused most of the participants to have positive perception to the instructor's face.

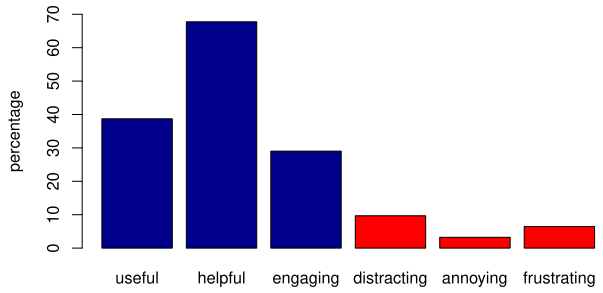

FIGURE 4. Participants' perceptions towards seeing the instructor.

VII. IMPLICATIONS

To the best of our knowledge, this is the first study that investigates the effects of instructor presence in an instructional video in the context of foreign language learning. Unfortunately, as our results are not statistically significant, we cannot provide any practical suggestions to online learning instructors or instructional designers. Nevertheless, we have several recommendations for researchers.

First, individuals differ so much in their language aptitude and motivation to perform well that random assignment is not enough to ensure balanced groups. Since these characteristics considerably affects learning outcomes, they may obscure the effect of treatment. Therefore, a more elaborate research design that can mitigate this problem is needed. That is, a matched-groups design, in which participants are first assessed on a characteristic that has a relatively strong effect on the dependent variable; then those whose characteristics match are grouped; and finally matched sets of participants are distributed randomly across the experimental groups [50].

Second, our study demonstrates that the approach employed to measure cognitive load and social presence is not suitable for a between-subject design, even though it has been utilized in prior research with this type of experimental design.

Lastly, a longitudinal field experiment should be considered. Our experiment might have been too short to demonstrate the benefits of instructor presence. Indeed, the experimental materials were new for the participants and probably, they were excited about the new experience, regardless seeing the instructor or not. Thereby, the boredom effect, which is common after a few weeks of classes, might have not been induced.

VIII. THREATS TO VALIDITY

A. CONSTRUCT VALIDITY

Construct validity reflects to what extent the variables used in the study accurately measure the concepts they purport to measure [51]. Cognitive load and social presence as constructs are difficult to measure. Since they are intrinsically subjective, there are no objective measures to capture them. Thereby, the measures of the two constructs relied on self-reported questionnaire items, which might have been interpreted differently by different participants based on their feelings, expectations, and past experiences. As such, they might have been influenced by the subjective perception of the participants and they might not have represented the real corresponding internal states of participants. Yet, a better approach to measure these constructs is not known; therefore, we adopted the measures that have been commonly used in many previous studies. It should be noted that the discussed threat is relevant in all studies utilizing questionnaires, as the collected data relies on human input.

Moreover, we are also aware that our assessment of learning outcomes did not verify effective vocabulary learning as we tested only the ability to recognize vocabulary spoken by someone else.

B. INTERNAL VALIDITY

Internal validity refers to the extent to which the observed effect is caused only by the experimental treatment condition. In our study, the main threat to internal validity is the selection effect, which occurs if the groups that are being compared are not similar according to the abilities of the members. To reduce individual differences between groups, we recruited a large number of students who had a common educational background and randomly assigned them into two groups. Furthermore, participants were required to report their mother language as well as their level of Chinese language proficiency. Non-native Polish speakers as well as those who reported at least some knowledge of Chinese language were excluded from the analysis. Nevertheless, as for learning outcomes, the variability within groups was high, which suggests that extraneous variables such as language aptitude and motivation to perform well could have contributed to a lack of statistical significance.

Since we conducted the experiment online, we could not guarantee an undisturbed learning environment. The participants could have encountered distractions, which might have affected their concentration. To prevent cheating, we set the rules in this way that the participants had nothing to gain from the actual outcome of the experiment. We encouraged them to perform as well as they could, but they received extra points only based on their participation in the experiment. Thereby, another potential threat is the fact that some of the participants might have just been interested in getting the reward and they did not put much effort into learning. Indeed, there was one participant who obtained a zero score in the posttest as well as participants who gave incongruent answers while responding to the questionnaire. To decrease this threat, we excluded such participants from further analysis.

C. EXTERNAL VALIDITY

External validity is the degree to which the results of the research can be generalized to the population under study and other research settings. An important threat to external validity concerns the representativeness of the participants. Our participants were computer science students in their 20s; hence, we cannot generalize the results to much younger or

older people, those who have a different educational background, or those whose first language is not Polish.

Furthermore, all assessments were taken after only one video lesson, which is not representative of real scenarios in which learners participate in a course that usually consists of a series of videos. It could be that participants were excited with the first-time experience and they reacted differently. Therefore, the lack of social presence might not have been felt in such a short period. Nevertheless, to keep the variables under control, participants were required to complete the experiment in one go without interruption. What is more, since the participants in the current study were not allowed to pause, rewind, or take notes, this may not replicate the authentic video watching experience, in which learners usually have control over learning pace. Thus, future studies could consider allowing participants to pause and rewind the video, as well as take notes.

IX. CONCLUSION

In this study, we explored how instructor presence in a foreign language learning video influences learning outcomes, cognitive load, and social presence. We did not find any statistically significant effects to the variables investigated. It is likely that other factors, especially individual learner differences or their motivation to perform well, could have moderated the effects of instructor presence in this study. Hence, by using a more sophisticated experimental design (i.e., a matched-groups design), these possible confounds could be ruled out. Furthermore, seeing the instructor's face induced positive affective responses among learners. This positive reaction to instructor presence may help to promote learning motivation and thereby maintain learners' persistence in online courses.

Despite the fact that we found no statistically significant differences between the groups, our study is crucial as it contributes to a better understanding of effective practices for designing future research. As discussed in Section VII, the three implications for research are as follows. First, a matched-groups design should be considered to ensure group balance. Second, the existing approaches to measure cognitive load and social presence, which were also used in our experiment, are not suitable for between-subject design. Lastly, a longitudinal field experiment should be considered to investigate the effects of instructor presence in a video in more realistic settings.

In the current study, the instructor was presented as a talking head. Note that there are still many open questions relating to the issue of instructor presence in instructional video design; one of them is whether the instructor's visibility should be in full body, a talking head or hands only [52]. Therefore, future studies should attempt to investigate different types of instructor visibility. Moreover, the present study particularly examined the products of learning, that is, learning outcomes and subjective perceptions; whereas the process of learning (e.g., based on additional data sources [53]) such as visual attention allocation was not investigated. Accordingly, in future studies, an eye-tracking analysis could be employed to provide objective data as well as insights into the learning process of different individuals [9]. Moreover, such analysis can also help researchers to discover the viewing pattern of successful learners; this could provide valuable guidelines on how to learn effectively. Finally, future studies should also attempt to test the effects of instructor presence on different populations of learners in the context of foreign language learning.

APPENDIX

PERCEPTION QUESTIONNAIRE (INSTRUCTOR-PRESENT GROUP)

1) In the video I just finished watching, I invested
   - very, very low mental effort,
   - very low mental effort,
   - low mental effort,
   - rather low mental effort,
   - neither low nor high mental effort,
   - rather high mental effort,
   - high mental effort,
   - very high mental effort,
   - very, very high mental effort.
2) I felt that the instructor was present.
   - strongly disagree,
   - disagree,
   - neutral,
   - agree,
   - strongly agree.
3) I felt that the instructor was very detached in her interactions with me.[1]
   - strongly disagree,
   - disagree,
   - neutral,
   - agree,
   - strongly agree.
4) I felt that the instructor was aware of my presence.
   - strongly disagree,
   - disagree,
   - neutral,
   - agree,
   - strongly agree.
5) I felt that the instructor remained focused on me throughout our interaction.
   - strongly disagree,
   - disagree,
   - neutral,
   - agree,
   - strongly agree.
6) I think seeing the instructor in the video is _____, compared to not seeing her. (You can choose more than one).
   - useful,

[1] this item in the questionnaire was reverse coded for analysis

- helpful,
- engaging,
- distracting,
- annoying,
- frustrating.

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