The instructor presence effect and its moderators in instructional video: a series of meta-analyses

Beege, Maik ; Schroeder, Noah L ; Heidig, Steffi ; Rey, Günter Daniel ; Schneider, Sascha

Abstract: Researchers disagree on the extent to which social cues in instructional videos influence learning and learning-relevant outcomes and processes. The instructor presence effect states that visible instructors in instructional videos lead to increased social presence and higher scores in subjective ratings like motivation, social presence, or affect, but do not improve learning outcomes. In contrast, the Cognitive-Affective-Social Theory of Learning in digital Environments outlines how social cues not only enhance social, emotional, and motivational processes, but they also potentially promote learning outcomes. We conducted a series of meta-analyses to explore the effects of instructor presence in instructional videos on retention, transfer, social presence, motivation, cognitive load, affect, and visual dwell time. The meta-analyses include 35 studies, which contained 46 pair-wise comparisons and 6339 participants. Results revealed a small, statistically significant positive effect of including a visual instructor on retention outcomes, but no significant effect on transfer performance. A visible instructor also significantly enhanced social presence, affective, and motivational ratings. Furthermore, we found that a visible instructor significantly reduced dwell time on relevant visual material but also reduced subjective perception of extraneous cognitive load. Significant moderator effects could be found regarding prior knowledge, the instructional domain as well as the size of the instructor.

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Review

The instructor presence effect and its moderators in instructional video: A series of meta-analyses

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ABSTRACT

Researchers disagree on the extent to which social cues in instructional videos influence learning and learning-relevant outcomes and processes. The instructor presence effect states that visible instructors in instructional videos lead to increased social presence and higher scores in subjective ratings like motivation, social presence, or affect, but do not improve learning outcomes. In contrast, the Cognitive-Affective-Social Theory of Learning in digital Environments outlines how social cues not only enhance social, emotional, and motivational processes, but they also potentially promote learning outcomes. We conducted a series of meta-analyses to explore the effects of instructor presence in instructional videos on retention, transfer, social presence, motivation, cognitive load, affect, and visual dwell time. The meta-analyses include 35 studies, which contained 46 pair-wise comparisons and 6339 participants. Results revealed a small, statistically significant positive effect of including a visual instructor on retention outcomes, but no significant effect on transfer performance. A visible instructor also significantly enhanced social presence, affective, and motivational ratings. Furthermore, we found that a visible instructor significantly reduced dwell time on relevant visual material but also reduced subjective perception of extraneous cognitive load. Significant moderator effects could be found regarding prior knowledge, the instructional domain as well as the size of the instructor.

1. Introduction

Due to the COVID-19 pandemic, courses across the world that were regularly held in a classroom or face-to-face contexts had to be moved to online platforms. The replacement of face-to-face interaction with digital instructional materials is often accompanied by a reduction in social interaction processes, both between learners as well as between learners and teachers (Baber, 2022). Nevertheless, these social processes might be of crucial importance for learning, since social cues activate social schemata and thus, influence learning processes. Current theoretical frameworks, such as the Cognitive-Affective-Social Theory of Learning in digital Environments (CASTLE, Schneider et al., 2021) emphasize that this occurs even in multimedia learning environments. Since online courses often

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contain video components, there is a pragmatic way to induce social processes: the visual representation of a human instructor (i.e., instructor presence; Fiorella & Mayer, 2018). Research in the area has led to researchers naming what they call the instructor presence effect. The instructor presence effect states that visible instructors in instructional videos increase social presence as well as motivation, and affective ratings, but do not improve learning outcomes (e.g., Wilson et al., 2018). However, extensive discussion exists about the learning benefits of on-screen instructors in video lectures (e.g., Almedag, 2022; Henderson & Schroeder, 2021). Often, results regarding learning outcomes are ambiguous. Studies state positive effects (Wang et al., 2022), do not find any effects (Stull et al., 2018) or even report detrimental effects (Yuan et al., 2021). An example of the implementation of a visible instructor is illustrated in Fig. 1. According to the instructor presence effect, we would expect the video on the left to increase perceived social presence and subjective ratings scores, but not increase learning compared to the video on the right.

Recently, researchers have conducted a systematic review (Henderson & Schroeder, 2021) and meta-analysis (Almedag, 2022) of the instructor presence effect on learning outcomes, and both support the hypothesis that instructor presence may not significantly impact learning. The current meta-analyses extend this work by including more recent studies, particularly those conducted during the COVID-19 pandemic, and investigating the instructor presence effect on a broader range of learning-relevant outcomes and processes. Since effects of visible instructors on learning outcomes are heavily discussed to date, these effects were the main focus of the meta-analysis and the impact of moderator variables on learning outcomes were also examined.

2. Literature review

2.1. Social cues in multimedia learning

According to social agency theory (Mayer et al., 2003), computer- or video-based instruction can be interpreted as a social event and computers can be perceived as social partners. Researchers have spent the last few decades examining the processes elicited from social interactions with computers and the characteristics of computers that trigger these social processes. For example, Domagk (2010) expanded social agency theory by stating that the valence, rather than the mere inclusion, of social cues is crucial for learning. Similarly, Beege et al. (2020) showed how social cues should be relevant for, and closely related to, the instructional information to facilitate learning. As a result of these and complementary lines of research, an overarching theory was created that specifies the influence of social cues on learning outcomes and learning-relevant processes to allow for the derivation of falsifiable hypotheses, the Cognitive-Affective-Social Theory of Learning in digital Environments (CASTLE; see Fig. 2; Schneider et al., 2021).

The CASTLE is based on the Cognitive Theory of Multimedia Learning (CTML; Mayer, 2005) and Cognitive-Affective Theory of Learning with Media (CATLM; Moreno & Mayer, 2007). According to the dual-channel assumption (Paivio, 1986; Robinson, 2004), visual as well as verbal information are processes separately in the working memory, and each channel has a limited capacity. The main processes that occur during learning are the selection and organization of information, as well as integrating the new information into relevant prior knowledge (Mayer, 2014a). According to Moreno and Mayer (2007), affective, motivational, as well as meta-cognitive processes influence how information is selected and organized. The CASTLE further developed these theories by integrating social processes into the existing frameworks, demonstrating how they could influence the learning process (Schneider et al., 2021). Specifically, social cues activate social schemata in long-term memory. Consequently, social processes get triggered that, in turn, influence the selection, organization, and integration of information (known as the Cognitive Influence Hypothesis), as well as motivational and emotional processes (known as the Interaction Hypothesis). As we discuss next, these processes are considered holistically to influence the effects of visible instructors on learning outcomes.

2.1.1. *Effect of instructor presence on cognitive processes*

According to the CASTLE, a visible instructor triggers social processes that influence the selection and organization of non-verbal information. While this has consequences for learning outcomes, it also impacts working memory capacity during learning. The lecturer has to be processed in addition to the learning content and requires working memory resources for this purpose. A result is that social cues can thus overload the visual channel of the working memory (Mayer, 2014a) and may be considered interesting, but

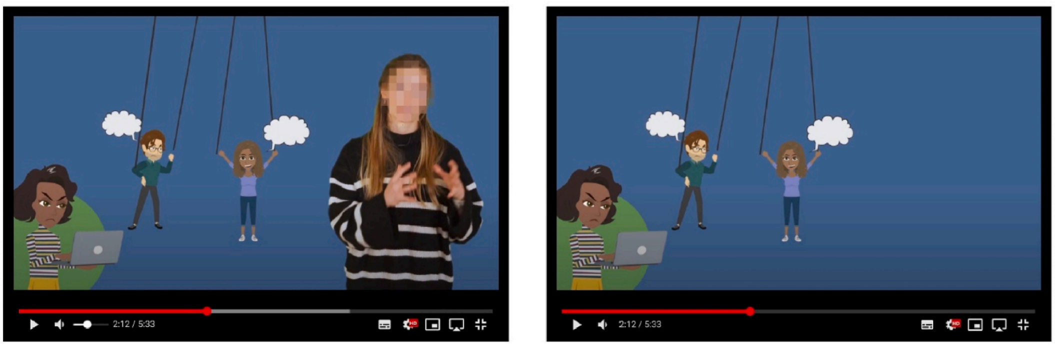

Fig. 1. An example of an instructional video with the instructor present (left) or absent (right).

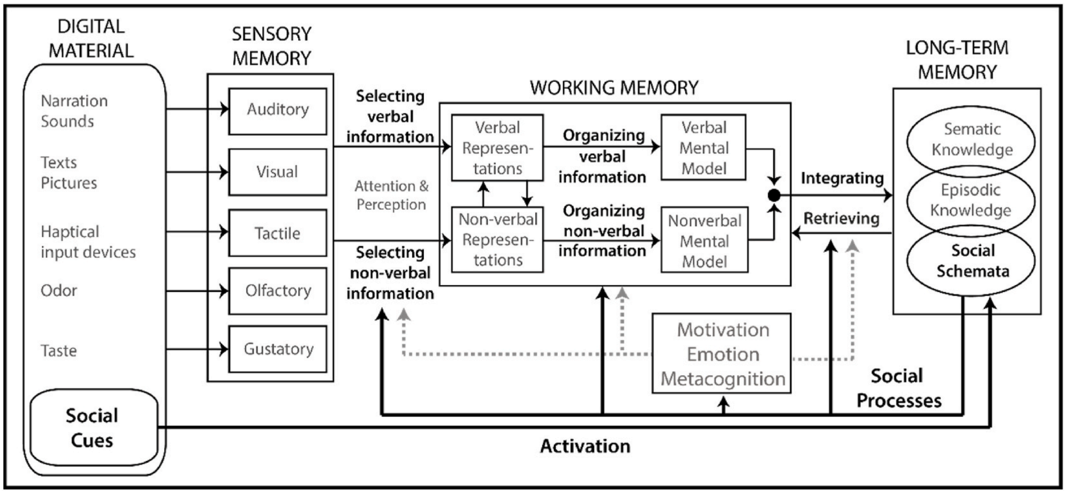

Fig. 2. Cognitive-Affective-Social Theory of Learning in digital Environments (CASTLE, Schneider et al., 2021).

otherwise irrelevant details (seductive details; Sundararajan & Adesope, 2020). Since learners have to divide their attention between the instructor and the instructional information, it is plausible that this could cause something like the split-attention effect and inhibit learning (Schroeder & Cenkci, 2018). Consequently, social cues can be viewed as extraneous cognitive load (ECL), a working memory resource load that arises from the design of the learning material and is also called learning-irrelevant load (Sweller et al., 2019). Research to date investigating these hypotheses has shown mixed results. For example, Van Wermesmerken and colleagues (2018) recorded eye-movements of participants who watched an instructional video that did or did not show the instructor. They found that learners looked at the instructor's face about 30% of the time, and concluded that the visibility of the instructor distracted participants from other visuals in the video. This was further supported by an eye-tracking experiment by Stull et al. (2018), who found that the participants attended less to the instructional material when the instructor was visible during a whiteboard lecture. While these findings were consistent, only a few studies used eye-tracking to explicitly investigate attention distraction in relation to the visibility of the instructor. It is also possible that the results from eye-tracking research may reach different conclusions about the consequence of a visible instructor on cognitive processing than other measurement techniques. For example, Wang et al. (2020b) used electroencephalogram and found that a visible instructor reduced cognitive load. It is therefore important that research continues to investigate how visible instructors influence cognitive processing.

A contrasting perspective is derived from the embodiment principle (Mayer, 2014b). This principle suggests that visible instructor in online courses activates the impression of a social presence (a sense of interacting with another social entity) in learners. According to Grice (1975), processes are activated that occur equivalent to natural human-to-human communication. Consequently, according to the CASTLE, social processes further influence the selection of verbal information as well as the organization of information. Learners try to understand the instructor's message in order to respond accordingly (cooperation principle; Grice, 1975) which results in the learner explicitly focusing their attention on the message (the learning content). Wang and Antonenko (2017) provided empirical evidence for these theoretical assumptions. In their study, participants watched instructional videos with the instructor either present or absent. Retention performance was fostered if easy topics were taught, implying that a visible instructor fostered attention toward the instructional material. Furthermore, even during difficult video lectures, participants reported a lower perceived mental effort when the lecturer was present.

In summary, theoretical positions on how a visible instructor in an instructional video would influence cognitive process are somewhat conflicting. On one hand, the instructor could foster feelings of a social interaction, increasing the student's drive to focus their attention on the learning material, thus influencing the selection and organization processes which presumably increases learning. However, one could also argue that this same increase in mental effort may distract from the learning task, increasing extraneous cognitive load, and thereby decreasing learning. While theoretical arguments differ in regards to the effects of visible instructors in instructional video on cognitive processes, they are more consistent in relation to affective and motivational processes, which we discuss next.

2.1.2. *Effect of instructor presence on affective and motivational processes*

Recall that the instructor presence effect suggests that a visible instructor in an instructional video can positively influence emotional and motivational processes. The emotional design hypothesis outlines that an appealing design of learning environments like graphics (Mayer & Estrella, 2014) or warm colors, round shapes and anthropomorphisms may increase the affective ratings of learners and learning outcomes (Plass et al., 2014; Um et al., 2012). This is important because social presence and affective processes, as well as engagement, are positively associated (Richardson et al., 2017). Even simple social cues such as anthropomorphizing static learning materials can offer affective/motivational advantages (Schneider et al., 2019). Consequently, social processes triggered by a visible instructor influence affective and motivational processing and indirectly, further influence cognitive processes through affective and motivational change.

Learners' perceptions of affect and motivation are a central component of instructor presence research and the results have been promising. Most researchers have highlighted the positive effects of a visible lecturer on motivational processes (e.g., Wang et al., 2022; Wilson et al., 2018). In their studies, the authors compared subjective motivational ratings of participants watching instructional videos with the instructor either present or absent. If the instructor was present, motivational ratings increased. Since motivational and emotional processes are interrelated in learning scenarios (Plass & Kalyuga, 2019), similar results were found for affective variables. For example, a visible instructor enhanced satisfaction (Wang & Antonenko, 2017) and was found to reduce negative emotions (i.e., frustration; Kizilcec et al., 2014). However, similar to motivational effects, these findings are based exclusively on subjective rating scales. Subjective impressions do not necessarily reflect the indirect effect of visible instructors on cognitive processes relevant to learning through affective or motivational benefits (Wilson et al., 2018).

2.1.3. *Effect of instructor presence on learning outcomes*

Although research into the instructor presence effect is still relatively new, the image principle refers to how a static image of an instructor does not increase students' learning outcomes (Mayer, 2021), and recent reviews of the research around instructor presence in instructional videos specifically suggest that visible instructors in instructional videos may not benefit learning outcomes (Almedag, 2022; Henderson & Schroeder, 2021). These findings contradict the Cognitive Influence Hypothesis of the CASTLE (Schneider et al., 2021). While it has been shown that a visible instructor indeed could promote social processes like social presence (Rosenthal & Walker, 2020), as well as affective and motivational variables (Zhang et al., 2021), there seemed to be no influence on further cognitive processes that promote learning outcomes. The lack of significant effects regarding learning outcomes is reported by numerous studies (e.g., Stull et al., 2018; van Wermesmerken et al., 2018). Only differences in other process variables, such as affective variables (e.g., "How much did you like the video?") are reported regularly (e.g., Wilson et al., 2018). Wilson et al. (2018) already outlined that increased subjective ratings may arise from the subjective sense of being engaged by the visible instructor while learners may not be aware of the information they are missing or a more superficial cognitive processing. Thus, the question of whether lecturer visibility positively or negatively influences learning cannot be answered per se. In relation, the image principle (Mayer, 2021) already outlined that a static image of an instructor has no educational value in increasing students' learning outcomes. Thus, recent research finds no effect on learning outcomes when only the visibility of the lecturer is manipulated but the quality of instruction otherwise remains identical.

That said, researchers have noted that implementation-related factors may be crucial when examining the instructor presence effect, and research in the area is relatively limited. For example, Ng and Przybyłek(2021) conducted a short-term study manipulating instructor presence (present vs. absent) and did not find any significant differences regarding learning outcomes or subjective measures. The authors concluded that long-term studies should be conducted with more sophisticated measures to investigate the instructor presence effect. Thus, based on the current state of research, no general recommendation has been made regarding instructor presence (Fiorella & Mayer, 2018; Henderson & Schroeder, 2021).

2.1.4. *Summary*

As shown, there are theories that show what effects a visible instructor in an instructional video could have across various process and outcome variables. However, to date, the work in the area is largely unclear, and it is generally not possible to explain in what situations we may expect to see specific effects. In particular, effects regarding learning outcomes are ambiguous. This may be due to the wide variety of potentially moderating variables. Due to this, in our meta-analyses, we consider various factors that could potentially moderate the effects of a visually present instructor, particularly on learning outcomes.

2.2. *Moderating effects*

As noted, presumably there are various factors that moderate the instructor presence effect. For the purposes of this study, we have classified them as learner features, study features, and instructor features.

2.2.1. *Learner features*

Based on the literature, we considered the learners' prior knowledge and the age of the learner as learner features that may moderate the instructor presence effect. Multimedia learning theories (e.g., CTML; Mayer, 2014a) consider learners' prior knowledge to be the most important moderating influence. It is possible that learners with low prior knowledge benefit from a visible instructor (Hong et al., 2018). Nevertheless, a meta-analysis with regard to the presence of pedagogical agents (Schroeder et al., 2013) showed that visible social entities are only effective for medium or high prior knowledge learners. A potential explanation can be derived from the CTML. Low prior knowledge learners might be particularly distracted by the visible lecturer. In line with the seductive detail effect (Sundararajan & Adesope, 2020), low prior knowledge learners invest too many resources into processing the visible lecturer, which can be viewed as ECL in this context, and do not have enough resources left for processing the learning content. Consequently, prior knowledge was included as moderator.

In addition, some researchers have considered learners' age differences when examining the effects of instructional designs (e.g., Van Gerven et al., 2006). More specifically, the educational level (e.g., primary school, secondary school, university) might moderate the effectiveness of visible instructors on learning processes. Two arguments have to be considered. First, the working memory capacity of primary-school students is limited (e.g., Cowan et al., 2006). It is of particular significance that working memory capacity is the mediator between age and updating processes (i.e., monitoring incoming information and replacing old/non-relevant information with new/relevant information; Miyake et al., 2000; Panesi et al., 2022). Consequently, primary and younger secondary students might have difficulties keeping/updating relevant information from the video lecture in working memory. A visual lecturer might consume additional resources, and learning inhibitory effects of visible instructors as potential sources of ECL may become even more prominent. Second, teachers are almost always present in instructional situations for primary or secondary students. Primary and secondary students are used to a constant social presence and support. For younger students, visible teachers create a sense of security and belonging in the classroom. Young students often rely on the presence and guidance of their teachers to feel safe and supported. When teachers are visible and accessible, students are more likely to seek help, share their thoughts, and engage in meaningful interactions (Baber, 2022). Consequently, these students might benefit from a visible lecturer in instructional videos and the resulting social processes.

2.2.2. Study features

Previous work has indicated that the pacing of the learning materials, the instructional domain of the study, the study setting, when learning was measured, and the duration of the instructional video could moderate the instructor presence effect. As such, we considered these study features as potentially moderating variables.

Prior meta-analyses on design guidelines for multimedia learning outlined the importance of the *pacing* of the materials (either *system-paced* or *learner-paced*; Ginns et al., 2013). While a learner-paced environment requires learners to time-independently discover their materials (for example by pausing the video), system-paced environments provide a pre-defined time. Learner pacing might reduce the ECL which is induced by the visible lecturer since learners can adapt the presentation of the video to their personal needs (Rey et al., 2019). Nevertheless, in system-paced videos the cognitive activation from social processes triggered by a visible lecturer might enhance attention and engagement on the instructional information (Mayer, 2014b), but the visible instructor may also be perceived as an additional burden in addition to the transient information effect (information presentation that is transient and difficult to retrieve rapidly and when required; Leahy & Sweller, 2011). To summarize, there is evidence or theory to support the position that the effects of a visible instructor in an instructional video may lead to different effects in learner- and system-paced environments.

Another potential moderator is the instructional domain of the study. Research in the field of multimedia learning has shown that various instructional technologies and instructional design techniques can have differential effects depending on the domain of the instructional materials. For example, audience response systems have been found to be particularly effective in social science classes, but not as effective in science and engineering classes (Hunsu et al., 2016). Meanwhile, pedagogical agents have been found to help students learn more in biology and English, but have been found to be less effective in history (Castro-Alonso et al., 2021). Finally, signaling in instructional multimedia has been found to be more effective in general human sciences than in natural sciences (Alpizar et al., 2020). A prior meta-analysis regarding instructor presence further outlined the importance of the instructional domain (Almedag, 2022). The author discussed the importance of visible instructors in science, technology, engineering, and math (STEM) education compared to history and social science (HSS) education. Since most instructional studies that were included in the meta-analyses by Almedag (2022) investigated STEM education, we found it pertinent to examine how the instructor presence effect may be moderated by the domain of the learning materials when additional studies were considered.

Further, the instructional setting has been investigated in previous research. Instructional design principles may be particularly effective in laboratory settings or even artifacts of laboratory settings (Sundararajan & Adesope, 2020), but the generalization of the effect to online or classroom settings may be questionable. In contrast, the effects generated from online experiments might be biased since strict experimental control is not always guaranteed. Almedag (2022) investigated the influence of the setting on instructor presence and found that positive effects were found in laboratory settings, but not in online studies. Since the instructional setting has significant implications for practitioners and researchers alike, we further investigate it as a potential moderator in our analyses.

Another factor that could have significant implications for practitioners is when the learning outcome test took place. For example, if learning gains were found immediately after viewing the video, but no gains were seen two weeks later, that has significant implications for those who use videos in their courses. A lot of studies regarding social cues in multimedia learning have emphasized the importance of delayed learning tests (e.g., Li et al., 2019) and some studies found different effect sizes comparing the test results directly after instruction and the test results after a delay (e.g., Heidig, 2022). Consequently, we analyzed the time when the learning outcome test took place as a potentially moderating variable.

Finally, the length of the video may also be an important factor that could moderate the effect of instructor presence and have significant implications for practitioners and researchers. Guo et al. (2014) outlined that learner engagement might depend on video length. The authors reported that general attention while watching videos significantly decreases after 6 min. Afify (2020) supported these results by stating that expanding video length over 6 min reduced learning outcomes and enhanced cognitive load. The authors argue that brief videos that concentrate solely on essential information facilitate the learning process by eliminating extraneous details that can overwhelm the working memory and are unnecessary for effective learning. Conversely, lengthy videos often contain excessive information that is either unrelated to the learning objectives or exceeds the cognitive capacity of learners' working memory. This was supported by Dart (2020), who stated that longer video lengths overload learners. However, most online courses are much longer than 6 min, and thus, the external validity of these results is limited. The length of the video was investigated as a moderator since longer videos are common in practice.

2.2.3. Instructor features

The literature specifies if the lecturer is high-embodied (i.e., with gesture, facial expression, eye gaze, body stance) or low-embodied (i.e., talking head or static image) (Deng et al., 2019; Mayer & DaPra, 2012). The difference emphasizes that various features of the instructor themselves could moderate the instructor presence effect. However, discussions of embodiment in the literature often use the dichotomy of 'high' and 'low' embodiment. This is problematic as embodiment has been defined as containing multiple variables, such as gestures, eye contact, facial expressions, and movement (Mayer, 2014b). Accordingly, the current analyses did not investigate 'high' vs. 'low' embodiment instructors to avoid confounding factors. In contrast, we investigated the specific design factors that were investigated in the literature to provide more nuanced insights. We discuss each of these design factors briefly below.

One factor investigated was the method used to integrate the instructor into the video. Instructors can be integrated via greenscreen (Kizilcec et al., 2014) or using a webcam with visible background (Alfasor, 2021). Whereas the implementation via webcam might result in a more natural appearance, additional objects within the webcam video might further increase ECL. It is therefore important to also consider the richness of background details in the instructor's video.

Further design features deal with the position (vertical and horizontal) as well as the size and image detail of the lecturer. In most of the studies we reviewed, the lecturer was placed on the lower right side and the position was fixed (e.g., Zhang et al., 2021). This might result in enhanced learning outcomes since this position may correspond to the viewing habits of the learners (e.g., this is a commonly used position to place videos of streamers and reaction YouTubers) and thus no irrelevant thinking occurs (enhanced process fluency; Maheswaran & Chaiken, 1991). Other positions might be distracting, as they may tend to be unfamiliar to learner. Nevertheless, viewing habits might strongly differ across participants and thus, this moderator is of rather exploratory nature.

Whereas most instructor videos appear at the same place in the video throughout the lecture, in other studies, the position varied, or the instructor was not constantly visible during the lecture. According to Rop et al. (2018), learners might become accustomed to an instructor who appears in a consistent position over time, and thus, the instructor should attract less attention. Consequently, a visible instructor as a potential source of extraneous load (but also social activation) may be successively ignored, and potential influencing factors may fade into the background. If the instructor changes position or disappears, and then appears again or changes position, he or she likely draws the learner's visual attention. This may be particularly true during a position change or (dis)appearance, which could distract the learners from relevant instruction. Furthermore, social presence might be lowered if social cues might not be presented consistently (Schneider et al., 2021). Consequently, the instructor's continuity in position and persistence across the video was investigated.

Reviewing the literature, we also found that the size and presented image detail of the instructor strongly varied. According to the CASTLE (Schneider et al., 2021), a small video of the instructor with little image detail (e.g., talking head) is sufficient to trigger social processes. However, a larger lecturer with more image detail (e.g., showing the upper body or even full body) might trigger stronger or additional processes. Yet, it is also plausible that a larger lecturer might be more distracting and thus, increase ECL (Sweller et al., 2019). We investigate these conflicting implications by including the size and the image detail of the lecturer as moderators.

Another important design feature deals with the gestures of the lecturer. Gestures can fulfill an explicit instructional purpose (e.g., signaling; Schneider et al., 2018) but also can be without instructional purpose. Whereby signaling gestures and thus, the dynamic interaction between the lecturer and the instructional material can foster learning, content-empty gestures are not relevant to learning outcomes (Beege et al., 2020). A meta-analysis in the context of pedagogical agents showed that gestures performed by humanoid agents in general decrease cognitive load (Davis, 2018) which can presumably impact learning. Consequently, gesturing is included as moderator in our analyses.

Finally, we also considered who the instructor was that was present in the instructional video. Several features such as gender, clothing, age, and personal or public relevance come into play but empirical results considering learning are ambiguous. For example, although the gender of the lecturer did not influence learning outcomes in previous studies (e.g., Hoogerheide et al., 2016), clothing was found to influence the perceived professionalism of the lecturer (Beege et al., 2022). According to studies regarding para-social processes during video or movie reception, publicly or personally relevant instructors should trigger stronger social processes (Konijn & Hoorn, 2017). We note however, that these same instructors may further distract learners from the instructional information.

2.3. Recent developments, research questions, and hypotheses

Research on the instructor presence effect strongly increased over the last few years, probably because of the recent pushes towards online learning. In a recent systematic literature review, Henderson and Schroeder (2021) discussed 12 studies that explicitly investigated the instructor presence effect (i.e., Does the inclusion of a visible instructor in instructional videos foster learning relevant processes?). Although the authors did not conduct a meta-analysis, they stated that the field has largely produced non-significant results, and this was particularly the case with learning outcomes. Consequently, they concluded that there was little rationale to include (or exclude) an instructor's presence in an instructional video. The effectiveness of visible instructors may largely be dictated by the educational context in which they are present, but the authors did not have enough empirical evidence to further specify this implication. It should also be noted that Henderson and Schroeder's review mostly focused on learning outcomes and affective processes. Potentially moderating variables (e.g., size of the instructor) were discussed but were not the focus of the review.

The work in the field has also recently been analyzed in a meta-analysis by Almedag (2022). By investigating 20 studies where participants watched an instructional video with or without an on-screen instructor, the author supported the claims from Henderson and Schroeder (2021) in that the effects of instructor presence on learning and social presence were not statistically significant. However, instructor presence increased cognitive load and motivational ratings. Nevertheless, emotional ratings, as well as eye-tracking measures were not included. Furthermore, while moderating variables were explored, the ambiguous results of recent experimental studies emphasize the importance of the investigation of additional moderators.

Consequently, this meta-analysis aimed to contribute to the ongoing discussion about instructor presence and to extend findings from Almedag (2022) and Henderson and Schroeder (2021) as follows.

(1) The large increase in studies between 2021 and 2022 shows how quickly the research landscape is growing. The additional studies can add meaningful implications, especially for moderator analyses.
(2) The meta-analysis will extend the meta-analysis from Almedag (2022) by investigating eye-tracking measures and differentiating between affective and motivational outcomes.
(3) Additional moderator variables will be investigated. Studies vary in terms of characteristics of the learner, the video, the lecturer, and other study characteristics. Consequently, optimal conditions under which visible lecturers are conducive to learning must be more thoroughly understood.

The first research question we examine in this study deals with the main effects of instructor presence on learning relevant variables. According to the instructor presence effect and related studies (e.g., Fiorella & Mayer, 2018), motivational, affective, social, and cognitive variables can all be influenced by the presence of a visible instructor. Our first research question is therefore.

RQ1: Does a visible instructor in an instructional video affect learning relevant processes in contrast to a video without a visible instructor?

To answer this research question, based on the CASTLE (Schneider et al., 2021), hypotheses were formulated with regard to social presence and their resulting influence on cognitive variables (Cognitive Influence Hypothesis), and motivational and emotional variables (Interaction Hypothesis). Our hypotheses include.

H1. Learners watching a video with a visible instructor report a higher social presence than learners watching a video without a visible lecturer.

H2. Learners watching a video with a visible instructor report a higher ECL than learners watching a video without a visible lecturer.

H3. Learners watching a video with a visible instructor exhibit a shorter dwell time on the instructional material than learners watching a video without a visible lecturer.

H4. Learners watching a video with a visible instructor report higher affect and motivation than learners watching a video without a visible lecturer.

However, these hypotheses regarding main effects do not address all facets of the instructor presence effect. Since relevant studies often did not find significant results with regard to learning outcomes and since many new potentially moderating variables were involved in primary studies, additional research questions were formulated. Since the literature in the field of instructor presence does not allow for concrete hypotheses because of ambiguous results or moderating effects that were not explicitly investigated to date, the research questions were considered more exploratory in nature. These research questions include the following.

RQ2: Does a visible instructor in an instructional video affect learning outcomes in contrast to a video without a visible instructor?
RQ3: Are characteristics of participants, the study, and the instructor moderator variables for the instructor presence effect?

3. Method

The meta-analyses were conducted according to comparable meta-analyses in similar fields of research (Almedag 2022; Schneider et al., 2018) and the PRISMA guidelines (Page et al., 2021). Specifically, we conducted one comprehensive literature search to identify all of the relevant studies in the area. We then conducted a series of meta-analyses of different outcome variables to understand the impacts of instructor presence. We also conducted moderator analyses for each of the meta-analyses dealing with learning outcomes.

3.1. Literature search

A literature search was conducted concerning the instructor-presence effect, which considered studies conducted between 1990 and 2022. The literature was searched up to September 15, 2022, by using ERIC, SSCI, PsycINFO®, PSYNDEX, and Google Scholar. Six main keywords were searched: “instructor presence (or visibility)”, “lecturer presence” (or visibility)”, “teacher presence (or visibility)”, “tutor presence (or visibility)”, “picture in picture”, and “talking head”. The keywords were searched separately and in combination with “online” and “learning”. Finally, the function “articles citing this article” in GoogleScholar was used for the studies that met the inclusion criteria. The literature search only considered works written in English and German and included published articles, doctoral dissertations, online first, book chapters, and conference papers. Finally, we requested unpublished work by sending out emails on the listservs of related professional organizations, such as “Deutsche Forschungsgemeinschaft” (DFG) and Special Interest Groups of the “European Association for Research on Learning and Instruction” (EARLI). In total, we located 1028 studies for consideration.

3.2. Inclusion and exclusion criteria

We set up a variety of inclusion and exclusion criteria to specify what qualities studies should have to be included in the analysis. These criteria were.

(1) Studies should investigate the instructor presence effect using real humans who were filmed and included in instructional videos. Studies concerning pedagogical agents or studies that did not focus on multimedia learning, such as technical reports (e.g., Liang et al., 2022), were not included.
(2) Studies must investigate the effects of visible instructors (high-embodiment as well as low-embodiment lectures) in comparison to a control group without a visible instructor. Studies without a control group (e.g., Yi et al., 2018) and studies without experimental manipulation (e.g., Zhong et al., 2022) were not included. Theoretical works were also excluded from the meta-analyses.
(3) Studies must investigate video lectures. Studies regarding example modeling (e.g., Hoogerheide et al., 2014) were excluded since the implementation of a modeling example that explicitly manipulates and changes the learning material might trigger additional learning processes in contrast to a lecturer that accompanies the learning material.
(4) Minimally, the head of a talking instructor must be shown and the presentation must be dynamic (changing over time). The implementation of static pictures (e.g., Xia et al., 2021) and studies that focused on other body parts (e.g., showing a hand; Carlson et al., 2014) were not considered.

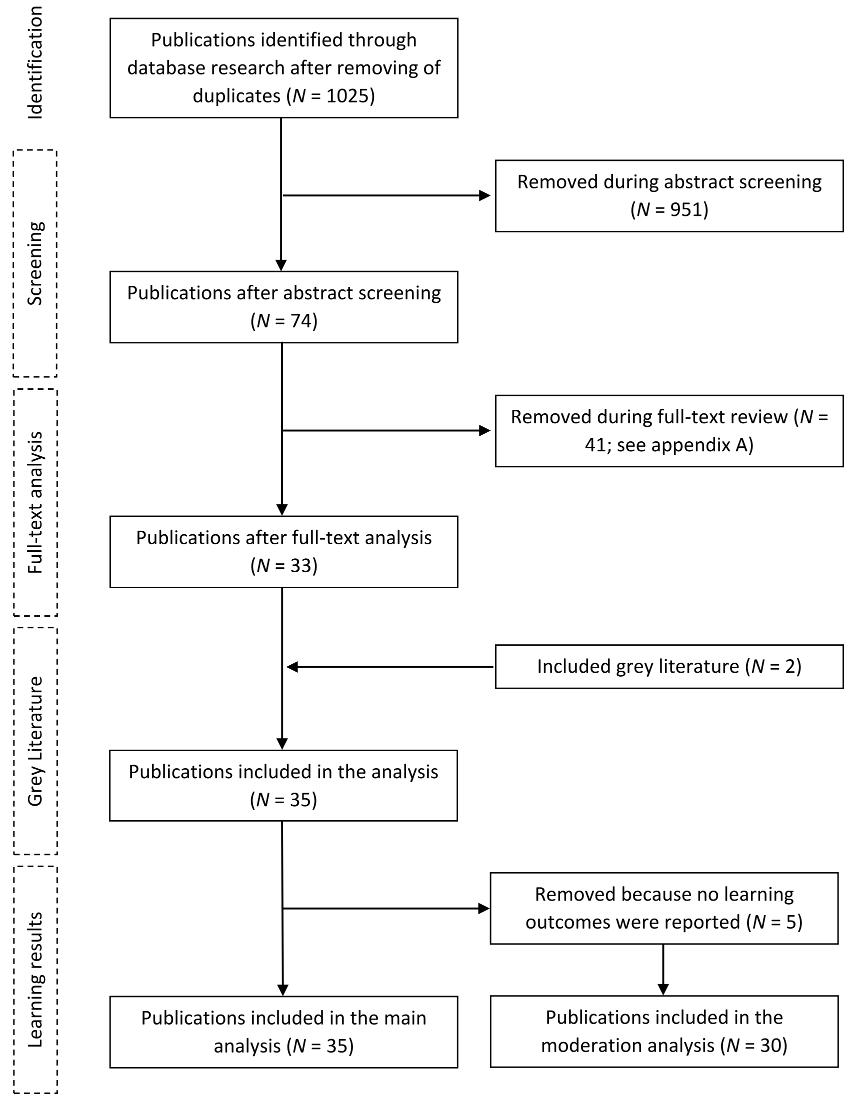

Fig. 3. Flow chart of included and excluded studies.

Table 1
Effect sizes (*g*) of outcome Measures (Anggraini et al., 2020; Fiorella et al., 2019; Heidig and Hauser, 2021; Homer et al., 2008; King et al., 2022; Kizilcec et al., 2015; Kokoç et al., 2020; Lassance et al., 2022; Lyons et al., 2012; Pierson, 2017; Rouan, 1995; Schmidt-Borcherding and Drendel, 2021; Schmidt-Borcherding et al., 2022; Schneider et al., 2022; Sondermann and Merkt, 2023b; Wang et al., 2020a; Zhang and Yang, 2022).

Study Nr.	Study	Retention	Transfer	Social Presence	Affect	Motivation	Extraneous Load	Dwell Time
1	Alfasor (2021)	0.625		0.66	0.415			
2	Colliot & Jamet (2018)	0.473	-0.265	0.124		0.02	0.332	-2.06
3	Fiorella, Stull, Kuhlmann & Mayer (2019)	-0.231	0.244					
4a	Heidig (2022)	0.344	0.182	0.256	-0.219	0.072	0.221	
4b	Heidig (2022)	0.05	0.117			0.211		
5a	Heidig & Hauser (2021)	0.259				-0.64		
5b	Heidig & Hauser (2021)	0.645		0.847	0.786	0.487	0.03	
6	Homer, Plass, & Blake (2008)	-0.199	-0.307	-0.274				
7a	Hong, Pi, & Yang (2018)	0.881						
7b	Hong, Pi, & Yang (2018)		-0.17					
8	King, Marcus, & Markant (2022)	0.256						
9	Kizilcec, Papadopoulos, & Sritanyaratana (2014)		0.351		0.909			
10	Kokoç, Ilgaz, & Altun (2020)	1.239						-0.551
11a	Kühl, Teske, Merkt, & Sonderman (2022)	-0.004	0.02	0.124			-0.137	
11b	Kühl, Teske, Merkt, & Sonderman (2022)	0.161	0.573	-0.203			0.041	
11c	Kühl, Teske, Merkt, & Sonderman (2022)	-0.078	0.102	0.134			-0.066	
11d	Kühl, Teske, Merkt, &	-0.078	0.12	-0.059			0.295	

Study Nr.	Study	Retention	Transfer	Social Presence	Affect	Motivation	Extraneous Load	Dwell Time
	Sonderman (2022)							
12	Lassance, Filgueiras, Dessus, Guntz, & Cowley (2022)	-0.065	-0.187		-0.636			
13	Ng & Przybyłek (2014)	0.21		-0.24				
14	Pi & Hong (2016)	1.076						
15	Rouan (1995)	-0.105						
16	Schmidt-Borcherding & Drendel (2021)	0.009	0.151					
17	Schmidt-Borcherding, Gehrke, & Bateman (2022)	0.347	-0.086					
18a	Schneider, Schluer, Kretzer, Fröhlich, & Rey (2022)	0.568		0.896	0.049			
18b	Schneider, Schluer, Kretzer, Fröhlich, & Rey (2022)	0.602		0.878	0.185			
18c	Schneider, Schluer, Kretzer, Fröhlich, & Rey (2022)	0.607		1.304	0			
19	Sondermann & Merkt (2023a)	-0.401		2.064	1.156		0.48	
20a	Sondermann & Merkt (2023b)	0.146		-0.049	0.249		-0.03	
20b	Sondermann & Merkt (2023b)	-0.008		0.027	0.227		0.359	
21	van Wermesmerken, Ravensbergen, & van Gog (2018)	-0.345	-0.413					-3

Study Nr.	Study	Retention	Transfer	Social Presence	Affect	Motivation	Extraneous Load	Dwell Time
22	Wang & Antonenko (2017)	1.044	0.199		1.655			
23	Wang, Antonenko, & Dawson (2020)	-0.081	0.36		1.654	1.708	0.776	
24	Wang, Antonenko, Keil, & Dawson (2020)	0.095	0.549				1.279	
25	Wilson, Martinez, Mills, D'Mello, Smilek, & Risko (2018)	-0.289			0.587	0.587		
26	Yuang, Zeng, Wang, & Shang (2021)	-0.775	-0.574	-0.058	-0.526			
27a	Zhang, Xu, Pi, & Yang (2021)	0.144			0.469	1.08		-1.839
27b	Zhang, Xu, Pi, & Yang (2021)	0.058			0.549	0.503		-2.81
27c	Zhang, Xu, Pi, & Yang (2021)	0.787			0.745	0.533		-1.743
28	Zhang & Yang (2022)	0.949						-0.687
29	Beege	0.361		0.934		0.811		
30	Rey	-0.151	-0.193	0.455	1.013	0.049	0.572	
Not included in the moderator analysis since learning outcomes were not reported:								
31	Anggraini, Sunawan, & Murtadho (2020)						0.383	-1.386
32	Kizilcec, Bailenson & Gomez (2015)				0.145			
33	Lyons, Reysen, & Pierce (2012)			-0.508	-0.215			
34	Pierson (2017)					0.39		
35	Wong, Marshall, Blank, & Hard (2022)			0.087	0.163	0.201		

Note. The grey area represents grey literature.

Note. The grey area represents grey literature.

Table 2

Coding of study Features.

Study Nr.	Study	Sample	Mean age (in years)	Proportion of females	Prior knowledge	Measurement time of learning	Pacing	Instructional domain	Instructional setting	Video length (in sek)	Integration	Image detail	Size in percent	Position	Horizontal position	Vertical Position	Gestures	Persistence	Age	Gender	Clothing	Relevance
1	Alfasor (2021)	university students	n.r.	1	no	after reception	system paced	Social Science	Online Study	n.r.	camera	head	n.r.	fixed	right	bottom	n.r.	always	lecturer	male	n.r.	personally
2	Colliot & Jamet (2018)	university students	21.16	0.63	low	after questionnaires	learner paced	Natural Science/ Mechanic	Laboratory Study	560	camera	upper body	10	fixed	left	top	other	always	lecturer	male	non-professional	non-prominent
3	Fiorella, Stull, Kuhlmann & Mayer (2019)	university students	19.43	0.84	low	after reception	system paced	Natural Science/ Mechanic	Laboratory Study	720	camera	upper body	21	fixed	middle	middle	signaling	always	lecturer	female	non-professional	non-prominent
4a	Heidig (2022)	university students	21.9	0.9	low	after questionnaires	system paced	Social Science	Field Study	2027	camera	head	7	fixed	right	bottom	no	always	lecturer	female	non-professional	personally
4b	Heidig (2022)	university students	21.9	0.9	low	delayed	system paced	Social Science	Field Study	2027	camera	head	7	fixed	right	bottom	no	always	lecturer	female	non-professional	personally
5a	Heidig & Hauser (2021)	university students	22.06	0.81	low	after questionnaires	learner paced	Informatics	Online Study	413	camera	head	8	fixed	right	bottom	no	always	student	female	non-professional	non-prominent
5b	Heidig & Hauser (2021)	university students	22.4	0.83	low	after questionnaires	learner paced	Social Science	Field Study	2027	camera	head	7	fixed	right	bottom	no	always	lecturer	female	non-professional	personally
6	Homer, Plass, & Blake (2008)	university students	n.r.	0.73	n.r.	after questionnaires	learner paced	Social Science	Laboratory Study	1200	camera	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	non-prominent
7a	Hong, Pi, & Yang (2018)	university students	20.76	0.75	low	after questionnaires	system paced	Informatics	Laboratory Study	500	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
7b	Hong, Pi, & Yang (2018)	university students	20.76	0.75	low	after questionnaires	system paced	Informatics	Laboratory Study	426	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
8	King, Marcus, & Markant (2022)	adult education	21.5	0.76	no	after questionnaires	system paced	Other	Online Study	262	camera	head	3	fixed	right	top	no	always	lecturer	female	non-professional	non-prominent
9	Kizilcec, Papadopoulos, & Sritanyaratana (2014)	university students	n.r.	0.5	n.r.	after questionnaires	system paced	Social Science	Laboratory Study	858	greenscreen	head	6	n.r.	right	bottom	no	partially	lecturer	male	professional	publicly
10	Kokoç, Ilgaz, & Altun (2020)	university students	20.87	0.43	n.r.	after reception	system paced	Informatics	Laboratory Study	180	camera	head	4	variable	right	n.r.	no	always	lecturer	male	professional	non-prominent
11a	Kühl, Teske, Merkt, & Sonderman (2022)	university students	22.37	0.7	low	after questionnaires	system paced	Other	Online Study	889	camera	head	6	fixed	right	top	no	always	student	female	professional	non-prominent
11b	Kühl, Teske, Merkt, & Sonderman (2022)	university students	22.37	0.7	low	after questionnaires	system paced	Other	Online Study	889	camera	head	6	fixed	right	top	no	partially	student	female	professional	non-prominent
11c	Kühl, Teske, Merkt, & Sonderman (2022)	adult education	28.96	0.5	low	after questionnaires	system paced	Other	Online Study	886	camera	head	6	fixed	right	top	no	always	student	female	professional	non-prominent
11d	Kühl, Teske, Merkt, & Sonderman (2022)	adult education	28.96	0.5	low	after questionnaires	system paced	Other	Online Study	886	camera	head	6	fixed	right	top	no	partially	student	female	professional	non-prominent

Study Nr.	Study	Sample	Mean age (in years)	Proportion of females	Prior knowledge	Measurement time of learning	Pacing	Instructional domain	Instructional setting	Video length (in sek)	Integration	Image detail	Size in percent	Position	Horizontal position	Vertical Position	Gestures	Persistence	Age	Gender	Clothing	Relevance
12	Lassance, Filgueiras, Dessus, Guntz, & Cowley (2022)	n.r.	n.r.	n.r.	low	after questionnaires	system paced	Other	Laboratory Study	578	greenscreen	upper body	27	fixed	right	bottom	no	always	lecturer	female	professional	non-prominent
13	Ng & Przybyłek (2014)	university students	n.r.	0.19	no	after questionnaires	system paced	Other	Online Study	600	camera	head	6	fixed	right	bottom	no	always	lecturer	female	n.r.	non-prominent
14	Pi & Hong (2016)	university students	20.25	0.76	n.r.	after reception	system paced	Social Science	Laboratory Study	1500	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	lecturer	female	n.r.	publicly
15	Rouan (1995)	university students	n.r.		n.r.	after reception	system paced	Other	Field Study	840	n.r.	n.r.	n.r.	fixed	right	bottom	n.r.	always				
16	Schmidt-Borcherding & Drendel (2021)	university students	24.96	0.84	low	after reception	system paced	Maths/Statistics	Laboratory Study	600	greenscreen	upper body	26	fixed	left	middle	other	always	lecturer	male	non-professional	personally
17	Schmidt-Borcherding, Gehrke, & Bateman (2022)	university students	24.5	0.87	low	after reception	system paced	Maths/Statistics	Laboratory Study	622	greenscreen	upper body	26	fixed	left	middle	other	always	lecturer	male	non-professional	personally
18a	Schneider, Schluer, Kretzer, Fröhlich, & Rey (2022)	university students	22.11	0.68	low	after questionnaires	learner paced	Informatics	Online Study	414	camera	upper body	16	fixed	right	middle	other	always	student	male	non-professional	personally
18b	Schneider, Schluer, Kretzer, Fröhlich, & Rey (2022)	university students	22.11	0.68	low	after questionnaires	learner paced	Informatics	Online Study	414	camera	upper body	33	fixed	right	middle	other	always	student	male	non-professional	personally
18c	Schneider, Schluer, Kretzer, Fröhlich, & Rey (2022)	university students	22.11	0.68	low	after questionnaires	learner paced	Informatics	Online Study	414	camera	upper body	50	fixed	right	middle	other	always	student	male	non-professional	personally
19	Sondermann & Merkt (2023a)	adult education	26.88	0.57	low	after questionnaires	system paced	Other	Online Study	419	greenscreen	head	7	fixed	right	bottom	no	always	lecturer	female	non-professional	non-prominent
20a	Sondermann & Merkt (2023b)	adult education	29.01	0.27	low	after questionnaires	system paced	Other	Online Study	1385	greenscreen	head	8	variable	left	bottom	no	always	student	male	non-professional	non-prominent
20b	Sondermann & Merkt (2023b)	adult education	28.68	0.42	low	after questionnaires	system paced	Other	Online Study	918	greenscreen	head	8	variable	right	bottom	no	always	student	male	non-professional	non-prominent
21	van Wermesmerken, Ravensbergen, & van Gog (2018)	university students	20.8	0.56	low	after reception	system paced	Maths/Statistics	Laboratory Study	537	greenscreen	upper body	24	fixed	right	bottom	other	always	lecturer	male	non-professional	non-prominent
22	Wang & Antonenko (2017)	university students	19.65	0.583	n.r.	after questionnaires	system paced	Maths/Statistics	Laboratory Study	600	greenscreen	upper body	7	fixed	right	bottom	other	always	lecturer	n.r.	non-professional	non-prominent
23	Wang, Antonenko, & Dawson (2020)	university students	18.36	0.65	no	after questionnaires	system paced	Maths/Statistics	Laboratory Study	420	greenscreen	upper body	7	fixed	right	bottom	other	always	lecturer	male	non-professional	non-prominent
24	Wang, Antonenko, Keil, & Dawson (2020)	university students	18.36	0.65	no	after questionnaires	system paced	Maths/Statistics	Laboratory Study	240	greenscreen	upper body	6	fixed	right	bottom	other	always	lecturer	male	non-professional	non-prominent
25	Wilson, Martinez, Mills, D'Mello,	adult education	34	0.33	n.r.	after questionnaires	system paced	Historical Science	Online Study	390	camera	whole body	n.r.	fixed	right	bottom	n.r.	always	n.r.	n.r.	n.r.	n.r.

Study Nr.	Study	Sample	Mean age (in years)	Proportion of females	Prior knowledge	Measurement time of learning	Pacing	Instructional domain	Instructional setting	Video length (in sek)	Integration	Image detail	Size in percent	Position	Horizontal position	Vertical Position	Gestures	Persistence	Age	Gender	Clothing	Relevance
	Smilek, & Risko (2018)																					
26	Yuang, Zeng, Wang, & Shang (2021)	university students	23.4	0.51	low	after reception	system paced	Historical Science	Online Study	540	camera	upper body	12	fixed	right	bottom	no	always	lecturer	female	non-professional	non-prominent
27a	Zhang, Xu, Pi, & Yang (2021)	university students	20.8	0.88	low	after questionnaires	system paced	Natural Science/ Mechanic	Laboratory Study	300	greenscreen	upper body	25	fixed	left	bottom	no	always	lecturer	female	non-professional	non-prominent
27b	Zhang, Xu, Pi, & Yang (2021)	university students	20.8	0.88	low	after questionnaires	system paced	Natural Science/ Mechanic	Laboratory Study	300	greenscreen	upper body	25	fixed	middle	bottom	no	always	lecturer	female	non-professional	non-prominent
27c	Zhang, Xu, Pi, & Yang (2021)	university students	20.8	0.88	low	after questionnaires	system paced	Natural Science/ Mechanic	Laboratory Study	300	greenscreen	upper body	25	fixed	right	bottom	no	always	lecturer	female	non-professional	non-prominent
28	Zhang & Yang (2022)	university students	19.72	0.5	low	after reception	system paced		Laboratory Study	n.r.	camera	head	7	fixed	right	top	no	always	lecturer	female	non-professional	non-prominent
29	Beege	secondary students	n.r.	n.r.	low	after questionnaires	system paced	Social Science	Field Study	n.r.	greenscreen	upper body	29	fixed	right	bottom	other	always	lecturer	female	non-professional	personally
30	Rey	university students	21.53	0.76	low	after questionnaires	learner paced	Social Science	Online Study	2873	greenscreen	head	33	fixed	right	bottom	signaling	always	lecturer	male	professional	personally
Not included in the moderator analysis since learning outcomes were not reported:																						
31	Anggraini, Sunawan, & Murtadho (2020)	secondary students	n.r.	n.r.																		
32	Kizilcec, Bailenson & Gomez (2015)	adult education	37.6	0.48																		
33	Lyons, Reysen, & Pierce (2012)	university students	23.34	0.899																		
34	Pierson (2017)	university students	n.r.	0.711																		
35	Wong, Marshall, Blank, & Hard (2022)	adult education	24.3	0.56																		

Note. The grey area represents grey literature; n.r. = not reported

Note. The grey area represents grey literature; n.r. = not reported.

(5) Studies that were included in the moderator analysis must report learning outcomes. Studies that did not contain an outcome test that could be assigned as learning test (e.g., Wong et al., 2022) were not included in the moderator analysis. Studies that did not report learning outcomes, however, are still included in the analysis of the overall effects.
(6) Enough statistical data had to be reported to allow the calculation of an effect size. Several investigations that did not report enough statistical information (e.g., means, test value, effect sizes; e.g., Yu, 2021) were excluded.

3.3. Study screening

The study screening process took place in four stages (Fig. 3). First, the titles and abstracts of all studies were screened to see if they met the inclusion criteria. Seventy-three studies remained for a full-text review. After reviewing the full-text of the 74 studies, 33 studies met the inclusion criteria. Finally, two additional grey literature studies were included that were provided to the authors. This resulted in 35 studies and $k = 46$ single comparisons for the meta-analysis. Five studies were excluded from the moderator analysis since no learning outcomes were reported, resulting in 30 studies and $k = 41$ single comparisons for the moderator analysis. An overview of the excluded studies can be found in Appendix A.

3.4. Outcome variables

Table 1 contains 41 pair-wise comparisons and includes the effect sizes concerning the following dependent variables.

(1) Learning outcomes: Retention ($k = 39$) and transfer ($k = 20$) performance were investigated. We considered retention as the ability to store information and retrieve or recognize the information later. This multidimensional ability can be measured by testing if learners can repeat, list, name, recognize, or reproduce factual information (cf. Anderson et al., 2001). Transfer performance is related to the multi-faceted potential to acquire the meaning of the stored information and apply it to new contexts. Therefore, in transfer questions, inferences should be drawn from the presented information in the multimedia instruction (cf. Mayer, 2014c).
(2) Subjective Ratings: Recent studies (e.g., Wilson et al., 2018) outlined that even if learning might not be influenced by instructor presence, other learning relevant processes can be fostered. To investigate the social benefits of visual social entities (e.g., Schneider et al., 2021), one meta-analysis was conducted for perceived social presence ($k = 19$). In line with research that outlines affective and motivational benefits of visible instructors (e.g., Alfasor 2021) affective ratings ($k = 22$), as well as motivational ratings ($k = 14$) were also examined. Finally, CLT implies that visible instructors might induce learning irrelevant cognitive load (van Wermeskerken et al., 2018). Consequently, ECL ratings ($k = 14$) were analyzed as well.
(3) Eye-Tracking Data: A visible instructor might distract learners from the relevant visual material (Stull et al., 2018). Consequently, effects of instructor presence on the dwell time ($k = 8$) on the learning-relevant material were also examined by meta-analysis.

A positive effect size is defined as supporting learning processes through instructor presence (higher retention or transfer scores, higher social presence, motivation and affective rating, lower cognitive load scores, and a higher dwell time on learning-relevant visual material).

3.5. Coding of study features

Table 2 outlines the study features for all included studies. It must be noted that moderator variables could only be coded when relevant information was presented in the publications (e.g., pictures of the experimental manipulation must be shown to code instructor-relevant variables). Consequently, some cells may not be reported. Two raters coded all study features to ensure inter-rater reliability. The inter-rater reliability was high or even perfect (Cohen's $\kappa = [0.87, 1]$; Landis & Koch, 1977; Warrens, 2015). A detailed overview of the specifications of the included studies is included in Appendix B.

3.5.1. Learner features

First, the educational level was coded in detail. Then, to create moderator variables, each sample was coded as "primary students," "secondary students," "university students," or "adult education."

Second, the domain-specific prior knowledge was coded. Learners either possessed no prior knowledge, low prior knowledge, or higher prior knowledge. No prior knowledge was assigned to studies where the authors explicitly wrote that participants did not have any prior knowledge or a fictitious learning topic was used. In the majority of the cases, no explicit information was specified; therefore, statistical data from these studies were used to code prior knowledge. The mean percentage of correct answers in relation to the maximum value reached in the prior knowledge test was computed for each study. In line with the meta-analysis from Schneider et al. (2018), a score of 50% was used to separate low and high prior knowledge. If participants scored up to 50% of a prior knowledge maximum score, they were designated as "low prior knowledge" learners. If participants scored above 50%, they were classified as "high prior knowledge" learners.

3.5.2. Study features

We coded when learning was measured. The measurement time was categorized into "directly after video reception", "after other questionnaires", and "delayed".

Another important moderator is the pacing of the video ("system-paced" vs. "learner-paced"). If participants had no control over the instructional video or were unable to set the pace, the "system-paced" category was used. If learners could modify the pace of the presentation (start, pause, stop, repeat sections, etc.), the material was categorized as "learner-paced." In case of learner pacing, it was additionally categorized if participants just could pause (start/stop during the reception) the video or if learners had additional options (e.g., rewind, replay).

To rate the instructional domain (or subject area), an adapted version of the categorization used by Rey et al. (2019) was used to code the instructional material domains. The domains were separated into "natural scientific topic or mechanics"; "social science"; "historical science"; "mathematic or statistic"; "ecology"; "informatics or software"; and "other".

A further moderator was the instructional setting ("laboratory study", "field study", or "online study"). Laboratory studies were conducted in highly controlled computer labs. Field studies were conducted within school or university courses in their course rooms. Online studies were conducted with a study-link that was distributed via online portals or mail distribution lists.

Finally, the length of the video in seconds was investigated as a continuous moderator. We coded the length of the video in seconds.

3.5.3. Instructor features

In addition to study and learner features, the implementation of the lecturer was analyzed and further potential moderators were coded. The first moderator was instructor integration. It was coded if the instructor was implemented via greenscreen or camera (with potential additional objects in the background). If additional objects were visible, the objects were coded as well ("no objects", "additional objects").

The next potential moderator was the image detail of the lecturer. It was categorized if only the head was visible if the upper body was visible (and thus if additional gesturing was possible), and if (nearly) the whole body was presented.

In addition to the image detail, the size of the instructor was also coded. The size of the instructor in relation to the whole video size was included as a continuous moderator. In this regard, the screenshots from the primary studies were used and the relation between the number of pixels of the video and the number of pixels of a rectangular box around the lecturer were used.

The next moderator was the position of the instructor. It was coded if the position was fixed or variable and if the position was fixed, the horizontal axis ("left", "middle", "right") and vertical axis ("top", "middle", "bottom") were coded.

To further investigate lecturer-relevant variables the gestures, ("no gestures", "signaling gestures", "other movements"), persistence ("always visible", "partially visible"), age ("peer", "lecturer"), gender ("male", "female"), clothing ("non-professional outfit" i.e., shirt or pullover and "professional outfit" i.e., formal shirt or suit), and personal or public relevance of the lecturer ("non-prominent & not personally known", "personally known", "publicly known") were coded.

3.6. Selection of relevant comparisons

In a few studies, experimental conditions and therefore participants had to be excluded. Exclusions were made when there was no manipulation in terms of instructor presence within the experimental group or additional manipulations took place (e.g., Pi & Hong, 2016). In a few cases, multiple relevant manipulations were made, and thus, the study was divided with respect to moderator analyses. For example, Zhang et al. (2021) manipulated the position of the lecturer (none vs. left vs. middle vs. right). Based on a meta-analysis from Rey et al. (2019), the study was included three times. To not overestimate the sample size in such cases, the number of participants in the control group was divided by the number of comparisons. In these cases, the participants of each experimental condition as well as in the control condition were still only included once in the meta-analyses, ensuring independencies in the data.

3.7. Analysis methods

The implementation and statistical evaluation of the meta-analyses were based on Field and Gillett's approach (2010) as well as approaches of recent meta-analyses (e.g., Almedag, 2022). For each dependent variable a separate meta-analysis was conducted. A small sample-adjusted standardized mean difference (Hedges' g for effect sizes from single investigations, Hedges $g+$ for aggregated effect sizes; e.g., Hedges & Olkin, 1985) was chosen as the standard effect size. The criterion for the interpretation of effect sizes was based on Hattie, 2009, which investigated over 800 meta-analyses. For educational research, values of $g+ = 0.20$, 0.40, and 0.60 were used to describe small, medium, and large effects. The effect sizes of all pair-wise comparisons were computed using the means and standard deviations reported in the studies. When standard deviations were not reported and only means were displayed, test scores (t or F values) were used to compute the average standard deviation. If only t or F values were reported and means and standard deviations were not presented, these t and F values (or the corresponding p-values) and sample sizes were used to calculate the effect sizes and the standard errors, using the Practical Meta-Analysis Effect Size Calculator (Wilson, 2001). If the experiment included more than one effect size per dependent measure, the effects were averaged. Since, for example, instructors, the implementation of instructions, or learning domains varied significantly across the studies, a random-effects model was preferred to a fixed-effect model (Hedges & Vevea, 1998). This approach is based on Field and Gillett (2010), who recommended a random-effects model be used in social sciences. Each computed effect size was standardized by the inversed squared standard error to increase the weighting of studies with larger sample sizes (e.g., Cooper et al., 2009). The overall effects and moderator analyses were calculated using JASP (JASP Team, 2022). R (R Core Team, 2022) and the metafor package (Viechtbauer, 2010) were used to check for outliers. The SPSS script MetaREG (Lipsey & Wilson, 2001; Wilson, 2010) was used for the investigation of the continuous moderators. Since learning results were in the main focus of the analyses, moderator analyses were conducted for retention and transfer separately.

The publication bias analysis was carried out using two methods for each meta-analysis. First, the funnel plot was conducted and observed (cf. Sterne et al., 2005). Additionally, the rank correlation (rank test for plot asymmetry) was computed (Begg & Mazumdar, 1994). To check for potential outliers, tests from Grubbs (1969) and Viechtbauer and Cheung (2010) were carried out.

4. Results

4.1. Sample characteristics

The overall sample size of all studies included in the analyses amounted to $N = 6339$ ($N = 3367$ for the visible instructor condition). The sample sizes varied from $N = 11$ to $N = 3494$. The mean sample size was $N = 137.80$ ($SD = 508.84$). There was one study with a particular large sample size (study number: 32). Without this study, the mean sample size was $N = 63.22$ ($SD = 55.83$). The mean age of the participants considered for the meta-analyses was 23.23 years, and the overall percentage of women was 66.7%.

The 46 pair-wise comparisons that included these effect sizes were published mainly as journal articles ($k = 29$), followed by ten conference proceedings, two contributions as grey literature, two online first publications, two doctoral theses, and one book chapter. Studies were conducted in English ($k = 16$), Chinese ($k = 8$), German ($k = 15$), and other languages ($k = 7$).

With respect to the moderator analyses ($k = 41$), further characteristics were described. The prior domain knowledge of the majority of the participants was low ($k = 29$) or participants had no prior knowledge ($k = 5$). There were no studies with high prior knowledge learners. Most studies were conducted as laboratory experiments ($k = 19$; field studies: $k = 5$; online-studies: $k = 17$). The learning topics of the multimedia instructions included natural scientific topics or mechanics ($k = 5$), social science ($k = 9$), historical science ($k = 2$), mathematic or statistic ($k = 6$), informatics ($k = 7$) and other topics ($k = 11$). The average instructional video duration was approximately 13 min ($M = 788.26$ s, $SD = 598.96$). Most investigations used system-paced videos ($k = 33$). Learner-paced investigations were carried out less frequently ($k = 8$).

Studies included instructors almost equally through greenscreens ($k = 16$) or webcams ($k = 21$). When webcams were used, the background was mostly an empty wall ($k = 14$). In only a few cases ($k = 6$) additional objects like chairs, a laptop, or a bookshelf were visible. In only one study, nearly the instructor's whole body was visible. Most videos included only the instructor's head ($k = 18$) or upper body ($k = 17$). The average size of the lecturer was 14.82 percent ($SD = 11.46$ percent; $Min = 3$ percent; $Max = 50$ percent) in relation to the video size. The instructor mostly had a fixed position ($k = 33$; variable: $k = 3$) in the instructional videos, and in most cases, the instructor was placed on the right ($k = 30$; middle: $k = 2$; left: $k = 5$) side on the bottom ($k = 23$; middle: $k = 6$; top: $k = 7$) of the screen. Since often only the instructor's head was visible, most instructors did not perform any gestures ($k = 21$). In two studies, the instructor performed signaling gestures and in 11 studies, the lecturer performed other, non-signaling movements. The instructor was visible all the time in most of the studies ($k = 34$). Only in three studies, the instructor was not always present. Concerning the age of the instructor, most studies used an adult lecturer ($k = 26$; student lecturer: $k = 10$). The gender of the instructor was evenly distributed (male: $k = 15$; female: $k = 20$). The instructor was generally dressed casually ($k = 25$; formal: $k = 8$). Since most videos were created explicitly for laboratory experiments, the instructor was mostly unknown to the participants ($k = 24$; personally known: $k = 11$; publicly known: $k = 2$).

4.2. Outlier and publication bias analyses

The tests from Grubbs (1969) did not detect any outliers. However, the test based on the procedure from Viechtbauer and Cheung (2010) detected one outlier with respect to social presence (the study from Sondermann and Merkt, 2023a) and one outlier with respect to ECL (the study from Wang et al., 2020b). We checked both studies and we did not find any anomalies regarding the manipulation of instructor presence, the measurement procedures or calculations. Consequently, in line with the argumentation outlined from Hunter and Schmidt (2004), we did not exclude these since the review of both studies revealed that effect sizes could not be interpret as erroneous data (Schmidt, 2008). Furthermore, we exploratively conducted the meta-analyses without these studies to ensure that the overall effect did not depend on few (potentially unusual) studies. The results demonstrated minimal changes in effect sizes, only occurring in the second decimal place.

We next conducted publication bias tests for each of the meta-analyses. All funnel plots are displayed in Appendix C. Some of the funnel plots showed asymmetry, which could indicate publication bias being present. However, the rank correlation tests indicated that no publication bias could be detected for any of the meta-analyses: social presence, τ ($N = 21$) $= 0.28$, $p = .09$; affective rating, τ ($N = 22$) $= -0.03$, $p = .87$; motivation, τ ($N = 14$) $= 0.21$, $p = .33$; extraneous load, τ ($N = 14$) $= 0.14$, $p = .52$; dwell time on relevant material, τ ($N = 8$) $= 0.29$, $p = .40$; retention, τ ($N = 39$) $= 0.17$, $p = .14$; and transfer, τ ($N = 20$) $= -0.13$, $p = .46$.

4.3. The overall instructor presence effect

An overview of the overall instructor presence effect on all outcome measures is provided in Table 3. Forest and violin plots for each analysis are included in Appendix C. We present our results by hypothesis and research question.

4.3.1. H1: learners watching a video with a visible instructor report a higher social presence than learners watching a video without a visible lecturer

Regarding H1, 14 out of 21 social presence effect sizes were positive, indicating that instructor presence enhances social presence. The weighted mean effect size for social presence was $g+ = 0.35$, 95% CI [0.08, 0.62], $SE = 0.14$, $z = 2.58$, $p = .01$, indicating a

Table 3
Aggregated effect sizes and confidence intervals for outcome measures.

Outcome measure	Number of comparisons *k*	Effect size *g* +	Standard Error	95% CI for *g* +
Retention	39	0.22**	0.08	[0.07, 0.37]
Transfer	20	0.06	0.08	[-0.09, 0.21]
Social Presence	21	0.35*	0.14	[0.08, 0.62]
Affect	22	0.43***	0.13	[0.18, 0.67]
Motivation	14	0.41**	0.14	[0.14, 0.68]
Extraneous Load	14	0.31**	0.10	[0.11, 0.51]
Dwell Time	8	−1.81***	0.35	[-2.49, −1.12]

Note. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

significant effect with a medium effect size. The heterogeneity statistics were significant, $I^2 = 95.44\%$, $Q = 399.95$, $df = 21$, $p < .001$. Consequently, H1 was supported.

4.3.2. *H2: learners watching a video with a visible instructor report a higher ECL than learners watching a video without a visible lecturer*

Recall that a positive effect size is associated with reducing cognitive load in our analysis. Regarding H2, 11 out of 14 effect sizes were positive for cognitive load, indicating that instructor presence reduced extraneous load. The computed significant effect size was small, $g+ = 0.31$, 95% CI [0.11, 0.51], $SE = 0.10$, $z = 2.98$, $p = .003$. The heterogeneity tests revealed that effect sizes were heterogeneous ($I^2 = 86.24\%$, $Q = 79.39$, $df = 13$, $p < .001$). Consequently, H2 was not supported.

4.3.3. *H3: learners watching a video with a visible instructor exhibit a shorter dwell time on the instructional material than learners watching a video without a visible lecturer*

Regarding H3, eight out of eight effect sizes were negative for dwell time on relevant information, indicating that instructor presence reduced dwell time. The computed significant effect size was large, $g+ = -1.81$, 95% CI [−2.49, −1.12], $SE = 0.35$, $z = -5.18$, $p < .001$. The heterogeneity tests revealed that effect sizes were heterogeneous ($I^2 = 77.58\%$, $Q = 35.69$, $df = 7$, $p < .001$). Consequently, H3 was supported.

4.3.4. *H4: learners watching a video with a visible instructor report higher affect and motivation than learners watching a video without a visible lecturer*

Regarding H4, 18 out of 22 effect sizes were positive for affective rating, indicating that instructor presence led to a higher rating. The computed significant effect size was moderate, $g+ = 0.43$, 95% CI [0.18, 0.67], $SE = 0.13$, $z = 3.37$, $p < .001$. The heterogeneity tests revealed that effect sizes were heterogeneous ($I^2 = 97.81\%$, $Q = 850.14$, $df = 21$, $p < .001$). In terms of motivational perceptions, 13 out of 14 effect sizes were positive for motivation, indicating that instructor presence fostered motivational ratings. The computed significant effect size was moderate, $g+ = 0.41$, 95% CI [0.14, 0.68], $SE = 0.14$, $z = 2.96$, $p = .003$. The heterogeneity tests revealed that effect sizes were heterogeneous ($I^2 = 93.25\%$, $Q = 128.55$, $df = 13$, $p < .001$). Consequently, H4 was supported.

4.3.5. *RQ2: does a visible instructor in an instructional video affect learning outcomes in contrast to a video without a visible instructor?*

With respect to RQ2, retention and transfer were investigated separately. Regarding retention performance, 24 out of 39 effect sizes were positive, meaning that positive as well as negative effect sizes were relatively balanced. The weighted mean effect size was $g+ = 0.22$, 95% CI [0.07, 0.37], $SE = 0.08$, $z = 2.89$, $p = .004$, indicating a significant effect with a small effect size for instructor presence. The heterogeneity tests were significant, $I^2 = 90.76\%$, $Q = 455.75$, $df = 38$, $p < .001$, indicating there was significant study heterogeneity and one or more variables might moderate this mean effect. Concerning transfer performance, 12 out of 20 effect sizes were positive. Again, positive as well as negative effect sizes were relatively balanced. The computed effect size was non-significant, $g+ = 0.06$, 95% CI [−0.09, 0.21], $SE = 0.08$, $z = 0.74$, $p = .46$. The heterogeneity tests were significant as well, $I^2 = 75.61\%$, $Q = 89.18$, $df = 19$, $p < .001$.

4.4. *RQ3: are characteristics of participants, the study, and the instructor moderator variables for the instructor presence effect?*

Since learning outcomes were the main focus of the meta-analyses, separate moderator analyses were computed for retention and transfer performance, respectively. Statistical data for moderator variables concerning retention performance are shown in Table 4. Statistical data for moderator variables concerning transfer performance are shown in Table 5. Differences between the individual moderator categories were tested using the 95% confidence intervals for significance.

4.4.1. *Moderators for retention performance*

4.4.1.1. Learner features. No moderating effects could be shown with regard to prior knowledge ($Q_{between} = 0.24$; $df = 1$; $p = .63$), or participant age ($Q_{between} = 4.27$; $df = 2$; $p = .12$).

4.4.1.2. Study features. The only significant moderator was instructional domain ($Q_{between} = 17.39$; $df = 5$; $p = .004$). A visible instructor was beneficial for instructing social science as well as informatics. A negative trend was found for historical science and no effects were found in regards to the other domains.

No significant moderating effects were found for the measurement time of the learning test ($Q_{between} = 0.25$; $df = 2$; $p = .88$), pacing ($Q_{between} = 0.47$; $df = 1$; $p = .49$), instructional setting ($Q_{between} = 3.58$; $df = 2$; $p = .17$), or length of the instructional video ($Q = 0.02$; $df = 1$; $p = .88$). To summarize, the effect of instructor presence was robust across the study feature moderators for retention measures.

4.4.1.3. Lecturer features. No moderating effects could be shown for integration ($Q_{between} = 0.42$; $df = 1$; $p = .52$), image detail ($Q_{between} = 1.24$; $df = 2$; $p = .54$), size of the lecturer ($Q = 0.06$; $df = 1$; $p = .81$), position ($Q_{between} = 0.96$; $df = 1$; $p = .33$), horizontal position ($Q_{between} = 0.76$; $df = 2$; $p = .68$), vertical position ($Q_{between} = 0.63$; $df = 2$; $p = .73$), gestures ($Q_{between} = 1.87$; $df = 2$; $p = .39$), persistence ($Q_{between} = 0.22$; $df = 1$; $p = .64$), age ($Q_{between} = 0.22$; $df = 1$; $p = .64$), gender ($Q_{between} = 0.65$; $df = 1$; $p = .42$), clothing ($Q_{between} = 0.09$; $df = 1$; $p = .76$), and personal or public relevance ($Q_{between} = 4.14$; $df = 2$; $p = .13$). In other words, the effect of instructor presence was robust across the lecturer feature moderators for retention measures.

4.4.2. Moderators for transfer performance

4.4.2.1. Learner features. Prior knowledge was a significant moderator ($Q_{between} = 7.46$; $df = 1$; $p = .006$). A positive effect was found for learners without prior knowledge ($g+ = 0.49$), whereas a non-significant effect was found for learners with low prior knowledge ($g+ = -0.05$). No moderating effects could be shown with regard to sample ($Q_{between} = 0.03$; $df = 1$; $p = .86$).

4.4.2.2. Study features. No moderating effects could be found for measurement time of the learning test ($Q_{between} = 3.13$; $df = 2$; $p = .21$), pacing ($Q_{between} = 2.21$; $df = 1$; $p = .14$), instructional domain ($Q_{between} = 6.05$; $df = 5$; $p = .30$), instructional setting ($Q_{between} = 0.26$; $df = 2$; $p = .88$), or the length of the instructional video ($Q = 0.03$; $df = 1$; $p = .86$). To summarize, the null effect of instructor presence for transfer measures was robust across the study feature moderators.

4.4.2.3. Lecturer features. The size of the instructor was found to be a significant moderator ($Q = 5.03$; $df = 1$; $p = .03$; $R^2 = 0.26$; $\beta = -0.51$). With increasing size of the instructor in relation to the size of the instructional video, transfer scores lowered. Meanwhile, no moderating effects were found for integration ($Q_{between} = 0.45$; $df = 1$; $p = .50$), image detail ($Q_{between} = 0.99$; $df = 1$; $p = .32$), position (no moderator analysis was possible since no study with a variable lecturer was conducted), horizontal position ($Q_{between} = 0.86$; $df = 2$; $p = .65$), vertical position ($Q_{between} = 0.07$; $df = 2$; $p = .97$), gestures ($Q_{between} = 0.02$; $df = 2$; $p = .99$), persistence ($Q_{between} = 1.99$; $df = 1$; $p = .16$), age ($Q_{between} = 0.56$; $df = 1$; $p = .45$), gender ($Q_{between} = 0.06$; $df = 1$; $p = .80$), clothing ($Q_{between} = 0.18$; $df = 1$; $p = .67$), and personal or public relevance ($Q_{between} = 0.76$; $df = 2$; $p = .68$). To summarize, the null effect of instructor presence for transfer measures was generally robust across the lecturer feature moderators, although we found that the larger the instructor's image was in the video, the lower the learners' transfer scores became.

5. Discussion

The results of these meta-analyses shed new light onto the emergence and moderators of the instructor presence effect. To answer RQ1, a detailed insight into the postulated hypotheses is provided. A visible instructor mainly enhanced subjective ratings (social presence, affective and motivational rating; supporting H1 and H4). Interestingly, a visible instructor reduced ECL (not supporting H2) even though dwell time on relevant visual material was reduced (supporting H3). With regard to RQ2, retention performance was enhanced by including a visible instructor, whereby transfer performance was not influenced by instructor presence.

In line with prior research and a recent meta-analysis, including a visible instructor within an instructional video enhanced perceived social presence, as well as affective and motivational ratings. Concerning the CASTLE (Schneider et al., 2021), visible instructors act as social cues that activate the impression of a social presence – a sense of interacting with another social entity in learners. In line with the interaction hypothesis, the implementation of social cues further enhanced motivational and affective ratings (Colliot & Jamet, 2018). This further supports results from Richardson et al. (2017) who outlined that social presence and affective/motivational processes as well as engagement are positively associated. Consequently, student engagement triggered deeper processes and learning should be fostered. This assumption could not be supported fully since retention but not transfer was enhanced. It is important to mention that positive effect sizes could, in particular, be observed in recent studies. It is also noteworthy that a previous meta-analysis did not detect a positive effect size for retention (Almedag, 2022).

The results about ECL and dwell time also have interesting implications. First, the negative effect of instructor presence on dwell time are obvious. A visible instructor distracted learners from the instructional material since dwell time on the visual material was significantly reduced. This can be seen as an indicator for a split-attention effect (Schroeder & Cenkci, 2018) or a seductive detail effect (Sundararajan & Adesope, 2020). Nevertheless, ECL was not increased when an instructor was present. ECL was even significantly reduced when a visible instructor was implemented in an instructional video. Consequently, a visible lecturer seemed not to overload the visual channel per se. One possible explanation might lie directly in the split-attention effect. Instructional videos often display complex formulas, scientific processes, or other information that might induce a high load in the visual channel. In particular, when considering the nature of transient information (Leahy & Sweller, 2011), difficult and changing visual information can overload the working memory. Consequently, averting the gaze from the material and looking at the instructor can lower the subjective perception of visual load, especially considering that including social and non-verbal information could be categorized as a fundamental

Table 4
Moderator analyses for retention performance.

Moderator	Number of comparisons *k*	Effect size *g* +	95% CI for *g* +
Prior knowledge			
No	5	0.24	[-0.09, 0.56]
Low	28	0.15(*)	[-0.001, 0.30]
High	–	–	–
Sample			
Primary students	–	–	–

(*continued on next page*)

Table 5
Moderator analyses for transfer performance.

Moderator	Number of comparisons *k*	Effect size *g* +	95% CI for *g* +
Prior knowledge			
No	2	0.49**	[0.14, 0.85]
Low	15	−0.05	[-0.20, 0.10]
High	–	–	–
Sample			
Primary students	–	–	–
Secondary students	–	–	–
University students	17	0.07	[-0.11, 0.25]
Adults	2	0.11	[-0.37, 0.59]
Elderly	–	–	–
Mixed	–	–	–
Learning Test			
After reception	5	−0.19	[-0.50, 0.12]
After other questionnaires	24	0.13	[-0.04, 0.30]
Delayed	1	0.12	[-0.75, 0.98]
Learner guidance			
System paced	17	0.10	[-0.06, 0.27]
Learner paced	3	−0.26	[-0.69, 0.18]
Instructional domain			
Natural Science/Mechanic	2	−0.05	[-0.50, 0.39]
Social Science	5	0.11	[-0.20, 0.42]
Historical Science	2	−0.57(*)	[-1.16, 0.01]
Mathematics/Statistics	6	0.17	[-0.08, 0.43]
Ecology	–	–	–
Informatics/Software	1	−0.17	[-0.89, 0.55]
Other	5	0.10	[-0.17, 0.38]
Instructional setting			
Laboratory Experiment	12	0.07	[-0.14, 0.27]
Field study	2	0.16	[-0.40, 0.72]
Online study	6	0.004	[-0.29, 0.30]
Integration			
Greenscreen	9	0.12	[-0.10, 0.34]
Camera	10	0.01	[-0.21, 0.23]
Image detail			
Head	8	0.18	[-0.09, 0.45]
Upper body	10	−0.0006	[-0.23, 0.23]
Whole body	–	–	–
Position			
Fixed	20	0.06	[-0.09, 0.21]
Variable	–	–	–
Horizontal position			
Left	3	−0.10	[-0.54, 0.34]
Middle	1	0.24	[-0.51, 1.00]
Right	14	0.10	[-0.09, 0.28]
Vertical position			
Up	5	0.10	[-0.23, 0.42]
Middle	3	0.12	[-0.36, 0.59]

(*continued on next page*)

Table 5 (*continued*)

Moderator	Number of comparisons *k*	Effect size *g* +	95% CI for *g* +
Bottom	10	0.06	[-0.17, 0.28]
Gestures			
No gestures	9	0.07	[-0.17, 0.31]
Signaling	2	0.05	[-0.53, 0.64]
Other movements	7	0.09	[-0.18, 0.37]
Persistence			
Always visible	15	0.02	[-0.18, 0.21]
Particularly visible	3	0.34$^{(*)}$	[-0.06, 0.74]
Age			
Student	4	0.20	[-0.16, 0.56]
Adult	14	0.04	[-0.15, 0.24]
Gender			
Female	9	0.05	[-0.20, 0.29]
Male	8	0.09	[-0.17, 0.36]
Clothing			
Non-professional	11	0.04	[-0.18, 0.27]
Professional	7	0.12	[-0.15, 0.40]
Personal or public relevance			
Unknown	13	0.04	[-0.17, 0.25]
Personally known	5	0.04	[-0.34, 0.43]
Publicly known	1	0.35	[-0.32, 1.02]

Note. $^{(*)}$ $p < .10$. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

biological process that does not induce heavy cognitive load (Kirschner et al., 2018). Both effects, the distraction from the instructional material which might lead to reduced learning outcomes as well as the deeper cognitive processing through the implementation of social cues counteract each other. This might then have resulted in only small effects for retention and no effect for transfer. These are important implications for the Cognitive Influence Hypothesis derived from the CASTLE (Schneider et al., 2021) since cognitive processes resulting from social processing could be specified. This is an important implication for future research.

Investigating RQ3, most of the moderating effects did not reach significance. Considering the moderators, it must be noted that many variables (or design possibilities) are underrepresented in empirical studies regarding the instructor presence effect. We want to discuss the significant effects and further, want to give insights in descriptive trends that, in our opinion, deserve attention in future research projects (see: Limitations and Future Directions). A significant moderation for transfer could be found based on the size of the lecturer. Instructors that take up little space in the video indeed led to positive effects. These effects seem to decrease with an increased size of the instructor, leading to an overall non-significant effect. The same trend was found for retention but results did not reach significance. In line with CTML (Mayer et al., 2014a) increasing the size of a potential seductive detail element (Sundararajan & Adesope, 2020) should decrease deep learning processes. According to CASTLE (Schneider et al., 2021), the inclusion of social cues activates a social response and triggers social schemata. Nevertheless, further increasing the size or image detail of the instructor might not lead to further benefits but rather impair learning-relevant processes. This might be an initial explanation for the significant moderation regarding the instructional domain. Negative effects from the two studies using a historical science domain used a rather large lecturer. However, it should also be noted that our analyses were focused on comparing instructor present and instructor absent conditions, rather than the size of the instructor specifically (i.e., we did not directly compare large vs. small instructor images. Rather, our analyses compared studies with a large instructor image present vs. no instructor image present, and small instructor images present vs. no instructor image present, then examined if the effect sizes were statistically different). This is one major implication for future research. In contrast to rather broad subdivisions like high-embodiment or low-embodiment instructors, specific elements like the image detail could be investigated under which conditions visible instructors might foster learning or act as seductive detail. Since the number of studies in our analysis investigating these different design features was relatively low, a systematic review specifically focused on the design of instructor-present videos is needed. Furthermore, prior knowledge was a significant moderator for transfer performance. A visible instructor was beneficial for learners without prior knowledge but not for learners with low prior knowledge (no studies were examined for high prior knowledge). These results imply that learners dealing with a completely new topic, benefit from social guidance through an instructor to maintain attention through social activation and, thus, to build up deeper cognitive schemata. Learners with at least some prior knowledge might not need this additional social activation since they can more rely on already existing superficial schemata with respect to the learning topic. They can integrate instructional information in their prior knowledge in the schema construction process and, thus, can constructively build knowledge without the need for additional social anchors. Nevertheless, only two studies reported no prior knowledge of the learner. Consequently, the results have to be viewed with caution.

5.1. Implications

On the practical side, the inclusion of visible instructors in learning materials is associated with motivational, affective, and social benefits as well as enhanced retention performance. Even though no positive effect on transfer was found, the inclusion of an instructor's image in instructional videos can be recommended. In particular, in video-based courses like Massive Open Online Courses (MOOCs) without existing social connections or interactions, visible lecturers can enhance social presence and thus, potentially the social connection to the course. Nevertheless, designers should be aware that a visible lecturer distracts learners from other visible material. Consequently, it might be recommended not to include instructors if the visual material accompanying them on the screen is necessary for learning. In addition, our findings showed that the instructor should not be included saliently in the video since a larger instructor might have no beneficial effects and might further distract learners. Consequently, integrating the instructor into a corner of the video might trigger social processes without binding too many attentional resources. Overall, we conclude that the context of the instruction must be considered when designing instructional videos. If the visual material is necessary to maximize learning, for example a nuanced diagram, consider leaving the instructor's image off of the video so the learner can focus their attentional resources on the diagram. However, if the images on the screen are primarily supplementary to the instructor's narration, an instructor's image seems to help improve perceptive outcomes and retention. We caution however, that one must also consider a cost-benefit analysis. It is difficult to recommend including an on-screen instructor's image if the costs outweigh the benefits.

On the theoretical side, the Interaction, as well as Cognitive Influence Hypothesis from the CASTLE (Schneider et al., 2021), can be addressed. On the one hand, social cues like visible instructors foster social, affective, as well as motivational processes. On the other hand, a visible instructor causes a seductive details effect even if the negative effects of attention shifting were not represented in the ECL measures. Consequently, the CASTLE could be applied and supported on a concrete learning scenario. It is also important to consider the discussed processes holistically to discuss the effects on learning outcomes. Results showed that a visible instructor indeed had effects on social processes and further positive effects on learning processes but with increasing size or image detail of the lecturer, attentional processes and ECL became more important since learning outcomes are affected negatively. Furthermore, additional social cues like personal or public relevance might strengthen the social context by providing additional socially relevant cues. The most important theoretical implication is the need for further research since most investigations with regard to potential moderators revealed only descriptive trends because of the low number of studies in many groups of numerous moderators.

5.2. Limitations and Future Directions

This meta-analysis showed how visible instructors have the potential to facilitate learning under multiple circumstances. Nevertheless, since this field of research is still at its beginning, moderators are difficult to investigate meta-analytically since many variables are underrepresented in empirical studies that met our inclusion criteria. However, we also note that the inclusion criteria of our study are an important consideration. For example, if a study examined various sizes of instructor image, but did not include a no instructor image group, it would have been excluded from our meta-analyses. Nevertheless, future research should focus on the research question of how and under which circumstances visible instructors should be included in instructional videos. This meta-analysis outlined some interesting moderators, but mostly, only descriptive trends occurred because of the low number of studies in some cells. For example, the image detail of the instructor could be of interest for future research Positive effect sizes regarding retention decreased when more body parts of the instructor were visible, but this effect did not reach significance. Other initial but non-significant trends could be found regarding instructional setting and personal or public relevance of the instructor. Positive effects could only be found in laboratory experiments. In field experiments as well as online experiments, effect sizes decreased. Future research should examine if the instructor presence effect might be an effect that is only present in highly-controlled settings. In more natural learning situations, learners might not pay enough attention to the visible lecturer, while merely listing to the verbal lecture or even increasing the speed of the video (Murphy et al., 2022). Consequently, the benefits of implemented social cues may not fully unfold. Furthermore, the benefits of an additional social cue in the form of the personal social relevance of the lecturer should be investigated. Instructors with personal or public relevance to the learner might trigger additional social processes that might strengthen attention and engagement toward the instructional message. Similar results have been found in the field of video commercials (Zipporah & Mberia, 2014).

It is of importance that most of the potential moderators were not investigated with appropriate experimental designs. Studies were coded after publication and thus, potential confounding cannot be ruled out with regard to moderator analyses (see the discussion on effects in the historical science domain). While this meta-analysis has implications for future research, the exploratory moderator analyses in particular should be viewed with caution.

Furthermore, most studies were conducted with student samples in laboratory settings. Effects concerning other samples (in particular primary and secondary students) were rare, and here seems to be additional potential of where the instructor presence effect might be found. Since only one study with a small sample size was conducted with secondary students and no study was conducted with primary students, the need for experimental research becomes particularly clear.

This meta-analysis focused on video lectures and did not include other types of instructional videos, for example, demonstration videos (modeling examples), since the implementation of a modeling example that explicitly manipulates and changes the learning material might trigger additional learning processes in contrast to a lecturer that accompanies the learning material. This field of research is further unique in that studies rarely included no instructor at all, but rather parts of the instructor (Van Gog, 2014). In addition, studies also use their own set of control conditions, such as sequences of rather static images illustrating solution steps (Hoogerheide et al., 2014). While this research is notably different from research around the instructor presence effect, it is nevertheless important that this work be synthesized in future research.

The current meta-analysis faced limitations related to the search strategy. Our focus was on exploring literature that investigated learning outcomes, as detailed in the Literature Search section. We also explored other relevant learning variables if they were reported in the studies. This approach resulted in a relatively small number of studies for certain outcome measures, leading to a broad categorization of these measures. For instance, various scores such as positive affect, satisfaction, and positive activation were grouped under the umbrella term "affective rating." This categorization is further crucial when considering learning outcomes. In some instances, it was challenging to determine if retention or transfer performance was measured based on the information provided in the publications, as different measures were employed, such as knowledge assessment, comprehension, and application. Future studies could benefit from a more sophisticated classification of learning outcomes or use finer sub-categorizations, such as distinguishing between near and far transfer scores. Due to the limited number of studies available, we applied Mayer's (2014b) classification into retention and transfer categories in this analysis.

Finally, CASTLE postulated a mediation hypothesis. According to Schneider et al. (2021), "Social processes triggered by social cues mediate the cognitive processing of information when learning with digital materials." (p. 8). Since these meta-analyses focused on moderation analyses, further analyses should investigate the mediation hypothesis in primary studies, as well as in systematic meta-analyses using meta-analytic structural equation modeling (e.g., Jak & Cheung, 2020).

6. Conclusions

The COVID-19 pandemic brought video-based teaching into the focus of teachers, lecturers, as well as researchers. Our results show that the justified concerns that social processes are greatly reduced with this form of teaching can be, to some extent, countered by integrating visual instructors into instructional videos. However, it is clearly not the panacea to this problem. The practical research or design question of the extent to which instructor presence negatively or positively influences learning processes can be answered based on the CASTLE (Schneider et al., 2021). The meta-analyses presented here outline positive effects concerning multiple learning-relevant processes as well as a small effect on retention performance. Exploratory moderator analyses gave insights into the boundary conditions of the effects of instructor presence but future research should focus on conducting appropriate experimental research to further specify the instructor presence effect.

Author statement

Maik Beege: Methodology; Investigation; Data Curation; Formal Analysis; Project Administration; Writing - Original Draft; Supervision.

Noah L. Schroeder: Formal Analysis; Writing - Original Draft; Writing - Review & Editing.

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Ethics statement

All procedures were performed in full accordance with the ethical guidelines of the German Psychological Society (DGPs, https://www.dgps.de/index.php?id=85) and the APA Ethics code with written informed consent from all subjects. Since no primary study was conducted, no special permission by an ethics committee is required for psychological research in the Institute for Psychology of the of the Freiburg University of Education as well as in Germany.

Declaration of competing interest

I declare that I and all Co-Authors have no conflict of interest.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.edurev.2023.100564.

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