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Designers in Canvas Course Design**



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The Power of Signaling: Insights from Prospective Instructional Designers in Canvas Course Design

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Abstract

Purpose: This qualitative study investigates how prospective instructional designers perceive and apply the signaling principle in Canvas course design. Grounded in the Cognitive Theory of Multimedia Learning (CTML), the study examines how signaling influences learner engagement and comprehension within digital learning environments.

Methodology: Data were collected through semi-structured interviews with seven graduate students enrolled in instructional technology courses at a public university in the Midwestern United States. Prior to the interviews, each participant interacted with a Canvas-based course intentionally designed with signaling elements, including bolded text, color-coded highlights, directional arrows, and square shapes. The data were analyzed using thematic analysis.

Findings: Thematic analysis of interview transcripts revealed that signaling enhanced learner engagement, directed attention to key content, and promoted deeper understanding. Participants also reported increased awareness of the strategic role of signaling in instructional design and expressed intentions to incorporate signaling principles into their future course designs.

Unique Contribution to Theory, Policy, and Practice: This study contributes to theory by extending the application of the Cognitive Theory of Multimedia Learning (CTML) to real-world instructional design practices within learning management systems like Canvas. It offers practical insights for educators and instructional designers on effectively integrating signaling techniques to improve learner engagement and comprehension. Additionally, the findings inform policy and curriculum development in instructional design programs by emphasizing the importance of explicitly teaching evidence-based multimedia principles.

Keywords: *Signaling Principle, Cognitive Theory of Multimedia Learning, Instructional Design, Learning Management Systems, Canvas*

INTRODUCTION

The rapid growth of digital learning environments has transformed instructional design, requiring educators and designers to leverage multimedia principles that enhance learner engagement and comprehension. Among these, signaling, a critical principle of multimedia learning theory, uses visual or textual cues to guide learners' attention to key content, thereby reducing cognitive load and enhancing comprehension.

Rooted in the Cognitive Theory of Multimedia Learning (CTML), signaling is one of twelve evidence-based principles proposed by Mayer (2001) to improve learning from multimedia materials. The signaling principle suggests that learning can be improved when cues are included to emphasize the structure and key elements of the material (Mayer, 2020). CTML posits that learners process information through dual channels (visual and auditory) with limited capacity, and that instructional strategies like signaling can help manage cognitive load and support meaningful learning.

Although prior research has established the benefits of signaling for attention and retention (Boucheix et al., 2013; Kalyuga, 2009; Jamet et al., 2008; Seufert & Brünken, 2006; Shchnider et al., 2018; Han et al., 2023; Tannert et al., 2023), most studies focus on learners as end users. Less is known about how future instructional designers, those responsible for creating learning experiences, understand and integrate signaling into their design practice. Understanding their perspectives is critical, as their ability to apply theory-informed principles, such as signaling, directly impacts instructional quality.

This inquiry is particularly relevant in platforms such as Canvas, a widely adopted learning management system in higher education, which offers built-in features for embedding signaling cues, such as bold text, color highlights, icons, and arrows. Still, the effective use of these features depends on the designer's pedagogical knowledge and intention.

This qualitative study addresses this gap by examining how graduate students in an instructional technology program perceive and respond to signaling elements embedded within a Canvas course intentionally designed with such features. Following their interaction with the course, participants engaged in semi-structured interviews to reflect on their experiences. The study examines how these experiences shaped their understanding of the signaling principle and influenced their future instructional design decisions. Through thematic analysis of the interview data, the study offers insights into how theory translates into practice, with implications for instructional design education and professional development.

LITERATURE REVIEW

Canvas LMS offers a flexible and customizable environment for implementing research-based instructional design strategies, including the signaling principle, which directs learners' attention to essential content and reduces cognitive load. Drawing on the CTML, signaling employs textual and visual cues, such as highlights, arrows, and color contrasts, to enhance engagement, navigation, comprehension, and retention, particularly for learners with lower prior knowledge. While evidence supports its effectiveness across multiple formats, its impact depends

on purposeful and context-sensitive application; poorly designed or excessive cues may hinder learning.

Despite its potential, little is known about how signaling is perceived and applied in authentic Canvas course designs from the perspective of graduate students in instructional technology programs, who are preparing to become future instructional designers. Understanding their interpretations and intended use of signaling can provide valuable insights into how emerging professionals may carry these principles into practice.

Learning Management Systems (LMSs), such as Canvas, have transformed instructional delivery by offering flexible, customizable, and data-driven learning environments. As one of the most widely used platforms in higher education, Canvas enables educators to design interactive and accessible courses that support both online and hybrid models. Its ability to integrate multimedia, third-party tools, and analytics makes it a powerful platform for enhancing learner engagement and supporting evidence-based instructional design practices.

Research highlights Canvas's adaptability for structured course design and alignment with pedagogical frameworks. For instance, Baldwin and Ching (2019) introduced the Canvas Course Evaluation Checklist (CCEC) to guide best practices in content organization, accessibility, and learner engagement, key considerations for effective multimedia learning. Similarly, the redesigned Canvas framework developed at Graz University of Technology (Schön et al., 2022) demonstrates how the platform can be intentionally structured to align instructional activities with course outcomes in blended environments. These frameworks illustrate how design decisions, such as layout, navigation, and content formatting, can directly influence learners' ability to focus on essential material.

Canvas's features also allow instructional designers to embed signaling elements, such as bolded text, color-coded highlights, directional arrows, and shapes, to direct learners' attention to key concepts. This aligns with CTML's emphasis on guiding attention to reduce cognitive load and enhance comprehension (Mayer, 2020). However, while these tools are readily available, the degree to which instructional designers recognize, understand, and apply them varies. Ifenatuora et al. (2023) identified ongoing accessibility gaps in LMS platforms, particularly for learners with cognitive disabilities and those who rely on assistive technologies. These issues highlight the importance of inclusive design practices and echo accessibility concerns raised by participants in similar studies. Despite its strengths, Canvas still presents usability challenges. Derlina et al. (2018) caution that signaling, if overused or irrelevant, can overwhelm learners, drawing an analogy to a person who talks too much and delivers unnecessary information, potentially leading to disengagement. Addressing these issues could further enhance the effectiveness of signaling by making key information even more visible and accessible.

Theoretical Foundations of the Signaling Principle

CTML provides a framework for understanding how individuals process and learn from multimedia content. According to Mayer (2020), CTML is based on three key assumptions about cognitive processing: (a) information is processed through separate channels, (b) each channel has

a limited capacity, and (c) meaningful learning occurs when learners actively select, organize, and integrate information with prior knowledge.

Mayer (2014) defines multimedia learning as the acquisition of knowledge through both verbal and pictorial elements, with outcomes heavily influenced by the design of these materials. Factors such as content complexity, the structure of the learning environment, and learners' prior knowledge affect how multimedia supports learning (Alpizar et al., 2020). Instructional designers should prioritize reducing extraneous cognitive load through learner-centered design. Austin (2009) reinforces that the signaling principle plays an essential role in guiding users while navigating learning media, ensuring that the learner's attention is directed toward the most relevant content.

Benefits of Signaling in Multimedia

Instructional design provides a framework for creating structured, engaging, and effective learning experiences, particularly in digital environments such as Canvas LMS. Signaling, a strategy that uses textual and visual cues such as highlights, arrows, and color contrasts, plays a critical role in guiding learners' attention to essential content, thereby reducing cognitive load and enhancing comprehension (Mayer, 2020). Research demonstrates that signaling improves learners' engagement, navigation, and understanding by directing focus toward key information and supporting efficient content processing (Dommez, 2018; Jamet et al., 2008).

Signaling also supports retention. Learners exposed to well-placed cues exhibit better recall and deeper understanding of material without increased cognitive load (Boucheix et al., 2013; Schneider et al., 2018). Textual cues, such as highlighted or underlined keywords, can be especially effective, possibly due to their familiarity from traditional learning materials (Schneider et al., 2018). Eye-tracking research confirms that signaling increases fixation time on important elements, indicating heightened attention and cognitive processing (Ozcelik et al., 2010).

Van Gog (2021) emphasizes that signaling cues highlighting relevant elements or the organizational structure enhance learning, and that different types of cueing may be effective under different boundary conditions. Similarly, Lin and Atkinson (2010) demonstrated that visual cueing reduces study time and improves learning efficiency in untimed environments, though this effect diminishes with animated visualizations, suggesting the type of visualization moderates signaling's impact.

The effectiveness of signaling depends on the learner's prior knowledge and the type of signaling used. Learners with lower prior knowledge tend to benefit more from signaling, as it helps them identify relevant information and reduces extraneous cognitive effort (Han et al., 2023; Johnson et al., 2015). Signaling can take multiple forms, textual, graphical, or auditory, and its impact may depend on modality and complexity of the cues (Kalyuga, 2009; Van Gog, 2021).

While signaling has proven benefits, research cautions that its application must be purposeful and context-sensitive. Overuse or poorly designed cues can overwhelm or distract learners, reducing their effectiveness and potentially impairing learning outcomes (Derlina, 2018; Farkish et al., 2022; Fiorella & Mayer, 2014; Mayer et al., 2001). Therefore, instructional designers

should integrate signaling elements thoughtfully to enhance learning without adding unnecessary complexity.

Beyond cognitive benefits, cultural and accessibility considerations are increasingly important. Lee et al. (2025) highlight that color meanings vary across cultures, requiring culturally responsive choices. This is important while implementing signaling. Ifenatuora et al. (2023) also identify persistent accessibility challenges on LMS platforms, especially for learners with cognitive disabilities or who rely on assistive technologies, emphasizing the need for accessible and inclusive signaling design.

Modern LMS platforms like Canvas provide features to implement signaling effectively, including multimedia integration and adaptive content release. La Torre and Désiron (2024) stress that successful multimedia teaching requires not only technical skill but also a solid grounding in multimedia learning principles, such as signaling, which impacts both course design and classroom instruction. Baldwin and Ching (2019) further advocate for structured, consistent course layouts in Canvas, which promote easier navigation and help learners focus on essential content, principles that align closely with effective signaling use.

Despite extensive research, significant gaps remain in understanding how signaling is experienced and applied in LMS platforms such as Canvas. Jiang et al. (2017) found limited research addressing both teacher and student perspectives on multimedia materials, while Ceken and Taskin (2022) noted a predominant focus on undergraduates, limiting the generalizability of findings to learners at different academic and professional levels. Further study is needed on how various signaling elements, such as type, complexity, and detail, affect learners across diverse instructional formats (Beege et al., 2021; Han et al., 2023).

The role of signaling in interactive and text-based learning within digital platforms such as Canvas remains particularly underexplored. To address this gap, the present study investigates how graduate students in instructional technology programs, who represent future instructional designers, perceive the use of signaling in a Canvas course and how their experiences may inform their own instructional design practices. Specifically, this study seeks to answer: (RQ1) What are instructional technology graduate students' understandings of the usefulness of the signaling principle in Canvas course design? and (RQ2) How will they plan to utilize the signaling principle in their instructional design practices?

METHODOLOGY

Research Design

This qualitative study explored how graduate students in instructional technology perceive and interpret the signaling principle within a Canvas course design. To capture authentic perceptions, participants first engaged with a Canvas-based course intentionally designed to integrate multiple signaling elements. Immediately afterward, semi-structured interviews were conducted to gather rich, in-depth data. This approach enabled a detailed examination of how participants noticed, interpreted, and reflected on the signaling features. The design also facilitated

connections between participants' immediate experiences with the course and their broader perspectives on instructional design practices.

Sample and Participants

Participants were master's and doctoral students enrolled in the Instructional Technology program at a Midwestern university in the United States. All participants had previously completed the course EDCT 6051: Multimedia Tools in Education and had experience using Canvas as learners. In addition, participants were familiar with designing courses on Canvas and had practiced creating instructional materials on digital platforms, providing them with relevant hands-on experience in instructional design. Purposive sampling was employed to ensure that participants met the inclusion criteria, specifically being graduate students in the program and having completed the targeted course using Mayer's (2020) book, *Multimedia Learning*, as the course textbook. A total of seven participants were interviewed to gather in-depth insight into their perceptions and experiences with the signaling principle in Canvas.

Canvas Course

The Canvas course reviewed by participants was specifically designed by the researchers to train new Graduate Assistants at the Center of Technology to operate the college's Webcast Studio. The goal was to prepare them to assist students, faculty, and staff in recording videos and podcasts. The course was developed using the signaling principle, incorporating visual cues such as arrows, bold text, color-coded sections, capital letters, and boxed content (see Figures 1 and 2). These features helped participants engage meaningfully with instructional materials structured according to the Cognitive Theory of Multimedia Learning (CTML).

The GAIN 1 and GAIN 2 knobs control the input gain for microphone signals in the control room, specifically for inputs 1 and 2. The LED rings offer visual confirmation: **green** indicates a **standard signal** level, while **red** signals a **high signal** level.



Figure 1. Canvas Course Interface with Arrows and Color-coded Sections Guiding Learners

1. Do not adjust the buttons and knobs inside the red box, as indicated in the picture.



Figure 2. Course Page Highlighting Key Instructions Using Boxed Content

Data Collection Instruments

Data were collected using a semi-structured interview protocol, allowing for consistency across interviews while also enabling participants to elaborate on their individual experiences. Interview questions focused on perceptions of signaling, its effectiveness, and anticipated future use in instructional design (see Appendix A).

Data Analysis

Thematic analysis, as outlined by Braun and Clarke's (2006), was employed to systematically guide the identification, analysis, and reporting of patterns within the data. Initially, the researchers independently coded the interview transcripts in NVivo, generating preliminary codes that captured salient aspects of participants' responses. These codes were then iteratively refined and organized into broader thematic categories. A consensus-building phase followed, during which the researchers compared and discussed their coding decisions to reconcile differences and identify both overlapping and complementary insights. This collaborative process produced a set of unified themes that accurately and comprehensively represented participants' perspectives.

Reliability and Validity

To enhance the trustworthiness of the findings, multiple strategies were employed. Triangulation was achieved through the use of multiple coders, peer debriefing, and the

development of a shared codebook to maintain coding consistency. Additionally, member checking was conducted with selected participants to validate the researchers' interpretations and ensure that the themes accurately represented their experiences.

RESULTS

Semi-structured interviews with seven graduate students in the instructional technology program provided valuable insights into their experiences and perceptions of the signaling principle. Three key themes emerged from the analysis. The first theme, Perceived Educational Value and Impact of Signaling, reflected participants' recognition of how signaling enhanced their learning and engagement, addressing how they understood and evaluated its role in supporting comprehension. The second theme, Design Awareness and Reflection on Signaling, captured their growing understanding of intentional design choices and the role of signaling in guiding learner attention, aligning with inquiries into how they identified and interpreted these strategies within a course. The third theme, Application and Transfer of Signaling Principle to Future Instructional Design Practices, highlighted participants' intentions to incorporate signaling strategies into their instructional materials and courses, responding to the question of how they envisioned applying signaling in diverse instructional contexts.

Theme 1: Perceived Educational Value and Impact of Signaling

Participants consistently reported that signaling enhanced their engagement, navigation, and comprehension in the Canvas course. Many described the design as "clear" and "easy to follow," attributing this to signaling's ability to draw attention to essential content. Several noted that signaling reduced confusion often associated with poorly designed online courses, while others appreciated how visual cues supported their ability to anticipate learning outcomes and understand content structure.

For example, Participant 2 explained:

"It is very helpful because... it directs me to the right material I'm reading. I'm not someone who reads word-for-word, so the signaling principle applies. It literally helps me identify important paragraphs that I need to pay attention to."

This illustrates how signaling can benefit learners who rely on scanning rather than linear reading, helping them locate critical information efficiently. Participant 1 similarly noted:

"The type of signaling principle that stood out to me was the text-based ones, especially the highlighted sections, such as when studying the control room. I thought it was important to know those things. When using the gadgets in the room, the photos of the equipment (with arrows) helped me understand how to operate some of them. So, yes, the text-based cues helped me, and the photo-based cues helped as well."

This highlights how signaling can be effective across both textual and visual modalities, reinforcing understanding through multiple representations.

Theme 2: Design Awareness and Reflection on Signaling

Engaging with the Canvas course heightened participants' awareness of instructional design principles, particularly the signaling principle. For those with prior theoretical exposure, the experience validated their understanding through practical application. Others realized, sometimes retrospectively, how signaling had shaped their learning. Several participants reflected on the importance of balancing signaling use—emphasizing that excessive cues could lead to cognitive overload—while stressing the need for intentional alignment with learners' cognitive needs.

Participant 5 reflected:

"I would say there was some text I would have liked to see in bold, such as the headings. For example, when you were talking about microphones, speakers, and OBS, I felt bolding would have helped emphasize those points."

"I think the lack of it was what caught my attention, and that worried me."

Here, the absence of signaling prompted recognition of its potential value, suggesting that omission can be just as impactful in raising design awareness. Participant 7 noted:

"If you don't realize that things like bold text are forms of signaling, you might overlook important aspects of it. You need to be aware of all these components; otherwise, you won't be able to apply the signaling principle effectively."

This emphasizes the necessity of designer awareness in applying the principle, highlighting that recognition of signaling forms is a prerequisite for effective use.

Some participants also identified poor practices, such as writing entire words in capital letters, as detrimental to readability and user experience, asserting that signaling must be applied thoughtfully to be effective.

Theme 3: Application and Transfer of Signaling Principle to Future Instructional Design Practices

All participants indicated that their experiences with the Canvas course would influence their future instructional design decisions. Many expressed intentions to integrate signaling strategically into their own materials, particularly in online learning contexts. The focus was on ensuring clarity, accessibility, and a user-centered approach.

Participant 6 observed potential limitations in signaling's effectiveness:

"I feel some people might argue that not everyone benefits equally from the signaling principle. For example, with color coding, like green, yellow, and red, someone who is colorblind might not be able to distinguish the differences, so the benefit would be limited for them."

This reflects the importance of accessibility, reminding designers to adopt inclusive practices when implementing signaling techniques.

Several participants also expressed increased confidence in applying multimedia principles, recognizing the value of real-world examples in shaping future design work.

Participant 3 explained:

“That’s exactly what I need when designing a course. A well-designed, clean course naturally has an influence. When you see quality work, your mind automatically picks up ideas you could implement, even if you aren’t consciously trying to learn them. Seeing something done well makes you recognize it as a good approach. I think I’ve already picked up a few ideas that I’ll probably use in the future.”

This demonstrates how exposure to well-executed designs can inspire the adoption of effective strategies, even though passive observation, which reinforces the role of modelled practice in instructional design.

DISCUSSION AND CONCLUSION

The present study examined instructional technology graduate students’ perceptions of the signaling principle in Canvas course design and explored how engaging with signaling might influence their future instructional design practices. In-depth analysis of participants’ reflections and experiences revealed insights related to the research questions, including perceptions of signaling’s effectiveness in enhancing engagement, navigation, and comprehension, as well as its anticipated application in future instructional design work.

RQ1: What are instructional technology graduate students’ understandings of the usefulness of the signaling principle in Canvas course design?

Findings indicate that participants viewed signaling as a highly effective strategy for enhancing engagement, navigation, and comprehension in a Canvas course. These perceptions align with Mayer’s CTML), which posits that signaling directs attention toward relevant content, reduces extraneous cognitive load, and facilitates deeper processing (Mayer, 2020). Several participants described the course as “clear” and “easy to follow” due to the intentional placement of visual cues. For example, Participant 2 noted, “It is very helpful because... it directs me to the right material I’m reading... it literally helps me identify important paragraphs that I need to pay attention to.” This supports prior research by Van Gog (2021) and Ozcelik et al. (2010), which demonstrated that signaling guides attention to key elements, increasing fixation time on relevant information.

Participants also associated signaling with improved comprehension and retention. Participant 4 stated, “It helped me understand the key concepts and the most important things I needed to know about using the control room.” This perception aligns with Jamet et al. (2008), who found that signaling helps learners focus on key elements, thereby enhancing understanding and knowledge transfer, and with Schneider et al. (2018), who reported that signaling draws

attention to clearly defined units of information and it improves retention by aiding recall of these units.

Beyond comprehension, participants emphasized signaling principles' role in navigation efficiency. Participant 2 explained, "I can easily navigate the course, pinpoint the most important ones... if it is an arrow, a cycle, I will just look at it to see the direction it is going." These observations mirror findings from Lin and Atkinson (2010), which showed that visual cues reduce search activity and improve learning efficiency in non-time-constrained environments.

However, participants also recognized potential drawbacks. Some pointed to the cognitive burden of excessive or inconsistent signaling. For example, Participant 5 warned, "I might not want to overuse signaling, because then you lose its impact and essence." This aligns with Mayer et al. (2001) and Mayer & Fiorella (2014), who cautioned against overloading learners with too many cues, as it may lead to distraction and diminished effectiveness. Other participants noted issues related to poor implementation, including inconsistent use of color, overuse or underuse of visual cues, writing entire words in capital letters (which may be perceived as shouting), and excessive combinations of bold, italic, and underline styles, which occasionally led to momentary confusion. This supports Derlina et al.'s (2018) recommendation that signals should be applied purposefully and consistently to avoid unnecessary cognitive effort.

Cultural considerations emerged as a crucial factor in participants' evaluations of signaling effectiveness. Several noted that colors or text treatments could convey unintended cultural meanings, such as red symbolizing danger, death, or disrespect in certain contexts. This aligns with broader instructional design literature emphasizing culturally responsive course design. Lee et al. (2025) found that color interpretations vary significantly across cultures, noting the need for culturally sensitive choices. For example, Participant 1 shared "I received feedback when designing project slides for a Korean company that Koreans really don't like the use of too much red because it refers to blood." Similarly, Participant 5 discussed the association of red with danger or death in Ghanaian culture, explaining, "In Ghana, red is linked to danger and mourning. People mostly wear red to funerals, so if you use red to highlight something that isn't dangerous, learners might be confused or misinterpret the message as a warning or something related to death." These insights stress the importance of adapting signaling elements to respect cultural diversity and create equitable learning experiences.

Accessibility concerns were also prominent in participant feedback and aligned with findings from Ifenatuora et al. (2023), who identified persistent accessibility gaps in LMS platforms, particularly for learners with cognitive disabilities or those using assistive technologies. Common barriers included insufficient video captions, low color contrast, and missing alternative text for multimedia issues, factors that can diminish the effectiveness of signaling cues. Participant 6 offered practical suggestions to improve accessibility, stating, "I would avoid using multiple colors for signaling and instead use one color for arrows and one for highlighting to maintain consistency." They also emphasized the importance of captions for videos to support learners with

hearing impairments. Regarding colorblind learners, Participant 6 recommended using contrasting shades, such as darker and lighter tones, instead of colors that may appear similar (e.g., yellow and orange), suggesting high-contrast options like black or gray to improve differentiation and usability.

The perceptions expressed in this study reinforce existing literature on signaling's capacity to enhance engagement and comprehension in multimedia learning. However, they extend the discussion by highlighting the role of cultural awareness, accessibility, and consistency factors that are less frequently addressed in course design practices.

RQ2: How will they plan to utilize the signaling principle in their instructional design practices?

Engagement with the signaling-rich Canvas course appeared to shape participants' intentions and confidence in applying the principle in their own design work. Many reported that the experience increased their design awareness, validating theoretical knowledge and inspiring practical strategies for course creation. Participant 7 reflected, "This course has actually informed me... multimedia learning principles are very key... knowledge about those principles always influences not only course design, but also how we teach in the classroom." This finding supports La Torre and Désiron (2024), who argue that effective use of multimedia in teaching requires not just technical skills but also design expertise grounded in multimedia learning principles, emphasizing its influence on both course design and classroom instruction.

Participants' comments also suggest that the course served as a strong example of effective design practices. Participant 3 noted, "A well-designed, clean course naturally has an influence... I think I've already picked up a few ideas that I'll probably use in the future." This aligns with Jiang et al. (2019), who found that CTML principles serve as a dependable framework for assessing the quality and suitability of multimedia courseware design. and aligns with Baldwin and Ching's (2019) call for structured, consistent layouts in Canvas to promote learner navigation and focus.

However, participants emphasized the importance of applying signaling thoughtfully and tailoring it to the specific context in their future designs. Participant 6 advised, "put[ting] yourself in the shoes of the student... use it purposefully... if there's no real benefit, it becomes distracting." This aligns with Farkish et al. (2022), who note that including irrelevant graphics or information in course design can divert attention from essential content and diminish focus on primary learning objectives

Accessibility and inclusivity were recurring themes in participants' forward-looking comments. Participant 6 recommended strategies to support color-blind users, such as using contrasting shades rather than multiple colors an approach supported by Hristov et al. (2022), who emphasize that accessible design should address visual impairments through high-contrast color combinations and by avoiding reliance on color alone for meaning. Participant 1 similarly suggested offering a brief guide to explain signaling choices when multiple cue types are used.

Additionally, the study revealed that not all participants found signaling equally necessary in every context. For example, Participant 2 noted that their prior knowledge of the course content made some signaling feel overwhelming or redundant: “Because of my prior knowledge... I feel it’s overwhelmed... but for a beginner, they will appreciate the signaling.” This aligns with research suggesting that learners with low prior knowledge benefit more from signaling cues, while those with higher prior knowledge may find them unnecessary or distracting (Kalyuga, 2012; Johnson et al., 2015). However, Schneider et al. (2018) found that prior knowledge did not significantly moderate the signaling effect, indicating mixed findings in this area.

In summary, engaging with a signaling-rich Canvas course influenced participants’ design thinking by reinforcing theoretical knowledge, modeling best practices, and prompting considerations for purposeful, inclusive, and context-sensitive application. This study extends existing literature by providing insight into how emerging instructional designers—occupying both learner and designer roles—translate exposure to signaling into concrete design intentions.

The findings highlight the value of hands-on, signaling-rich experiences in moving learners from theoretical understanding to practical application. Intentional activities that model effective signaling can foster comprehension, engagement, and design confidence while teaching students to balance cues to avoid cognitive overload. The findings further underscore the importance of cultural sensitivity and accessibility in signaling, suggesting that instructional design curricula should prepare designers to create inclusive and adaptable learning environments. These insights can inform practical design guidelines and curricular frameworks for varied educational contexts.

Limitations include the small, homogenous sample of graduate students from a single university, reliance on self-reported experiences, and exclusive focus on signaling in a Canvas course, which may limit generalizability. The study did not include direct observation or empirical measurement of learner behavior, suggesting that future research could employ methods such as eye-tracking or experimental designs to objectively assess signaling’s impact on attention, engagement, and learning outcomes.

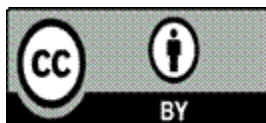
REFERENCES

- Alpizar, D., Adesope, O. O., & Wong, R. M. (2020). A meta-analysis of signaling principle in multimedia learning environments. *Educational Technology Research and Development*, 68, 2095–2119. <https://doi.org/10.1007/s11423-020-09748-7>
- Austin, K. A. (2009). Multimedia learning: Cognitive individual differences and display design techniques predict transfer learning with multimedia learning modules. *Computers & Education*, 53(4), 1339-1354. <https://doi.org/10.1016/j.compedu.2009.06.017>

- Baldwin, S. J., & Ching, Y.-H. (2019). Online course design: A review of the Canvas course evaluation checklist. *The International Review of Research in Open and Distributed Learning*, 20(3). <https://doi.org/10.19173/irrodl.v20i3.4283>
- Beege, M., Nebel, S., Schneider, S., & Rey, G. D. (2021). The effect of signaling in dependence on the extraneous cognitive load in learning environments. *Cognitive Processing*, 22(2), 209-225. <https://doi.org/10.1007/s10339-020-01002-5>
- Boucheix, J. M., Lowe, R. K., Putri, D. K., & Groff, J. (2013). Cueing animations: Dynamic signaling aids information extraction and comprehension. *Learning and Instruction*, 25, 71–84. <http://dx.doi.org/10.1016/j.learninstruc.2012.11.005>
- Çeken, B., & Taşkın, N. (2022). Multimedia learning principles in different learning environments: A systematic review. *Smart Learning Environments*, 9(1), 19. <http://dx.doi.org/10.1186/s40561-022-00200-2>
- Derlma, D., Dalle, J., Hadı, S., Mutalıb, A. A., & Sumantri, C. (2018). Signaling principles in interactive learning media through expert's walkthrough. *Turkish Online Journal of Distance Education*, 19(4), 147-162. <https://doi.org/10.17718/tojde.471911>
- Dönmez, M., Doğan, S., & Baran, E. (2018). How signaling principle affects learning: An eye tracking study. *Mersin Üniversitesi Eğitim Fakültesi Dergisi*, 14(2), 700-713. <http://dx.doi.org/10.17860/mersinefd.360724>
- Farkish, A., Bosaghzadeh, A., Amiri, S. H., & Ebrahimpour, R. (2023). Evaluating the effects of educational multimedia design principles on cognitive load using EEG signal analysis. *Education and Information Technologies*, 28(3), 2827-2843. <http://dx.doi.org/10.1007/s10639-022-11283-2>
- Han, J., Liu, G., & Zhang, Q. (2023). Prior knowledge as a moderator between signaling and learning performance in immersive virtual reality laboratories. *Frontiers in Psychology*, 14, Article 1118174. <https://doi.org/10.3389/fpsyg.2023.1118174>
- Han, J., Liu, G., & Zheng, Q. (2023). Prior knowledge as a moderator between signaling and learning performance in immersive virtual reality laboratories. *Frontiers in Psychology*, 14, Article 1118174. <https://doi.org/10.3389/fpsyg.2023.1118174>
- Ifenatuora, G. P., Awoyemi, O., & Atobatele, F. A. (2023). Systematic review of accessibility compliance in LMS platforms for inclusive online learning. *International Journal of Multidisciplinary Research and Growth Evaluation*, 4(2), 785–791. <http://dx.doi.org/10.54660/IJMRGE.2023.4.2.785-791>
- Jamet, E., Gavota, M., & Quaireau, C. (2008). Attention guiding in multimedia learning. *Learning and Instruction*, 18(2), 135-145. <http://dx.doi.org/10.1016/j.learninstruc.2007.01.011>

- Jiang, D., Renandya, W. A., & Zhang, L. J. (2017). Evaluating ELT multimedia courseware from the perspective of cognitive theory of multimedia learning. *Computer Assisted Language Learning*, 30(7), 726-744. <https://doi.org/10.1080/09588221.2017.1359187>
- Johnson, A. M., Ozogul, G., & Reisslein, M. (2015). Supporting multimedia learning with visual signalling and animated pedagogical agent: Moderating effects of prior knowledge. *Journal of Computer Assisted Learning*, 31, 97–115. <https://doi.org/10.1111/jcal.12078>
- Kalyuga, S. (2009). Instructional designs for the development of transferable knowledge and skills: A cognitive load perspective. *Computers in Human Behavior*, 25(2), 332-338. <https://doi.org/10.1016/j.chb.2008.12.019>
- Lee, A., Lee, C. H., & Lee, D. B. (2025). Exploring the cultural influence on tourists' color perceptions: A study of tourist photography. *Tourism Management*, 110, 105183. <https://doi.org/10.1016/j.tourman.2025.105183>
- Lin, L., & Atkinson, R. (2011). Using animations and visual cueing to support learning of scientific concepts and processes. *Computers & Education*, 56(3), 650–658. <https://doi.org/10.1016/j.compedu.2010.10.007>
- Mayer, R. E. (2014). *The Cambridge handbook of multimedia learning* (2nd ed.). Cambridge University Press. <https://doi.org/10.1017/CBO9781139547369>
- Mayer, R. E. (2020). *Multimedia learning* (3rd ed.). Cambridge University Press.
- Mayer, R. E., & Fiorella, L. (2014). Principles for reducing extraneous processing in multimedia learning: Coherence, signaling, redundancy, spatial contiguity, and temporal contiguity principles. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (2nd ed., pp. 43–71). Cambridge University Press.
- Mayer, R. E., Heiser, J., & Lonn, S. (2001). Cognitive constraints on multimedia learning: When presenting more material results in less understanding. *Journal of Educational Psychology*, 93(1), 187–198. <https://doi.org/10.1037/0022-0663.93.1.187>
- Ozcelik, E., Arslan-Ari, I., & Cagiltay, K. (2010). Why does signaling enhance multimedia learning? Evidence from eye movements. *Computers in Human Behavior*, 26(1), 110-117. <https://psycnet.apa.org/doi/10.1016/j.chb.2009.09.001>
- Schneider, S., Beege, M., Nebel, S., & Rey, G. D. (2018). A meta-analysis of how signaling affects learning with media. *Educational Research Review*, 23, 1-24. <https://doi.org/10.1016/j.edurev.2017.11.001>
- Schön, S., Braun, C., Hohla, K., Mütze, A., & Ebner, M. (2022). The ReDesign Canvas as a tool for the didactic-methodological redesign of courses and a case study. In *Proceedings of EdMedia + Innovate Learning* (pp. 1049–1055). Association for the Advancement of Computing in Education. <http://dx.doi.org/10.3217/hptt1-s0c54>

- Seufert, T., & Brünken, R. (2006). Cognitive load and the format of instructional aids for coherence formation. *Applied Cognitive Psychology*, 20, 321–331. <https://psycnet.apa.org/doi/10.1002/acp.1248>
- Tannert, S., Eitel, A., Marder, J., Seidel, T., Renkl, A., & Glogger-Frey, I. (2023). How can signaling in authentic classroom videos support reasoning on how to induce learning strategies? *Frontiers in Education*, 8, Article 974696. <https://doi.org/10.3389/educ.2023.974696>
- Van Gog, T. (2021). The signaling (or cueing) principle in multimedia learning. In R. E. Mayer & L. Fiorella (Eds.), *The Cambridge handbook of multimedia learning* (3rd ed., pp. 221–230). Cambridge University Press. <https://doi.org/10.1017/9781108894333.022>



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