The Effects of Higher Agency Roles on Learning and Perceptions

by

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ABSTRACT

Educational technologies can be great tools for learning. The implementation of learning aids and scaffolds within these technologies often make them effective; however, due to various problems, students may take more passive approaches to learning when using these educational tools. This tends to lead to interactions that impair learning. This study approaches this issue by reexamining the *learner's* role when interacting with educational technologies. Specifically, the current study attempts to support learning and perceptions by inviting students to approach a learning task like an *interface designer* or *instructional designer*. These roles derive from a previous study on higher agency roles. The results of the current study indicate that participants learned across all conditions, suggesting the assignment of roles may not impair learning. However, learning outcomes did not differ between conditions. Additionally, the *interface designer* and *instructional designer* roles were more critical of the sounds and organizations of each video than the *learner* role. Limitations of the study and future directions are discussed.

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CHAPTER 1

INTRODUCTION

Educational technologies are often developed to facilitate meaningful learning. For that reason, developers and educators of educational technologies often implement educational research, such as scaffolds (Azevedo & Hadwin, 2005) and multimedia principles (Mayer, 2017), to support learning experiences and further learning. Students also bring with them a variety of beliefs concerning how they should learn while interacting with these technologies (Harteis & Gruber, 2010). Similarly, the development of technology can dictate how students can interact. For example, with educational games, students learn by playing under the conditions created by the developers.

However, students do not always adopt this *learner* role very well. For example, a problem with assuming learners' behaviors is that students can cognitively engage with educational technologies in different ways (Chi & Wylie, 2014). Some learners prefer to be more passive in their engagement—watching videos without overt behaviors. While others may choose to be more active or constructive. In other cases, students may disengage because of boredom and frustration (Baker et al., 2010), or students may feel unguided and may engage in off-task behaviors (Ryan et al., 2009). In other words, learners are not always good at learning.

The current study explores alternative roles students can adopt while interacting with educational technology. Research from design thinking and agency is used to develop roles that support deeper levels of cognitive engagement. Specifically, the roles of *instructional designer* and *interface designer* are used to provide learners with opportunities to critique and explore the content they are provided. It is posited that these new roles can be used to benefit learning while also giving learners an opportunity to engage in positive experiences.

CHAPTER 2

BACKGROUND LITERATURE

Learning Approaches and Challenges

To provide a framework for how students engage academic materials, Chi and Wylie (2014) introduced the ICAP framework of cognitive engagement. This framework categorizes engagement into four distinct modes that are defined by the overt behaviors a learner performs to cognitively engage with learning materials: interactive, constructive, active, and passive. This framework's hierarchical nature predicts that a passively engaged student would underperform against an actively or constructively engaged student. Consequently, not all engagement activities are equal; however, students can be taught activities that elicit a more constructive or interactive approach.

An important characteristic of the ICAP framework is the overt behaviors associated with each level of cognitive engagement (Chi & Wylie, 2014). Passively engaged students listen to lectures or read materials without other overt behaviors. Actively engaged students may rehearse materials or highlight materials as presented. Active engagement differs from constructive engagement in that the latter refers to generating original thoughts or explanations of the learning materials while the former refers strictly to manipulations. The highest form of cognitive engagement, according to ICAP, is interactive. This type of engagement requires an active discussion between individuals.

Encouraging students to constructively engage with educational technologies can be challenging. Technologies can be designed with scaffolds like deep-level reasoning questions (Craig et al., 2006) as well as hints and instructions to effectively aid learners

(Van de Pol et al., 2010). However, the effectiveness of these scaffolds is moderated by students' cognitive engagement, and computer-based environments have a persistent problem of boredom and poor engagement (Baker et al., 2010). Consequently, students often adopt a passive position which result in a minimal understanding of presenting information (Chi & Wylie, 2014).

Another challenge with promoting deep cognitive engagement concerns learners' epistemic beliefs. Muis and Franco (2009) discovered that students' epistemic beliefs influence the types of goals and strategies learners use when engaging in learning activities. Similar effects have also been found in beliefs concerning e-learning (Harteis et al., 2010). Users' beliefs in how they should be *learners* may ultimately lead to adopting passive levels of engagement with educational technologies.

Despite these challenges, changing student roles can be effective in supporting cognitive engagement. Educators have traditionally facilitated constructive and interactive behaviors by having students teach one another. Tutoring others provides opportunities for students to reflect on their knowledge and engage in cognitive and metacognitive processes that enrich the learning experience (Roscoe & Chi, 2008). Consequently, the role of teaching peers acts as a catalyst for many beneficial processes that are inherent in the teaching experience (Roscoe & Chi, 2007). For example, ideal tutors may generate novel explanations by evaluating their current knowledge, selecting relevant information, and providing a coherent explanation to pupils (Fiorella & Mayer, 2016).

Agency Roles

Agency

Agency may be another potential factor for improving cognitive engagement. Giving students a chance to strategically plan, act, and reflect on personal behaviors and thoughts is a way of providing agency—argued by some as a quintessential element of engagement and student success (Bandura, 1986). The fundamental component of agency is reflecting and taking ownership of one's actions. It can often be the case that educational settings afford students little in the way of engaging in meaningful and impactful decisions as well as self-reflections (Martin, 2004).

Research on promoting student agency has been conducted in various educational settings. Lindgren and McDaniel (2012) designed a course that featured agentic components. They implemented both narrative and choices to study their effects on engagement. The narrative was designed to change based on student decisions: choice alone is not enough to elicit agency—the choice must be meaningful and impactful (Martin, 2004). When comparing their designed course to traditional courses, students reported engaging in more worthwhile learning experiences and performing more critical analyses of course material.

The current study examines if roles, rather than designs, embedded with agentic components are sufficient to improve cognitive engagement and subsequent learning outcomes. Agency has been embedded in the higher-agency roles (*instructional designer* and *interface designer*) with instructions that inform participants that their notes will be carefully considered in future iterations. Like the findings of Lindgren and McDaniel (2012), this agentic component may also influence how worthwhile and involved these tasks are perceived.

Design Thinking

Another potential role for improving engagement may be through design thinking. This paradigm is defined as an iterative process of defining problems and engaging in problem solving (Cochrane & Munn, 2016). In essence, design thinking is not directly about designing, but about thinking differently and strategically about problems (Scott-Webber & Corcorran, 2013). An important feature of design thinking is that it encourages people to see constraints as opportunities—fostering a type of control over learning experiences (Micheli, Wilner, Bhatti, Mura, & Beverland, 2018). It also provides opportunities to build creative confidence by engaging in creative problem solving (Munyai, 2016).

There are several explanations for why design thinking can be beneficial for learners. To start, learners must cognitively engage with materials to learn (Mayer, 2017). This is often accomplished using learning strategies (Chi & Wylie, 2014), and design thinking is similar in that it presents different activities for learners to use as a way of promoting learning. For example, the core elements of design thinking include identifying problems, generating ideas, planning an approach, and an iterative cycle of implementing and evaluating (Chin, Blair, Wolf, 2019). These elements parallel many activities that define constructive cognitive engagement, such as making plans, generating predictions, and reflecting as well as monitoring self-regulatory processes (Azevedo et al., 2006; Chi & Wylie, 2014). In fact, many of the processes involved in thinking like a designer parallel processes of self-regulated learning (Winne, 2005).

This study implements elements of design thinking in both the *instructional designer* and *interface designer* roles. Each role invites participants to review, evaluate, and take notes for improving the learning material’s design. Additionally, participants are supplied a brief overview of different elements to examine. These tasks are intended to provide opportunities for participants to plan an approach, identify problems, and generate alternative solutions: Put differently, participants are encouraged to think like a designer.

Previous Study

This study is a subsequent iteration of a previous study that examined alternative roles students could use to support both learning and positive perceptions. The study used three roles: *learner*, *designer*, and *teacher*. Like the current study, the *designer* role was based on design thinking literature, which encourages questioning, decision making, and evaluating processes (Dym et al., 2005). The *teacher* role was based on literature on learning by teaching. Wherein, students who teach their peers can learn more from the experience than when they study alone (Duran, 2016).

The previous study posited that (a) the *teacher* would outperform the *designer* and *learner*, while (b) the *learner* would outperform the *designer*. One reason for the second hypothesis concerns cognitive demand. Students who adopt the *designer* might find the role to be cognitively taxing, which could hinder performance. The previous study also hypothesized that students in the *designer* or *teacher* role would have perceptions of their assigned tasks that reflected deeper cognitive engagement. The results of the study indicated that all three conditions learned, but the *learner* role might have outperformed the others although this finding was statistical non-significance. In terms of perceptions, the participants rated their tasks as creative, enjoyable, and worthwhile regardless of the condition.

Although successful, there were a few limitations with the previous study. For one, the role descriptions were superficial. Participants may have had problems adopting the roles because of a lack of description. This may have resulted in participants defaulting into their normal learning roles. Furthermore, the higher agency roles were inauthentic in that they lacked behaviors representing—the teacher did not teach, and the designer did not design. Moreover, the agentic component for each role may not have been enough. Participants were explicitly told they would not be "teaching" or "redesigning" the videos, which may have left students feeling less agentic.

the current study addresses the limitation of the previous study by providing students with a developed description of each role and how that role is to be applied. Furthermore, to promote agency, students assigned to the higher agency roles are told their feedback will be considered in the future redesign.

Current Study

Researching alternative roles can provide a new perspective for supporting cognitive engagement in the design and instruction of educational technologies. By inviting students to critique, evaluate, and redesign the presentation and learning content of multimedia materials, we may foster meaningful learning experiences. The current study examines how the alternative roles of *instructional designer* and *interface designer* might support improved learning in students as they examine multimedia lessons on writing cohesion.

These designer roles were developed because of a limitation from the previous study. The previous *designer* role did not outperform the *learner* as hypothesized. Participants may have been distracted by the task which may have offset learning. To parse out the effects of the *designer*, the *interface designer* role was created with the intent to distract participants (i.e. focusing on video elements rather than learning content). In contrast, the *instructional designer* role was created to channel attention toward the desired learning content.

Regarding learning outcomes, it is hypothesized that (a) the *instructional designer* role will outperform the *interface designer* and *learner* roles, and the (b) the *learner* will outperform the *interface designer*. Previous research has shown that instructional roles can be beneficial at supporting learning outcomes (Fiorella & Mayer, 2014). Similarly, the designer roles incorporate elements of design thinking which parallel many of the processes found in self-regulated learning. For example, thinking like a designer is an iterative process of defining the problem, evaluating, and redesigning, which align with the learning processes of planning, enacting, monitoring, and adapting (Winne, 2005).

Alternatively, although the *interface designer* incorporates many of the process found in design thinking and agency, the focus of this role is on the presentation of the content rather than the content itself. This role helps differentiate the influences that design thinking can have on learning outcomes. Students who adopt the *interface designer* properly, might have their attention drawn away from the desired learning materials resulting in reduced learning. However, the *interface designer* should offer a more constructive perception of the video details, such as the clarity, controls, and sound.

Furthermore, for task perceptions, we hypothesize that (c) the higher agency roles will support task perspectives that are more “challenging,” “enjoyable,” “creative,” and “worthwhile” while also encouraging “critical thinking” and “learning.” These perceptions align with the types of influences design thinking and agency can have on students' perceptions of learning experiences (Lindgren & McDaniel, 2012; Munyai, 2016; Panke, 2019). Similarly, for video perceptions, it is hypothesized that higher agency roles, being essentially related to design, will be more critical of the videos than the *learner* role.

CHAPTER 3

METHODS

Participants

A total of 95 participants were recruited from an introductory Human Systems Engineering course at Arizona State University. All students were recruited through the school's subject pool, and each participant was awarded one hour of credit for participating. Due to time constraints, two participants had to drop out of the study while answering the posttest questions, and consequently, only data from 93 participants were used in the final analysis.

On average, students were 21 years of age (M = 21.01, SD = 2.72). Students self-identified as male (81.7 %) or female (18.3 %). In terms of race and ethnicity, most students self-identified as Caucasian (43.0 %) or Hispanic (22.6 %) although others were present (see Table 1). Most students primarily spoke English only (60.2 %) or were fluent in English and an additional language (35.5 %). A small proportion of participants identified English as a secondary language (4.3 %) but were sufficiently proficient at English to participate. Academically, the most common majors were Engineering-related (60.2 %), Computing-related (14.0 %), and Aviation-related (12.9 %). Table 1 provides further details.

Table 1
Information on Demographics and Academic Majors by Percentage

	%	*M*	*SD*
Age		21.01	2.72
Gender			
Female	18.30		
Male	81.70		
Race/Ethnicity			
African-American	1.08		
Asian	13.98		
Caucasian	43.01		
Hispanic	22.58		
Middle Eastern	6.45		
Native American	1.08		
Multiracial or Not Given	11.83		
Major			
Aviation-related	12.90		
Business-related	3.23		
Computing-related	13.98		
Engineering-related	60.22		
Psychology-related (social science)	2.15		
Science-related (including medical)	6.45		
Multiple or Dual Major	1.08		

Design

The experiment was a 2 (Test: pretest, posttest) x 3 (Condition: learner, instructional designer, interface designer) mixed design with test as a within-subjects variable and conditions as a between-subjects variable. Both learning scores and perceptions were dependent variables. Participants were randomly assigned to one of three conditions. All conditions were created and administered using Qualtrics. The pretest and posttest were identical.

Conditions

Participants were randomly assigned to one of three conditions. The materials, measures, and time were consistent across all conditions. However, each condition was given unique instructions which reflected the assigned role. Participants were asked to write a short explanation of their task prior to watching the videos (Appendix A).

Learner Role

Participants in this condition were given 30 minutes to "carefully study" each video. We asked they "take notes for learning" and include "valuable ideas and concepts worth remembering and understanding." This condition entailed the typical behaviors seen in active and constructive learners (Chi & Wylie, 2014).

Instructional Designer

Participants within this condition were given 30 minutes to take notes on how to "improve the instructional design" of each video. A brief description of instructional design was provided within the instruction. Participants were told that "instructional design refers to creating educational materials that teach useful information and examples in an understandable way." Participants were told their instructional design recommendations would be carefully considered when redesigning the videos.

Interface Designer

Within this condition participants were allotted 30 minutes to take notes for "improving the interface design" of the videos. They were told this entails "creating materials with easy navigation, straightforward controls, appealing appearance, and clarity." Participants in this condition were told that their "interface design recommendations and comments" would be carefully considered when redesigning the videos.

Materials

Presentation

All materials were presented on computers within a controlled lab. The study itself was assembled through Qualtrics--were it was administered.

Demographics

Each participant received a brief survey of demographic information. They were asked to self-report their gender, year of birth, and race/ethnicity. Participants were also asked for their academic major, year in school, and number of spoken languages.

Knowledge test.

A knowledge test was administered before and after the video portion of the study. This test assessed students' knowledge of cohesion in writing. These questions were adopted from a previous study on cohesion (Roscoe et al., 2018):

1. Please carefully define the concept of cohesion. What is cohesion? How is writing that is "cohesive" different from writing that is "not cohesive"?
2. Please carefully explain how cohesion affects the quality of writing. Why does cohesion improve writing quality? Why does a lack of cohesion decrease writing quality?
3. Please carefully describe strategies that writers could use to make their writing cohesive. What are a variety of ways that writers can build cohesion, and how to they work?

4. In the past/future, how have/will you check your own writing to make sure it was cohesive?

Attitudes and Perceptions

At the end of the study, participants were asked to rate their experiences with the study (Appendix B). This involved a 6 points-scale ranging from *strongly disagree* to *strongly agree*. It included perceptions of both the task and videos. For the task, students were asked to rate how challenging, worthwhile, enjoyable, thoughtful, and involved the task was. Since students were asked to take notes, an additional perception asked how useful their notes would be to others. Furthermore, for the videos, participants were asked to rate the clarity, information, organization, explanations, narration, and examples provided in the videos.

Videos

Participants were provided videos on the topic of cohesion. These videos were taken from the Writing-Pal tutoring system (Roscoe et al., 2014). Screen captures of each video can be found in Appendix C. Each video had a unique virtual agent. Each agent had a unique voice and animation. The lessons were self-paced, so students were able to pause, play, and jump to different segments. Each video was approximately five minutes long.

There were four videos with the first covering an overview and the others covering a different strategy for building cohesion: an overview, signpost strategy, connectives strategy, and threading strategy. Each video provided a definition and examples of the strategy at work. For example, the signpost strategy is defined as avoiding vague terms by using clearly defined referents, and the video included examples of ill-defined referents and why they can be confusing. Similarly, in the threading video, threading was defined as repeating key terms and ideas across sentences and paragraphs; students were provided examples of how unclear terms might appear in texts and how threading can be a remedy.

Procedure

Students signed up for the study through the SONA system on ASU's Polytechnic Campus. Students were instructed to come to the Sustainable Learning and Adaptive Technology for Education (SLATE) Lab at the Polytechnic Campus to participate in the study.

Once participants arrived, they were greeted by the researcher and placed at a workstation. Once seated, participants were shown a consent form on the screen and asked to read it thoroughly. Once participants confirmed they had read the consent form, a brief overview of their rights were provided, and they were given a unique identification code. Each code was randomly assigned to participants and indicated participation number and assigned condition.

After entering their assigned participation numbers, students were presented with the demographics survey. This was followed by the pretest. Students were told to answer each question to the best of their abilities. Following the pretest were the instructions for the condition they were assigned. At the bottom of each instruction was a small box that required each participant to briefly describe their task.

The video portion of the study came next. Students watched each video and were instructed to take notes in the provided box. After the videos, the posttest was administered and consisted of the same questions from the pretest. Participants were then instructed to fill out the perceptions and attitudes portion of the study. After completion of the experiment, participants were thanked and issued credit hours as compensation.

Scoring

To score the pretest and posttest responses, a coding scheme for cohesion was adopted from a previous study that examined the same learning materials (Roscoe, et al, 2015). This scheme investigates three major constructs for cohesion that were derived from the learning materials: definition of cohesion (*linking of ideas*, *unity,* and *organization*), impact of cohesion (*flow* and *readabilit*y), and strategies of cohesion (*connectives*, *signpost*, *threading*, *planning*, and *other*).

For the scoring process, a participant's response would receive credit for a major construct if evidence was found in the response to any of the four questions. For example, a participant might receive credit for defining cohesion when answering the question on cohesive strategies. Each construct could potentially receive multiple points: three for the Definition of cohesion (*linking of ideas*, *unity*, and *organization),* two for the impact of cohesion (*flow* and *readabilit*y), and five for strategies of cohesion (*connectives*, *signpost*, *threading*, *planning*, and *other*).

To reliably score the data, two researchers independently coded a subset of 20% of the data for interrater reliability. Cohen's kappa was calculated for each construct*:* *linking of ideas* (k = 1.00), *unity* (k = .62), *organization* (k = 88), flow (k = .60), *readability* (k = 0.89), *understandability* (k = 0.86), *on-topic* (k = 1.00), *engaging* (k = 0.86), *connective words* (κ = 1.00), *signposting* (κ = 0.89), *threading* (κ = 1.00), *planning* (κ = 0.88), and *other* strategies (κ = 0.875). Once interrater reliability was established, a single coder scored the remaining data.

CHAPTER 4

RESULTS

Learning outcomes

Pretest Equivalency

A preliminary one-way analysis of variance (ANOVA) was performed to compare the effects of condition on pretest scores. The results indicated a statistically non-significant difference between groups, $F(2, 90) = .903$, $p = .409$; $\eta^2 = .02$, indicating each condition had statistically equal pretest scores. Means and standard deviations by condition for pretest and posttest scores can be found in Table 2.

Table 2

Mean (Standard Deviations) Knowledge Test Scores by Condition

Test	Condition		
	Learner	Instructional Designer	*Interface designer*
	M (*SD*)	*M* (*SD*)	*M* (*SD*)
Total Pretest	3.83 (1.98)	3.26 (1.63)	3.72 (1.71)
Total Posttest	6.03 (1.54)	5.68 (1.94)	5.06 (1.37)
New Concepts	3.80 (1.54)	3.90 (1.89)	3.22 (1.66)

Learning Gains

The pretest and posttest scores for each condition were analyzed using a 2 (Test: pretest, posttest) x 3 (Condition: learner, instructional designer, interface designer) repeated measure ANOVA. The alpha level for all statistical tests was set at .05. The main effect of test was statistically significant, $F(1, 90) = 82.29$, $p < .001$; $\eta^2 = .478$, indicating a significant difference between total pretest (*M* = 3.60, *SD* = 1.77) and total posttest (*M* = 5.59, *SD* = 1.62) scores across all conditions. The main effect of condition was non-significant, $F(2, 90) = 1.47$, $p = .236$; $\eta^2 = .032$, indicating mean scores for *learner* (*M* = 4.93, *SD* = 1.76), *instructional designer* (*M* = 4.47, *SD* = 1.785) and *interface designer* (*M* = 4.39, *SD* = 1.54) did not significantly differ across conditions. The interaction of Condition and Test was non-significant, $F(2,90) = 2.29$, $p = .10$; $\eta^2 = .048$.

Given the significant main effect of test, a series of paired samples t-tests were performed for each condition to determine the effect size between pretest and posttest scores. For *learners,* there was a statistically significant increase in score from pretest (*M* = 3.83, *SD* = 1.98) to posttest (*M* = 6.03, *SD* = 1.54); $t(29) = 6.11$, $p < .001$; $d = 1.24$. Similarly, the *instructional designer* condition had a statistically significant increase from pretest (*M* = 3.26, *SD* = 1.63) to posttest (*M* = 5.68, *SD* = 1.89); $t(30) = 5.99$, $p < .001$; $d = 1.34$. The *interface designer* condition also had a statistically significant increase from pretest (*M* = 3.72, *SD* = 1.71) to posttest (*M* = 5.06, *SD* = 1.37); $t(31) = 3.61$, $p < .001$; $d = .87$.

Analysis of New Concepts

Open-ended responses may be challenging to analyze because participants may ignore concepts reported in the pretest when answering posttest questions. Because of this, an additional score was calculated for *new concepts* reported in the posttest (see Table 2). To analyze this data, a one-way ANOVA compared the effects of condition on new concepts and was statistically non-significant, $F(2, 90) = 1.58$, $p = .212$; $\eta^2 = .034$, indicating students did report new concepts in the posttest (M = 3.64, SD = 1.70), but the scores did not differ across conditions.

Student Perceptions

To test for effects of condition assignment on task and video perceptions, a series of ANOVAs were performed on the seven task subscales (challenge, creativity, enjoyable, critical thinking, worthwhile, learning, notes) and seven video subscales (clear controls, accurate info, organized, explanations, clear sound, relevant examples, and clear images). The ANOVA results can be found on Table 3, and the means and standard deviations can be found on Table 4.

Table 3
ANOVAs for Task and Video Perceptions

Perceptions	$F(2,90)$	p	η^2
Note Perception			
Useful Notes	0.21	0.81	0.00
Task Perceptions			
Challenge	0.66	0.52	0.01
Creativity	0.26	0.78	0.01
Enjoyable	0.57	0.57	0.01
Critical Thinking	1.48	0.23	0.03
Worthwhile	0.67	0.51	0.01
Learning	0.57	0.57	0.01
Video Perceptions			
Clear Navigation	1.38	0.26	0.03
Accurate Info	2.23	0.11	0.05
Organized	6.96	0.00	0.13
Explanations	2.30	0.11	0.05
Clear Sound	8.42	0.00	0.16
Multiple Examples	1.78	0.18	0.04
Clear Images	1.46	0.24	0.03

Table 4

Mean and Standard Deviations by Condition for Perceptions

Rating	Condition		
	Learner	Instructional Designer	Interface Designer
Note Perceptions			
Useful Notes	4.40 (1.22)	4.58 (1.31)	4.41 (1.21)
Task Perceptions			
Challenge	2.33 (1.37)	2.10 (1.08)	2.44 (1.13)
Creativity	3.17 (1.49)	3.42 (1.34)	3.31 (1.33)
Enjoyable	3.80 (1.03)	3.48 (1.26)	3.63 (1.16)
Critical Thinking	3.87 (1.28)	4.42 (1.43)	3.97 (1.31)
Worthwhile	4.37 (0.85)	4.29 (1.07)	4.06 (1.27)
Learning	5.20 (0.81)	4.94 (1.21)	5.03 (0.86)
Video Perceptions			
Clear Navigation	5.20 (0.76)	4.90 (1.30)	4.78 (0.91)
Accurate Info	5.50 (0.51)	5.35 (1.02)	5.09 (0.69)
Organized	5.33 (0.66)	4.74 (1.24)	4.28 (1.30)
Explanations	5.30 (0.53)	4.94 (1.29)	4.81 (0.78)
Clear Sound	4.70 (1.53)	3.42 (1.75)	3.13 (1.50)
Multiple Examples	5.27 (0.74)	4.87 (1.12)	4.94 (0.72)
Clear Images	4.83 (1.15)	4.23 (1.61)	4.53 (1.37)

$N = 93$

Task perceptions

Overall, participants thought the *learner*, *instructional designer*, and *interface designer* tasks were “worthwhile” ($M = 4.24$, $SD = 1.06$) and involved “learning” ($M = 5.06$, $SD = .96$) as well as “critical thinking” ($M = 4.09$, $SD = 1.34$) across all conditions. However, students somewhat disagreed that the tasks were “challenging” ($M = 2.29$, $SD = 1.19$) and were neutral on rating tasks as being “enjoyable” ($M = 3.64$, SD

= 1.15) and involving "creativity" (*M* = 3.30, *SD* = 1.39) across all conditions. The ANOVAs for task perceptions were statistically non-significant (*ps* > .05), indicating ratings did not differ by condition (See Table 3).

Participants in all conditions were asked to take notes while watching the learning materials. The *instructional designers* and *interface designers* were told their notes would be carefully considered in future redesigns (Appendix A), and a task rating was implemented for participants to rate how useful their notes would be to other people. Although statistically non-significant, all conditions rated their notes as being useful to others (*M* = 4.46, *SD* = 1.25).

Correlation coefficients were also produced to evaluate relationships between task perceptions using Pearson's correlation. Correlation coefficients and statistical significance can be seen in Table 4. Most task perception correlations were statistically significant (*p*s < .05); however, relationships between "useful notes" and "challenge" as well as between "learning" and "creativity" were statistically non-significant (*p*s > .05). A strong relationship was observed between "worthwhile" and "critical thinking" (*r*(93) = .702) Moderate relationships were observed between "learning" and "worthwhile" (*r*(93) = .570) as well as "worthwhile" and "enjoyable" (*r*(93) = .676).

Table 5

Pearson Correlation Coefficients for Task and Note Perceptions

Task Perceptions	1	2	3	4	5	6	7
1. Challenge	--						
2. Creativity	.331**	--					
3. Enjoyable	.347**	.415**	--				
4. Critical Thinking	.410**	.391**	.469**	--			
5. Worthwhile	.309**	.363**	.676**	.702**	--		
6. Learning	.268**	.102	.476**	n**	.570**	--	

Note. N = 93

*p < .05, **p < .01,

Video perceptions

Across all conditions, participants generally agreed the videos had clear controls (*M* = 4.96 , *SD* = .99), accurate information (*M* = 5.31 , *SD* = .74), organized layouts (*M* = 4.78 , *SD* = 1.07), detailed explanations (*M* = 5.02 , *SD* = .87), and relevant examples (*M* = 5.03 , *SD* = .86). Participants somewhat agreed the videos had clear sound (*M* = 3.75, *SD* = 1.59) and clear images (*M* = 4.53, *SD* = 1.38). The ANOVAs for video perceptions were mostly non-significant (See Table 3); however, there was a main effect for video organization, $F(2,90) = 6.96$, $p = .002$; $\eta^2 = .134$.

Post-hoc analyses using Tukey's HSD for video "organization" indicated participants assigned to the *learner* condition were more likely to agree that the videos were well organized than the *interface designer* (*d* = 1.02 ; *p* = .001), but the *learner* condition did not differ from the *instructional designer* (*d* = .60 ; *p* = .10). Similarly, the *instructional designer* did not differ from the *interface designer* condition (*d* = .36; *p* = .23).

Furthermore, the main effect of “clear sound” was statistically significant, $F(2,90) = 8.42$, $p < .001$; $\eta^2 = .158$. Post-hoc analyses using Tukey’s HSD indicated the *learners*’ rated the videos as having clearer sound than both *instructional designers* ($d = .78$; $p = .007$) and *interface designers* ($d = 1.04$; $p < .001$), but *instructional designers* did not differ from *interface designers* ($d = .18$; $p = .745$)

Correlation coefficients were also produced to evaluate relationships between video perceptions using Pearson’s correlation. Correlation coefficients and statistical significance can be found in Table 5. All video perception correlations were statistically significant (ps < .05). A strong relationship was observed between “clear images” and “relevant examples” ($r = .739$) as well as “relevant examples” and “explanations” ($r = .733$). Most other correlations were observed with moderate strength (see Table 5).

Table 6

Pearson Correlation Coefficients for Video Perceptions

Video Perceptions	1	2	3	4	5	6	7
1. Clear Controls	--						
2. Accurate Info	.659**	--					
3. Organized	.641**	.585**	--				
4. Explanations	.613**	.619**	.669**	--			
5. Clear Sound	.439**	.420**	.644**	.514**	--		
6. Relevant Examples	.519**	.621**	.494**	.733**	.568**	--	
7. Clear Images	.421**	.407**	.482**	.560**	.607**	.739**	--

Note. $N = 93$

*p < .05, **p < .01,

CHAPTER 5

DISCUSSION

The current study investigated the impact higher agency roles have on learning outcomes and task perceptions of multimedia content. It was hypothesized that learning outcomes would be influenced by participants' assigned role as *learner*, *instructional designer*, or *interface designer*. More specifically, it was reasoned that (a) the *instructional designer* would outperform the *learner* and *interface designer* roles, and (b) the *interface designer* would outperform the *learner*. Furthermore, it was hypothesized that (c) higher agency roles would find the tasks more challenging and worthwhile than the *learner* condition while also being more critical of the videos.

Learning Outcomes

Results from this study indicated students learned about cohesion from the multimedia videos. These findings align with previous evidence that roles can be effective at promoting cognitive engagement (Roscoe, et al. 2018). Although no main effect of condition was observed, inspecting score changes between pretest and posttest suggested the *instructional designer* condition had a larger change in scores than did the other two conditions—with the *interface designer* condition trailing the *learner* condition. These findings suggest agency roles can be as effective as a traditional learner role.

Since open-ended responses were used to measure knowledge changes, students may ignore concepts reported in the pretest when answering posttest questions. Comparisons of raw means may be deceptive when investigating learning outcomes. Furthermore, we investigated *new concepts* articulated in posttest responses, and the analysis suggested all conditions learned from the videos, supporting our claim that all conditions learned, but learning outcomes did not differ between conditions.

Learning outcomes may not have differed between conditions because of how roles were adopted. As a way of evaluating how participants demonstrated their assigned roles, all participants were asked to take notes that reflected the roles to which they were assigned. Although analyzing the notes is beyond the scope of this study, a cursory glance revealed that all conditions focused on learning content while few participants in the higher agency roles focused on video details—such as the clarity of images and sounds.

Since differences in cognitive engagement can predict variations in learning (Chi & Wylie, 2014), the results of this study indicate participants had similar levels of cognitive engagement across all conditions. Consequently, the manipulations for the higher agency roles may have been too weak to demonstrate differences. Students were given a brief overview of what their assigned role entailed, but students were not taught how to adopt the assigned role. Consequently, students may have reverted to their typical learning behaviors.

Task Perceptions

At the start, it was hypothesized that task perceptions would differ between conditions. It was reasoned that higher agency roles would find their tasks more “challenging” and “worthwhile” while also being “enjoyable” and involving “learning.” However, perceptions did not differ between conditions. On average, participants did not feel the tasks involved creativity or were challenging. This suggests the materials may have been too easy for participants, or the manipulations were too weak; however, participants did feel they learned and that the tasks involved critical thinking and were overall worthwhile, despite the lack of a challenge.

Furthermore, it was thought the higher agency roles would perceive their notes as more useful to others given the agentic hint that their notes would be “carefully considered” in future redesigns, but all participants agreed their notes would be useful to others. Participants in the *learner* condition may have interpreted “other” as fellow students and agreed their notes would be useful to those wanting to learn, despite not being told their notes would be used.

The correlation coefficients also revealed interesting trends. There was a strong relationship between “worthwhile” and “critical thinking” as well as a moderate relationship between “worthwhile” and “learning.” These findings suggest that being assigned a role prior to learning might have an impact on the value of the learning experience.

Video Perceptions

Participants rated the videos as having clear controls, accurate information, organized layouts, detailed explanations, and relevant examples. It was hypothesized that participants in the *interface designer* and *instructional designer* conditions would be more critical of the videos’ presentations than the *learner* condition, and there is evidence that conditions differed with two ratings. The perceptions of both “video organization” and “clear sound” differed between conditions. In both cases, the high agency roles were less likely than the *learner* condition to agree that the videos had clear sound and good organization. This suggests that participants did focus on their tasks at some point during the videos. This also provides evidence that the higher agency roles were able to critique the videos with a minimal impact to learning outcomes.

Limitations and Future Direction

A limitation with the current study was that participants were not taught specific ways of enacting their assigned roles. For example, although the higher agency roles were influenced by design thinking, none of the roles had to engage in design behaviors, such as redesigning the content or presentations. Future research may examine how specific higher agency role strategies could benefit task perceptions and learning outcomes by providing a more applied connection with the role.

Although beyond the scope of this paper, future analyses should be conducted on notes written by participants. These notes could reveal specific reasons why conditions did not differ in learning outcomes or why perceptions varied from those hypothesized. Furthermore, despite learning outcomes not differing between conditions, an important future step would be to examine if similar effects hold outside of a controlled lab.

Future research could examine how learning objectives could influence outcomes with similar conditions. Learning objectives help students learn by directing focus toward the desired learning outcome. For the *learner* role, we might have seen substantial changes to learning outcomes if learning objectives were used to guide how students remember, understand, and apply the learning materials. Furthermore, learning objectives do not only help students learn, they help instructors select and organize content. Providing structure to content requires an understanding of how the learning content is interrelated. By understanding both the learning content and organization, instructors can provide learning objectives that guide how students approach learning. In this study, had we provided learning objectives to the designer roles, we might have seen changes in learning outcomes. For example, by providing learning objectives of potential users, *instructional designers* would have been better equipped to evaluate the content as it aligns with those objectives—potentially altering the learning outcomes for instructional designers.

Conclusion

This study examined how higher agency roles might influence learning outcomes while also impacting task and video perceptions. Although conditions did not differ in their learning outcomes, the findings from this study have several implications that may prove useful to instructors and developers alike. For one, providing students with alternative roles can provide unique learning opportunities that do not take away from students' learning experiences. Educational technologies assume users are often learners whose task is to use these technologies to learn; however, as the current study has shown, developers and instructors could use alternative tasks to engage students without fully redesigning the technology or affecting learning outcomes.

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APPENDIX A

TASK INSTRUCTIONS BY CONDITION

Learning Task

Your task is to study four multimedia educational videos in order **to learn about cohesion and writing**. Each video is only a few minutes long.

Task Instructions:

1. Carefully **study** each video. The videos can be paused.

2. Using the space provided, **take notes** for **learning** the information. Your notes should include the **valuable ideas** and **concepts** that are worth **remembering** and **understanding**.

3. You have up to **30 minutes** to study the videos and take notes.

To continue to the videos, please type a short description of your assigned task.

Instructional Design Task

Your task is to review four multimedia educational videos about **cohesion and writing** in order **to improve the instructional design of each video**. Instructional design refers to **creating educational materials that teach useful information and examples in an understandable way**. Each video is only a few minutes long.

When we redesign the videos for future students, we will carefully consider your **instructional design recommendations** and comments. Thank you for your input!

Task Instructions:

1. Carefully **review** each video. The videos can be paused.

2. Using the space provided, **take notes** for improving the **instructional design** of the videos. Videos with good instructional design provide accurate information, detailed explanations, and multiple relevant examples. A variety of students should be able to remember and comprehend the lesson content.

3. You have up to **30 minutes** to review the videos and make design recommendations.

To continue to the videos, please type a short description of your assigned task.

Interface Design Task

Your task is to review four multimedia educational videos about **cohesion and writing** in order **to improve the interface design** of each video. Interface design refers to **creating materials with easy navigation, straightforward controls, appealing appearance, and clarity.** Each video is only a few minutes long.

When we redesign the videos for future students, we will carefully consider your **interface design recommendations** and comments. Thank you for your input!

Task Instructions:

1. Carefully **review** each video. The videos can be paused.

2. Using the space provided, **take notes** for improving the **interface design** of the videos. Videos with good interface design should have clear navigation and controls, organized layout, clear narration and sounds, and clear images and animations. The videos should be easy to use and appealing to a variety of viewers.

3. You have up to **30 minutes** to review the videos and make design recommendations.

To continue to the videos, please type a short description of your assigned task.

APPENDIX B

ATTITUDES AND PERCEPTIONS SURVEY

Attitudes and Perceptions Survey

The final part of this study asks you to describe your attitudes toward (1) your assigned **task** and (2) the **videos** that you reviewed. Please **read carefully** and **answer honestly**. We are interested in your opinions and perceptions, and there are no right or wrong answers.

First, think carefully about **the task you were asked to complete**. In the space below, we have provided a few statements that *might* describe the task.

Using the scale on the right, tell us **how much you agree or disagree with the descriptive statements**.

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
The task was challenging.	○	○	○	○	○	○
The task involved creativity.	○	○	○	○	○	○
The task was enjoyable.	○	○	○	○	○	○
The task involved critical thinking.	○	○	○	○	○	○
The task was worthwhile.	○	○	○	○	○	○
The task involved learning.	○	○	○	○	○	○
My task notes will be useful to other people.	○	○	○	○	○	○

Next, think carefully about **the videos you reviewed**. In the space below, we have provided a few statements that *might* describe the videos.

Using the scale on the right, tell us **how much you agree or disagree with the descriptive statements**.

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
The videos had clear navigation and controls.	○	○	○	○	○	○
The videos provided accurate information.	○	○	○	○	○	○
The videos had an organized layout.	○	○	○	○	○	○
The videos provided detailed explanations.	○	○	○	○	○	○
The videos had clear narration and sounds.	○	○	○	○	○	○
The videos provided multiple relevant examples.	○	○	○	○	○	○
The videos had clear images and animations.	○	○	○	○	○	○

APPENDIX C

VIDEOS ON COHESION

Video 1: Overview of Cohesion

Note: at the end of the video, the character will instruct you to close the window. Please ignore those instructions. **Do not close the browser window.**

Learning Notes

Video 2: Connectives Strategy

Note: at the end of the video, the character will instruct you to close the window. Please ignore those instructions. **Do not close the browser window.**

Instructional Design Notes

Video 3: Signpost Strategy

Note: at the end of the video, the character will instruct you to close the window. Please ignore those instructions. **Do not close the browser window.**

Instructional Design Notes

Video 4: Threading Strategy

Note: at the end of the video, the character will instruct you to close the window. Please ignore those instructions. **Do not close the browser window.**

Interface Design Notes

APPENDIX D

CONSENT FORM

Information for Study Participants

You are invited to participate in a research study conducted by Dr. Rod D. Roscoe from Arizona State University. The purpose of this study is to investigate multimedia educational materials. Participants must be 18 years of age or older and possess a reasonable level of English language proficiency.

This study consists of a computer-based survey with several components. You will be asked to respond to a brief survey about your background and answer questions about the topic of writing. You will also be asked to review multimedia educational materials and take notes.

We expect that this study will require about 60 minutes to complete. For your time and effort, you will receive course credit via SONA if participating as part of a course (1.0 credit).

If you are participating via a course, alternative course credit opportunities are available to you if you choose not to participate in this research study.

Your data will be used for research purposes only, such as academic publications and presentations. Your data will only be reported in aggregate or summarized form. Your responses are anonymous. Your name and identifying information will not be collected as part of your survey responses. Thus, your name can never be linked to the data. Your responses are also voluntary. You are free to withdraw from the study at any time and choose not to answer questions. There are no anticipated risks to participating in this study.

If you have any questions, comments, or suggestions about the study, please do not hesitate to contact the primary investigator: Dr. Rod D. Roscoe (rod.roscoe@asu.edu, 480-727-2760). If you have questions about your rights as a participant in this research, or feel that you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance (480-965-6788).

If you agree to participate in this study, please enter the ID code given to you by the experimenter and then click on the button below that says "Continue."

Choosing to continue and complete the survey will be considered as your consent to participate.

APPENDIX E

INSTITUTIONAL REVIEW BOARD EXEMPTION

ASU Knowledge Enterprise Development

EXEMPTION GRANTED

Rod Roscoe
IAFSE-PS: Human Systems Engineering (HSE)
480/727-2760
Rod.Roscoe@asu.edu

Dear Rod Roscoe:

On 10/9/2019 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Effects of 'Learner' and 'Designer' Roles on Learning with Educational Multimedia
Investigator:	Rod Roscoe
IRB ID:	STUDY00010853
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• Learner Roles Protocol, Category: IRB Protocol; • Information for Study Participants, Category: Consent Form; • Complete Survey (PDF format), Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 10/9/2019.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator