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Evaluating Cognitive Theory Using Interactive Videos with Female Bachelor Students as Participants

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ABSTRACT

Purpose Few studies have clarified the connection between educational technologies and psychological theories and how they relate to each other to provide students with the highest educational experience. Further studies are needed to understand the types of connections required to achieve high educational input. **Methodology** This study conducted in Saudi Arabia employed the cognitive theory dimension using interactive videos with female bachelor's degree students as participants. An experiment involving 102 participants was conducted based on a study approach. Data analyses included descriptive statistics, normality tests, associated tests, and multinomial logistics regression model analyses. **Findings** The results showed that the student's cognitive achievement was related to the skills and sub-skills imparted through videos and clear/conversational language. Moreover, the logistics regression model shows almost associated with task completion and scores regarding using interactive video, scores of cognitive theory skills related to the video subject, and scores about students' ideas about interactive video tools. **Implications** The study findings can benefit all individuals who work and train in the education field and tool designers who provide interactive digital video-based learning and training.

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1. Introduction

The correlations between the brain, hand, and tools can be physical, neural, mental, cultural, or social. This interactive relationship constitutes the cognitive aspects of the humans. In the current era, educational technology has digitalized this interaction in multiple ways, including interactive videos as a popular method of flipped or blended learning, known to reduce the cognitive load (Ervianti, Sampelolo, & Pratama, 2023). Karaca and Ocak (2017) emphasize that well-structured field knowledge reduces the cognitive load. Therefore, interactive videos must be included in lessons to gain sufficient knowledge. However, according to a comprehensive meta-analysis, interactive videos are different from video game training because they ensure improved cognitive abilities (Sala, Tatlidil, & Gobet, 2018). The continued exploration of everyday interaction in educational disciplines is fundamental to developing the expertise of the hand tools in games like hand–brain puzzles, teaching strategies, instructions, curricula, and tools that help in the cognitive development of the human mind (Marchand, 2012).

The use of interactive videos is an essential strategy in flipped learning. Interactive videos are a new type of media that has been proven to capture students' attention and educate them more effectively than any other online material. Unlike traditional linear videos, students can interact by pressing, pausing, and rewinding the play. Understanding the meaning of an interactive video is critical to obtain the best cognitive experience. Interactive videos require certain essential elements for professional use. Brame (2016) stated that instructors must consider three details while using compelling videos as educational tools: "how to manage the cognitive load of the video, maximize student engagement with the video, and promote active learning from the video" (p. 1).

Kuhail (2017) defined an Interactive Digital Video as "a digital multimedia presentation that can provide user input. Such multimedia directly incorporates various interactive elements into a video, including hotspots, questions, and calculations. Such videos play like regular videos but include various clickable areas, or 'hotspots' that perform a specific action when you click on them" (pp. 9-10). Computer-based instructional systems engage students in learning. However, interactive videos improve other computer-based systems to engage students in two-way dialog by adding dimensions (Kuhail, 2017).

In the context of Saudi Arabia, there has been a significant push towards educational technology adoption in recent years (Alyami, Pileggi, & Hawryszkiewycz, 2023; Tan et al., 2022). The Saudi Vision 2030 plan emphasizes the importance of technology in education. Initiatives like the "Digital Saudi" program aim to modernize the education system, making it more technology-driven. This involves investing in infrastructure, training educators, and developing digital content. The current study aimed to analyze how psychological and cognitive elements are integrated educational technology to make an impact of social interaction, environment, learning outcomes, developing personal styles, and solving problems using tools and materials. There is a dearth of studies in the Saudi Arabian context which explored the connections between physiological theories that could relate to using educational technology tools such as cognitive theory. This study is therefore significant as it deeply explored these connections to understand the pros and cons of using educational technologies based on scientific physiological theories.

Literature Review

Although previous studies have demonstrated an association between affective and cognitive learning (Keskin, 2019; Sweller, 2020), there is still a need to form agile interdisciplinary teams encompassing psychological expertise (Crompton, Bernacki, & Greene, 2020), helpful in creating adaptive instructional systems enabling technology and digital literacy. In order to keep up with the rapid pace of change in the digital world (Ervianti et al., 2023), an interdisciplinary approach that values technical and psychological expertise can help address these challenges and ensure that students receive practical and up-to-date instruction. Integrating psychology and technology allows for rigorous evaluation of educational interventions, contributing to evidence-based educational practices. According to Hong et al. (2016), mental research experience and cognitive failure may cause an absence of mindedness and a loss of attention, reducing Internet learning competence. However, few studies have examined cognitive failure in social media usage for physiological or behavioral reasons.

There is a great need to bridge the gap between educational technologies and psychological theories for several reasons. First, it would help in optimized learning and enhanced learning outcomes. An integration of educational technology and psychological theories would help learners process information, retain knowledge, and engage with educational content as they can understand the design of technology more effectively. When educational technologies align with psychological theories, they can cater to individual and personalized learning experiences and cognitive processes. Psychological theories like the zone of proximal development (Chaiklin, 2003) and self-determination theory (Chiu, Sun, & Ismailov, 2022; Ryan & Deci, 2000) have emphasized tailoring instruction to the learner's level and interests, to which educational technologies have contributed in the form of adapting content, and pacing with the difficulty level of each student.

Second, technology can be tailored to understand how students think, learn, and retain information, and meet their cognitive needs. Technology provides motivating educational tools which leverage emotion and cognition principles. A few educationists recommend integrating technology education design with motivational theories (e.g., Self-Determination Theory, Expectancy-Value Theory) to help maintain and boost student motivation (Puspitarini & Hanif, 2019). Gamification with interactive features (Saleem, Noori, & Ozdamli, 2022), and real-world relevance are such educational tools that can be integrated with curriculum to engage learners, and foster their interest and participation in learning (Ertmer et al., 2012). Third, combining technology with psychology enables adaptive learning systems, which can dynamically adjust with each student's learning style, maximizing their potential and design individualized learning paths (Davlataliyevna, 2022; Dunn et al., 2011). This is helpful in improved assessment as well as psychological insights can be applied to improve assessment tools. While technology can potentially gather more precise student performance and behavior data, leading to more accurate evaluations and targeted interventions, psychological theories can inform the design of assessment methods aligned with how students learn and think (Graesser, Sabatini, & Li, 2022). Collectively, constructive feedback of both entities can help students understand and correct their mistakes.

Fourth, cognitive load theory (Sweller, 2020) can guide the design of educational technologies to manage the cognitive demands placed on learners. Well-designed tools can reduce extraneous cognitive load, allowing students to focus on the essential aspects of the content. Sweller (2020) designed instructional procedures for complex information that require a reduced working memory load with the assistance of educational technology. Fifthly, numerous adaptive educational systems have been created to educate students in technology and digital literacy (Chiu et al., 2022). Nevertheless, the rapid evolution of subject matter and pertinent skills has posed challenges in integrating principles from the field of psychological science within design teams. These teams are often predominantly composed of engineers and computer scientists. Last, but not the least, when psychological theories help to design technology, it fosters inclusive education, and accommodates diverse learning needs, making education more inclusive, accessible and equitable, including those with disabilities or different learning styles.

These were some of the potential benefits associated with the integration of technology and psychological theories, which can promote the use of evidence-based practices in education. Research and data collected from educational technology can be analyzed using psychological principles to determine what works and what does not.

Theoretical framework

The cognitive theory represents psychology as well as the human mind and human competence. Resnick (2017) observed that it is increasingly apparent that the evolving psychological conceptions of human competence should impact educational practices. Resnick (2017) expounded that cognitive theory in practice revolves around rewards. This implies that this theory specifies how individuals form new connections through a trial-and-error process in which associations that receive positive reinforcement or rewards become stronger, while those subjected to punishment or neglect gradually become weaker. Training provides the most significant opportunity to reward correct answers and strengthen bonds. Gestalt (Jeganathan & Shanmugam, 2022) showed that the discovery of teaching methods depends on the underlying knowledge structure, to which Resnick (2017) states that practice can be organized from easiest to most difficult, which into summarized a theory of instruction using the current cognitive theory: anything can be done to help students learn new capabilities.

However, both theories (the psychological theory of pedagogy and cognitive theory) are descriptive (Korobova et al., 2018; Lind, 2023; Tomlinson, 2008; Wen et al., 2023). Teachers must explain why and how they use specific activities or tools. In sum, Resnick (2017) pointed out "three components of a theory of instruction: (l) specification of capabilities to be acquired, (2) description of acquisition processes, and (3) principles of intervention" (p. 5). Therefore, teachers must explain what should be done to achieve the desired results; when goals are stated and explained, students' express the desire for a new capability and illustrates their learning processes.

This suggests that a cognitive theory of instruction evolves with the growing complexity of cognitive performance and development theories. Nevertheless, it is imperative to establish clear definitions for cognitive theory and interactive videos before starting a study. While referring to Resnick's (2017) observation, the primary aim of the current research was to construct a research agenda within the cognitive theory of

instruction. Such a theory should inform educational practices and push the boundaries of our understanding regarding how individuals learn and develop. The study was thus based on the cognitive theory model (Schunk & Usher, 2012) as seen in Figure 1.

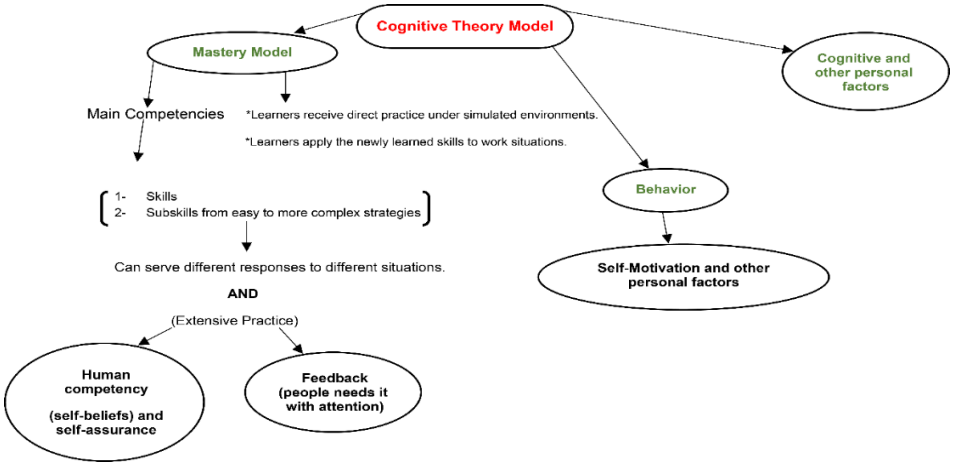

Figure 1. *Cognitive Theory Model (Source: Schunk & Usher, 2012)*

Based on the extant argument about cognitive principles and the integration of psychological principles and technology, the study framed the following two questions:

1. According to cognitive theory, what is the relationship between the use of interactive videos and student achievement?
2. To what extent do students attain the dimensions of cognitive theory using interactive videos?

The questionnaire designed to collect the data was divided into three sections to answer these two research questions and make observations during the experiment. The first section was related to the use of H5P; the second section measured the cognitive theory skills related to the videos; and the third section concerned the students' ideas about interactive video tools. All sections were scored on a 5-point Likert scale (1 = completely disagree, 2 = somewhat disagree, 3 = neither agree nor disagree, 4 = somewhat agree, and 5 = completely agree).

Methodology

- *Research Design*

The stud adopted an experimental research design to create an interactive video using the HTML5 (H5P) package for an interactive web experience. The researcher uploaded the learning videos and designed questions and practical exercises, following interactive video instructions that the students could perform after watching the explanation of each specific objective. Objectives related to one of the curriculum subjects were included in the video study in addition to basic cognitive theory in the video scenario and design. The cognitive theory dimension was applied in the study by designing the interactive video based on the theory's three models: (mastery model, behavior, and cognitive and other personal factors. Moreover, the questionnaire was designed to measure appropriately these three models by specific questions.

The mastery model was the main competency after participants received the direct practices through the interactive video in a simulated environment. The principal competencies in the theory included in the video to teach subject skills and subskills from easy to more complex strategies that can serve different responses from the participants to different situations through the designed video. Further, participants did extensive practice in two ways through the active questions and exercises designed in the interactive video. Regarding the behavior (self-motivation and other personal factors in the theory, by watching and doing each skill and measuring that through the observations and statistically through the questionnaire filled by hotspots through the end of the video designed. In addition, the researcher used a questionnaire to measure student achievement through interactive videos based on the principles of cognitive theory. The questionnaire was designed based on theoretical principles.

- *Data Collection and Participants*

The data was collected from a participant group comprising 102 female participants drawn from an agricultural college that exclusively admitted female students. Participants were selected from all nine classes enrolled in the Introduction to Computers Course because one of the course's modules focused on interactive video, which was pertinent to this research. The selection of participants was done randomly, with no specific inclusion criteria. The Research Ethics Committee of the university had granted its ethical approval to the protocol. The study participants provided written informed consent for participation. The participants were informed that they had the right to withdraw from the study at any time and that their anonymity would be ensured.

Data was collected using the researcher's HTML5 Package (H5P), observations and a questionnaire. The questionnaire was translated into the mother tongue, Arabic, and collected after four weeks. The data instrument also included a video study using a hotspot link for individuals. All the participants responded to the questions after having watched the video, and performing the practical exercises. Each participant was explained how to use the research videos. They were also explained the items in the questionnaire, as each question was linked by the hotspot through the designed video.

- *Data Analysis*

Descriptive statistics, including mean, standard deviation, median, and inter-quartile range (IQR), were calculated for quantitative variables, and numbers and percentages for qualitative variables. The normality of the continuous data was tested using Kolmogorov-Smirnov and Shapiro-Wilk's normality tests. Mann Whitney U and Kruskal Wallis H tests were used to find associations between subscale scores and demographic variables. Multinomial logistic regression models were used to find the predictors of task completion with different subscale scores and other variables. A p-value of less than 0.05 was considered statistically significant in all these tests.

The subscale scores were subjected to normality tests, and the analysis of normality tests indicated that they were not in normal distribution. Mann Whitney U test (in case of 2 groups) and Kruskal Wallis H test (in case of 3 groups) were used to find the association between scores with demographic variables and task completion. Multinomial logistic regression analysis was

used to find the predictors of task completion with different subscale scores and other variables. Effect sizes were also provided for all logistic regression models.

Results

The study was conducted to study the relationship between the use of interactive videos and student achievement, according to cognitive theory, and to find to what extent students attained the dimensions of cognitive theory using interactive videos. The data was collected from a total of 102 study participants. Table 1 presents the demographic characteristics of the study participants (N = 102). All study participants were females. In terms of age group, most participants were in the 18-20 years range (84.3%), with smaller percentages in 21-22 years (8.8%) and 23-25 years (6.9%) categories. Regarding marital status, 83.3% were unmarried, while 16.7% were married. All participants were student, with study disciplines varied. Agricultural Applied Economics was the most common (28.4%), followed by Agricultural Economy (29.4%). Most participants completed all tasks (31.4%), while 17.6% completed almost all tasks, and 51.0% completed some tasks.

Table 1.

Demographic Variables Among the Study Participants (N = 102)

Demographic variables		Number	Percentage
Gender	Female	102	100
	Male	0	0
Age group	18-20 years	86	84.3
	21-22 years	9	8.8
	23-25 years	7	6.9
Marital status	Unmarried	85	83.3
	Married	17	16.7
Work status	Student	102	100
Study discipline	Agricultural Applied Economics	29	28.4
	Agricultural Science	5	4.9
	Agriculture	5	4.9
	Agriculture and food science	9	8.8
	Agricultural economy	30	29.4
	Consumer Science	9	8.8
	Economy	12	11.8
	General	1	1
	Nutrition sciences	1	1
	Not specified	1	0.98
Task completion	All	32	31.4
	Almost	18	17.6
	Some	52	51

Table 2.

Statements Of Variables Used in The Study Tool (N = 102).

Statements	Categories	Number	Percentage
• Statements related to the Interactive Video H5P (HTML5 Package)			
1. The interactive video design was straightforward.	Completely Disagree	6	5.9
	Somewhat Disagree	1	1
	Neither Agree nor Disagree	3	2.9
	Somewhat Agree	10	9.8
	Completely Agree	82	80.4
2. I understood the video content.	Completely Disagree	5	4.9
	Somewhat Disagree	0	0
	Neither Agree nor Disagree	3	2.9
	Somewhat Agree	11	10.8
	Completely Agree	83	81.4
3. I felt engaged watching the video.	Completely Disagree	5	4.9
	Somewhat Disagree	4	3.9
	Neither Agree nor Disagree	9	8.8
	Somewhat Agree	23	22.6
	Completely Agree	61	59.8
4. The video is presented by following hotspots, clicking on the buttons, taking the short quizzes, sending info, and reaching the video creator.	Completely Disagree	0	0
	Somewhat Disagree	0	0
	Neither Agree nor Disagree	0	0
	Somewhat Agree	0	0
	Completely Agree	102	100
• Statements that measured cognitive theory skills related to the video subject			
5. The video was developed based on the essential competencies of the topic.	Completely Disagree	6	5.9
	Somewhat Disagree	1	1
	Neither Agree nor Disagree	0	0
	Somewhat Agree	13	12.7
	Completely Agree	82	80.4
6. The video was built based on specific skills and subskills.	Completely Disagree	4	3.9
	Somewhat Disagree	0	0
	Neither Agree nor Disagree	9	8.8
	Somewhat Agree	24	23.6
	Completely Agree	65	63.7
7. The video was constructed from easy to more complex strategies and extensive practices.	Completely Disagree	6	5.9
	Somewhat Disagree	3	2.9
	Neither Agree nor Disagree	12	11.8
	Somewhat Agree	24	23.5
	Completely Agree	57	55.9
8. The video provided feedback to the participants from the instructor.	Completely Disagree	18	17.7
	Somewhat Disagree	18	17.7
	Neither Agree nor Disagree	16	15.6
	Somewhat Agree	15	14.7
	Completely Agree	35	34.3
9. The video verified beliefs and	Completely Disagree	7	6.9

self-confidence in the knowledge of the subject.	Somewhat Disagree	1	1
	Neither Agree nor Disagree	16	15.7
	Somewhat Agree	21	20.6
	Completely Agree	57	55.8
	Completely Disagree	4	3.9
10. The video helped me to apply the new knowledge or the newly learned skills in a work situation.	Somewhat Disagree	0	0
	Neither Agree nor Disagree	2	2
	Somewhat Agree	14	13.7
	Completely Agree	82	80.4
	Completely Disagree	5	4.9
11. The video offered different responses based on user interactions.	Somewhat Disagree	2	2
	Neither Agree nor Disagree	16	15.7
	Somewhat Agree	21	20.6
	Completely Agree	58	56.8
	Completely Disagree	14	13.7
12. Written copies of the video guidelines were needed.	Somewhat Disagree	17	16.7
	Neither Agree nor Disagree	21	20.6
	Somewhat Agree	13	12.8
	Completely Agree	37	36.2
	Completely Disagree	3	2.9
13. The interactive video addresses motivation and beliefs about the subject.	Somewhat Disagree	4	3.9
	Neither Agree nor Disagree	12	11.8
	Somewhat Agree	29	28.5
	Completely Agree	54	52.9
• Statements related to students' ideas about interactive video tools			
14. Including guiding questions and objectives for the lecture topic in the video is important.	Not important	1	1
	Somewhat important	27	26.5
	Important	74	72.5
15. The video was part of a more significant homework assignment.	No	13	12.7
	Yes	89	87.3
16. The video had interactive features that gave students control	No	2	2
	May be	11	10.8
	Yes	89	87.2
17. The video is short.	No	9	8.8
	May be	32	31.4
	Yes	61	59.8
18. The speaker uses clear, conversational language in the video.	No	5	4.9
	May be	5	4.9
	Yes	92	90.2
19. The speaker speaks relatively fervently.	No	16	15.7
	May be	23	22.5
	Yes	63	61.8
20. The video contains other unique videos related to the lecture.	No	16	15.7
	May be	21	20.6
	Yes	65	63.7

The questionnaire that measured cognitive achievement among the students contained 20 statements (Table 2). The first four statements (1-4) represented statements related to the interactive video H5P, next nine statements (5-13) dealt with statements that measured cognitive theory skills related to the video subject, and the last seven statements (14-20) dealt with students' ideas about interactive video tools. A 5-point Likert scale was used for measuring the scores of statements 1-13 (1 = completely disagree, 2 = somewhat disagree, 3 = neither agree nor disagree, 4 = somewhat agree, and 5 = completely agree). For statement 4, a 3-point Likert scale was used (1 = not important, 2 = somewhat important, and 3 = important). For statements 15-20, another 3-point Likert scale was used (1 = no, 2 = may be, and 3 = yes).

Table 3 presents the descriptive statistics, Mean, SD and Median, of the three cognitive scores obtained among the study participants.

Table 3.

Descriptive Statistics of The Cognitive Scores Obtained Among the Study Participants

Scores	Mean ± SD	Median (IQR)	(minimum, maximum)
1-4 (statements related to the interactive video)	18.50 ± 20.00	20 (18-20)	(8, 20)
5-13 (statements measuring cognitive theory skills)	37.28 ± 6.67	38 (33.75-42.25)	(12, 45)
14-20 (statements representing students' ideas about interactive video tools)	18.62 ± 2.09	19 (18-20)	(12, 21)

All these three scores were subjected to normality tests (Kolmogrov-Smirnov and Shapiro Wilk's test), and the results of the normality tests indicated that they were not in the normal distribution. Table 4 presents the association between scores regarding the use of interactive videos and demographic variables, as well as task completion. There were no statistically significant differences in these scores with all variables.

Table 4.

Association Between Scores of Interactive Videos with Demographic Variables and Task Completion

Variables		Mean ± SD	Median (IQR)	P value
Age group	18-20 years	18.48 ± 2.96	20 (18-20)	0.300^
	21-22 years	19.11 ± 1.62	20 (19-20)	
	23-25 years	18.00 ± 2.08	18 (17-20)	
Marital status	Unmarried	18.54 ± 2.77	20 (18-20)	0.589^^
	Married	18.29 ± 3.08	19 (18-20)	
Teaching discipline	Agriculture related	18.59 ± 2.68	20 (19-20)	0.865^^
	Non-agriculture related	18.26 ± 3.18	20 (18-20)	
Task completion	All	18.59 ± 3.01	20 (19-20)	0.843^
	Almost	18.83 ± 1.51	19 (18-20)	
	Some	18.33 ± 3.05	20 (18-20)	

Note: ^Kruskal Wallis H test; ^^Mann Whitney U test.

Table 5 presents the association between scores regarding cognitive theory skills related to video with demographic variables and task completion. There were no statistically significant differences in these scores with all variables.

Table 5.

Association Between Scores Regarding Cognitive Theory Skills Related to Video with Demographic Variables and Task Completion

Variables		Mean ± SD	Median (IQR)	P value
Age group	18-20 years	37.14 ± 7.06	37 (33-44)	0.960^
	21-22 years	37.89 ± 3.92	38 (34.50-42)	
	23-25 years	38.29 ± 4.46	38 (35-41)	
Marital status	Unmarried	37.28 ± 6.99	38 (33-43.50)	0.623^^
	Married	37.29 ± 4.87	37 (34.50-41.50)	
Teaching discipline	Agriculture related	37.85 ± 6.03	39 (34-44)	0.315^^
	Non-agriculture related	35.70 ± 8.11	37 (33-40)	
Task completion	All	37.06 ± 6.59	38.50 (35-40.75)	0.734^
	Almost	36.83 ± 6.14	36.50 (32.75-43.25)	
	Some	37.58 ± 6.99	37 (35-44)	

Note: ^Kruskal Wallis H test; ^^Mann Whitney U test.

Table 6 presents the association between scores regarding students' ideas about interactive video tools with demographic variables and task completion. There were no statistically significant differences in these scores with all variables.

Table 6.

Association Between Scores Regarding Students' Ideas About Interactive Video Tools with Demographic Variables and Task Completion

Variables		Mean ± SD	Median (IQR)	P value
Age group	18-20 years	18.59 ± 2.19	19 (17.75-20.25)	0.123^
	21-22 years	19.56 ± 0.88	20 (19-20)	
	23-25 years	17.71 ± 1.50	18 (17-19)	
Marital status	Unmarried	18.76 ± 2.05	19 (18-20)	0.077^^
	Married	17.88 ± 2.01	18 (17-19)	
Teaching discipline	Agriculture related	18.64 ± 2.08	19 (18-20)	0.865^^
	Non-agriculture related	18.56 ± 2.17	19 (17-21)	
Task completion	All	18.69 ± 1.60	19 (18-20)	0.900^
	Almost	18.61 ± 2.52	19 (17.75-21)	
	Some	18.58 ± 2.24	19 (17.25-20.75)	

Note: ^Kruskal Wallis H test; ^^Mann Whitney U test.

In Table 7, the logistic regression model results with task completion as the outcome variable and scores regarding the use of interactive videos as the predictor variable are presented while controlling for age, marital status, and teaching discipline. For the

outcome group "Task completion - All," no significant associations were found for age groups, marital status, teaching discipline, or scores. In contrast, for "Task completion - Almost," teaching discipline showed a significant association with a P value of 0.024. Specifically, in agriculture-related teaching disciplines, the odds of achieving "Task completion - Almost" were significantly lower (OR 0.242, 95% CI 0.070-0.831). The other variables did not exhibit significant associations in this group.

Table 7.

Result Of a Logistic Regression Model with Task Completion as The Outcome Variable and Scores Regarding Using Interactive Videos as The Predictor Variable, Controlling for Age, Marital Status, And Teaching Discipline

Outcome groups (Reference: Task completion is 'some')	Model parameters		B	P value	OR	95% CI of OR
Task completion – All		Intercept	-0.346	0.843		
	Age group	18-20	-0.824	0.327	0.439	0.085-2.275
		21-22	-0.247	0.816	0.781	0.098-6.239
		23-25 (reference)				
	Marital status	Unmarried	0.184	0.751	1.202	0.386-3.742
		Married (reference)				
	Teaching discipline	Agriculture related	-0.345	0.535	0.708	0.386-3.742
		Non-agriculture related (reference)				
	Scores (Q1-Q4)		0.036	0.665	1.037	0.880-1.222
Task completion – Almost		Intercept	-38.426	0.996		
	Age group	18-20	18.386	0.421	96631409	0-NA
		21-22	17.902	0.998	59536128	0-NA
		23-25 (reference)				
	Marital status	Unmarried	18.371	0.998	95139288	95139288-95139288
		Married (reference)				
	Teaching discipline	Agriculture related	-1.421	0.024*	0.242	0.070-0.831
		Non-agriculture related (reference)				
	Scores (Q1-Q4)		0.094	0.421	1.098	0.874-1.379

Note: *Significant P value; B: beta coefficient; OR: odd's ratio; CI: confidence interval.

In Table 8, the logistic regression model results with task completion as the outcome variable and scores of cognitive theory skills related to the video subject as the predictor variable while controlling for age, marital status, and teaching discipline are presented. For the outcome group "Task completion - All," none of the variables showed significant associations with task completion. In the "Task completion - Almost" group, teaching discipline was significantly associated with a P value of 0.032. Specifically, in agriculture-related teaching disciplines, the odds of achieving "Task completion - Almost" were

significantly lower (OR 0.258, 95% CI 0.075-0.888). The other variables did not exhibit significant associations in this group.

Table 8.

Result of a Logistic Regression Model with Cognitive Theory Skills Related to The Video Subject

Outcome groups (Reference: Task completion is 'some')	Model parameters		B	P value	OR	95% CI of OR
Task completion – All	Intercept		0.76	0.636		
	Age group	18-20	-0.838	0.32	0.433	0.083-2.252
		21-22	-0.225	0.831	0.798	0.101-6.327
		23-25 (reference)				
	Marital status	Unmarried	0.192	0.74	1.212	0.390-3.769
		Married (reference)				
	Teaching discipline	Agriculture related	-0.303	0.589	0.739	0.247-2.212
		Non-agriculture related (reference)				
	Scores (Q5-Q13)		-0.012	0.727	0.988	0.921-1.059
Task completion – Almost	Intercept		-34.578	0.993		
	Age group	18-20	17.401	0.997	36087827	0-NA
		21-22	16.969	0.997	23416952	0-NA
		23-25 (reference)				
	Marital status	Unmarried	17.361	NA	34673424	0-NA
		Married (reference)				
	Teaching discipline	Agriculture related	-1.355	0.032*	0.258	0.075-0.888
		Non-agriculture related (reference)				
	Scores (Q5-Q13)		0.011	0.998	1.001	0.924-1.084

Note: *Significant P value; B: beta coefficient; OR: odd's ratio; CI: confidence interval.

In Table 9, the logistic regression model results with task completion as the outcome variable and scores related to students' ideas about interactive video tools as the predictor variable while controlling for age, marital status, and teaching discipline are presented. For the outcome group "Task completion - All," none of the variables showed significant associations with task completion. In the "Task completion - Almost" group, teaching discipline was significantly associated with a p-value of 0.028. Specifically, in agriculture-related teaching disciplines, the odds of achieving "Task completion - Almost" were significantly lower (OR 0.256, 95% CI 0.076-0.866). The other variables did not exhibit significant associations in this group.

Table 9.

Result of a Logistic Regression Model About Students' Ideas About Interactive Video Tools

Outcome groups (Reference: Task completion is 'some')	Model parameters		B	P value	OR	95% CI of OR
Task completion – All	Intercept		-0.16	0.942		
	Age group	18-20	-0.832	0.323	0.435	0.083-1.293
		21-22	-0.259	0.81	0.772	0.094-6.360
		23-25 (reference)				
	Marital status	Unmarried	0.163	0.781	1.177	0.371-3.732
		Married (reference)				
	Teaching discipline	Agriculture related	-0.335	0.545	0.715	0.242-2.118
		Non-agriculture related (reference)				
	Scores (Q14-Q20)		0.027	0.818	1.027	0.816-1.293
Task completion – Almost	Intercept		-35.644	0.996		
	Age group	18-20	18.461	0.998	1.148	0-NA
		21-22	18.072	0.998	70573724	0-NA
		23-25 (reference)				
	Marital status	Unmarried	18.424	NA	1.108	0-NA
		Married (reference)				
	Teaching discipline	Agriculture related	-1.363	0.028*	0.256	0.076-0.866
		Non-agriculture related (reference)				
	Scores (Q14-Q20)		-0.055	0.685	0.946	0.725-1.235

Note: *Significant P value; B: beta coefficient; OR: odd's ratio; CI: confidence interval.

4. Discussion

- *Connection Between Students' Cognitive Achievement and Other Variables of The Interactive Video*

The majority of participants confirmed their interaction with the interactive video, and a substantial number ultimately agreed that their usage of the interactive video was in line with their cognitive abilities. Most participants endorsed a high level of agreement with statements assessing their perspectives on using interactive video. This was because their interaction with the interactive videos and their content was very effective in many ways. First, the interaction was aligned and well-matched with their cognitive abilities as the video content was in sync with their intellectual and cognitive capabilities. Second, the reason for a strong agreement with the statements that they were related to their perceptions of using interactive video. For this reason, most participants interaction held positive perspectives about the interactive videos and found them effective in achieving the intended educational goals. This finding is consistent with Mayer (2014), who demonstrated that learning cognitive theory through multimedia means receiving

information through auditory and visual channels effectively. Each channel has a specific capacity and treatment capability that are responsible for their effectiveness. For example, auditory and visual information are processed through both auditory and visual physical channels when a person watches a video.

Additionally, the findings showed that 90.2% of respondents affirmed that the speaker employed clear and conversational language in the video. The results revealed that a significant majority, precisely 90.2% of the respondents, agreed or confirmed that the speaker in the video used clear and conversational language. This suggests that most respondents found the speaker's communication style easy to understand and engaging, a positive indicator of effective communication in the video content. This is contrary to the opinion held by Sweller (2010), who believed that the continuous flow of video information may result in an intense cognitive burden. Likewise, Mayer and Pilegard (2014) also opined that if information is presented quickly to a learner without controlling the speed or length of the video, the intrinsic load may increase because channels are loaded. In this study, language speed was related to the student's cognitive achievement. Thus, it is essential that people in the education field or tool designers must consider and control the speed limit and clear language while designing interactive learning videos.

- *To What Extent Do Cognitive Theory Dimensions Use Interactive Videos on Students?*

In the logistic regression models, where task completion is the outcome variable, and scores related to the use of interactive videos are the predictor variable while controlling for age, marital status, and teaching discipline, the association between task completion and scores was "almost" significant with a p-value of 0.024. Additionally, the scores related to cognitive theory skills in the video subject showed an "almost" substantial association with a p-value of 0.032. Moreover, scores related to the student's ideas about interactive video tools "almost" offer significant association with a p-value of 0.028.

These results can be interpreted in three ways: first, the analysis suggests a relationship between task completion and scores related to the use of interactive videos. However, the relationship is not highly significant but still noteworthy, with a p-value of 0.024. This indicates that there may be a connection between how well students perform tasks and their scores related to using interactive videos, though it is not extremely strong. Secondly, the scores related to cognitive theory skills in the context of video subjects also show a relationship with task completion, but again, the association is not very strong. The p-value of 0.032 suggests that this relationship is "almost" substantial. This means that students' cognitive theory skills in the context of video subjects might have some influence on their task completion, though it is not a highly significant factor. Finally, the scores related to students' ideas about interactive video tools exhibit a similar pattern. There is an association with task completion, but it is not highly significant, with a p-value of 0.028. This implies that students' perspectives and opinions about interactive video tools may impact their task completion, though it is not a very strong or clear relationship.

These results suggest statistically noticeable associations between the predictor variables (use of interactive videos, cognitive theory skills in video subjects, students' ideas about interactive video tools) and the outcome variable (task completion). However, these

associations are not extremely strong, as indicated by the "almost" significant terminology and the p-values ranging from 0.024 to 0.032. Further research might be needed to understand these relationships' strengths more.

The study also attempted to measure the influence of the length of video on the logistic regression model results. Of the participants, 59.8% found the video short, 31.4% were uncertain (stated 'maybe'), and 8.8% considered it not to be short. Those who found videos short (59.8%) also realized that the video content was concise. Those who found videos uncertain (31.4%, stated 'maybe') could not judge the video's length. They used the term "maybe" to describe their perception, indicating that they were neither sure whether it was short or not. Those who found videos not short (8.8%) also implied that they perceived the video as average or long duration rather than concise. In summary, these results reveal the varying perceptions of the participants regarding the video's length, with the majority considering it short, a significant portion being uncertain, and a smaller group viewing it as not short.

Afify (2020) stated that using different types of interactive videos, their length throughout learning, and student preferences are essential topics because of the results available from research and studies conducted on this variable. Simultaneously, there is a perpetual need to understand the effects of interactive video length on university students' learning performance, retention, and cognitive load. Merely 31.4% of the students indicated they had completed all assigned tasks. It suggests that a relatively low percentage of the student population completed all assigned tasks. Specifically, it means that out of the surveyed or studied students, only 31.4% reported completing their assigned tasks. This result indicates that most students did not complete all their assigned work, and it might be an area of concern or consideration for educators, tool designers, or researchers when assessing student performance or workload management. Although this result influenced external factors such as Internet connection, it is consistent with the outcomes of previous studies.

Mayer and Pilegard (2014) showed that the intrinsic load might increase because both auditory and video channels will be loaded if the information is presented quickly to the learner without enabling him or her to control the video speed and length. Moreover, the length of the interactive video, which was a long video of 36 minutes, it was rather difficult for most participants to control its speed nor could compete watching it. Therefore, the results indicated that only 31.4% of them completed the task. However, the findings from the observations of this study suggest that, despite the video length, all students understood the subject through the interactive video. Some participants completed all the tasks, while others completed only some. Those who completed some tasks could do so if they had sufficient time. In addition, diversity in practice and rewatching short videos have an essential effect on learning retention, helping students continue their performance and the connection between stimuli and responses for a long time, leading to learning and retention.

Avoiding interference between one set of ideas and another reduces forgetting and contributes to remembering and retaining learning because students are likely to forget information when ideas interfere. In addition, preventing interference and conflict between information sources through short videos focused on a specific skill at a time or a specific digital photography rule is essential in eliminating confusion caused by interference or

conflict. Avoiding was impossible with medium and long videos, which showed many varied topics and skills, leading to interference, forgetting, and, thus, the absence of long-term retention. This result aligns with the cognitive theory of multimedia learning, which states that students are more cognitively active in developing their learning skills when multimedia integrates into meaningful learning processes (Oje, Hunsu, & May, 2023; Park, 2022; Sorden, 2013). This process occurs when learners choose new information from old stimuli, attempt to complement it, and integrate it into their previous knowledge. Furthermore, the short, interactive video assists learners' engagement and interaction with the learning content. In addition, the results are supported by the theory of the cognitive processing of information, which assumes that learners' attention is limited (Rapp & Braasch, 2023). Therefore, selective attention should be given to this issue.

Based on this theory, the study concludes that short learning videos provide interactive learning activities practical for learner achievement and retention. Short videos may reduce learners' cognitive load, influence learning retention, create an appealing learning environment, increase student engagement, provide learning opportunities, and retain learning in the long term (Afify, 2020). Based on findings and experience observations, it is also concluded that education professionals or tool designers can utilize medium or long interactive videos; however, they must divide/extend studying the subject matter across two or more days of lectures or lessons.

Conclusion

This study provides a practical example of an interactive video learning experience. Thus, these interactive videos helped students to form knowledge strategies and affected their mental and psychological learning performance, as observed during the study, although the test and model results differed. Furthermore, interactive videos helped teachers explain learning content to students and deliver knowledge in more interactive and knowledgeable ways to ensure that their students acquire knowledge through guidance, observation, and feedback. Therefore, teachers must use efficient and current teaching practices to receive information from their students and save time. As per findings by Kirschner et al. (2017), multimedia possesses significant potential for enhancing the authenticity of assessments, as it can effectively replicate real-world tasks in greater detail compared to conventional paper-based assessments.

Nonetheless, research grounded in cognitive learning theories underscores the importance of prudent consideration when employing multimedia instruction. The design of multimedia materials should consider the intricacies of human cognitive processes to avoid any negative impact on performance. Thus, it is crucial to investigate different technological tools, such as interactive videos, to understand better when, where, and how to use these educational tools proficiently.

In conclusion, the study findings can be summarized as follows. First, most participants affirmed their engagement with the interactive video, and a considerable number ultimately concurred that their utilization of the interactive video aligned with their cognitive capabilities. A majority of participants also strongly agreed with statements evaluating their viewpoints on using interactive video. This finding indicates the efficacy of incorporating interactive video. Secondly, the results indicated that 90.2% of survey participants confirmed that the speaker utilized clear and casual language in the video.

Third, within the logistic regression models, where task completion serves as the dependent variable, and scores concerning the utilization of interactive videos function as the independent variable while accounting for age, marital status, and teaching discipline as covariates, the relationship between task completion and scores found to be "nearly" significant, as indicated by a p-value of 0.024. Additionally, scores associated with cognitive theory skills within the video content exhibited an "almost" substantial correlation with a p-value of 0.032. The scores related to students' perspectives on interactive video tools also displayed an "almost" significant relationship with a p-value of 0.028. Fourth, among the participants, 59.8% perceived the video as brief, 31.4% expressed uncertainty (saying 'maybe'), and 8.8% believed it was not concise. Finally, based on these observations, it was concluded that most students could understand the subject. They could complete all or some tasks, regardless of their differentiation of engagement, for reasons such as a lack of Internet connection, time consumption, and video length. However, the length of the video was the most crucial reason because if students had time to complete the task, they could do so.

The study made it evident that video-based learning is considered one of the most essential learning media to integrate with modern teaching strategies, such as micro-teaching, flipped classrooms, gamification-based learning, and mobile learning. People in the education field or tool designers can benefit from these findings that interactive video is an effective tool for delivering knowledge. Interactive digital videos are often used in e-learning to define concepts, explain texts, deliver content, and assist in events, attitudes, and processes. They are also used for scientific training, projects, collaborative learning, on-time formative assessments, and feedback.

Limitations and Recommendations

This study faced a few limitations that warrant attention in future iterations. First, the results' generalizability was constrained since data was exclusively gathered from a single college within one university in a specific geographic area. Therefore, future research must expand its scope by encompassing more universities/schools and diverse samples to enhance the external validity of the findings. Second, a dearth of knowledge exists regarding the interactions between technology tools and physiological theories due to limitations in the current research implementation. Consequently, there is a pressing need for further exploration to examine the impact and scrutinize more of these interdisciplinary scientific combinations. Third, this study did not have any time frame so it was difficult to measure with accuracy the duration of the impact of interactive videos. Future studies could consider extending the research timeframe by involving students in a longitudinal study spanning one year or more. This approach would facilitate a comprehensive assessment of the effects of specific types of interactive tools, allowing for comparisons with non-users of interactive videos. Lastly, it is essential to acknowledge that this application was primarily implemented at the higher education level. Therefore, the extrapolation of these findings to other educational levels remains uncertain. Future studies should explore this approach's applicability by conducting comparative analyses across different educational levels and disciplines, potentially applying the same design framework in K–12 settings or adult education contexts.

Based on the findings, a few suggestions and recommendations were set for designing learning environments that are conducive to interactive videos:

- Short videos should be used more often.
- Dividing the lesson into small sections using media or long interactive videos is crucial to ensure task completion.
- Consider using clear and conversational language in the designed video.
- The designed video must be straightforward, understand the content, engage watching, and presented by following hotspots, clicking buttons, taking short quizzes, sending information, and reaching the video's creator.
- The designed video must be developed based on the topic of the study subject, skills, and subskills, constructed from easy to more complex strategies and extensive exercises, provided direct feedback from the design system, applied the knowledge to the work situation, offered different responses, continues written copies as needed, and addressed motivation and beliefs about the subject.
- The video design must include guided questions and objectives about the subject, be part of the assignment, have interactive features, and contain other unique videos related to the lecture.
- More research should be conducted that connects other variables related to interactive videos.
- Additional research should investigate the dimensions of cognitive theory that use interactive videos.
- Additional research should be conducted to measure cognitive knowledge received by interactive video.
- Further research is recommended to evaluate the association between students' cognitive achievement and the skills and sub-skills imparted through videos with clear/conversational language.

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References

Afify, M. K. (2020). Effect of interactive video length within e-learning environments on cognitive load, cognitive achievement and retention of learning. *Turkish Online Journal of Distance Education, 21*(4), 68-89. https://doi.org/10.17718/tojde.803360

Alyami, A., Pileggi, S. F., & Hawryszkiewycz, I. (2023). Knowledge development, technology and quality of experience in collaborative learning: a perspective from Saudi Arabia universities. *Quality & Quantity, 57*(4), 3085-3104. https://doi.org/10.1007/s11135-022-01476-9

Brame, C. J. (2016). Effective educational videos: Principles and guidelines for maximizing student learning from video content. *CBE—Life Sciences Education, 15*(4), es6. https://doi.org/10.1187/cbe.16-03-0125

Chaiklin, S. (2003). The zone of proximal development in Vygotsky's analysis of learning and instruction. *Vygotsky's Educational Theory in Cultural Context, 1*(2), 39-64. https://doi.org/10.1017/CBO9780511840975.004

Chiu, T. K., Sun, J. C.-Y., & Ismailov, M. (2022). Investigating the relationship of technology learning support to digital literacy from the perspective of self-determination theory. *Educational Psychology, 42*(10), 1263-1282. https://doi.org/10.1080/01443410.2022.2074966

Crompton, H., Bernacki, M., & Greene, J. A. (2020). Psychological foundations of emerging technologies for teaching and learning in higher education. *Current Opinion in Psychology, 36*, 101-105. https://doi.org/10.1016/j.copsyc.2020.04.011

Davlataliyevna, S. N. (2022). Psychology and its principles. *Scientific Impulse, 1*(5), 823-826. https://nauchniyimpuls.ru/index.php/ni/article/view/2952

Dunn, D. S., Wilson, J. H., Freeman, J., & Stowell, J. R. (2011). *Best Practices for Technology-Enhanced Teaching and Learning: Connecting to Psychology and the Social Sciences*. Oxford University Press. https://doi.org/10.1093/acprof:osobl/9780199733187.001.0001

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education, 59*(2), 423-435. https://doi.org/10.1016/j.compedu.2012.02.001

Ervianti, E., Sampelolo, R., & Pratama, M. P. (2023). The Influence of Digital Literacy on Student Learning. *Klasikal: Journal of Education, Language Teaching and Science, 5*(2), 358-365. https://doi.org/10.52208/klasikal.v5i2.878

Graesser, A. C., Sabatini, J. P., & Li, H. (2022). Educational psychology is evolving to accommodate technology, multiple disciplines, and Twenty-First-Century skills. *Annual Review of Psychology, 73*, 547-574. https://doi.org/10.1146/annurev-psych-020821-113042

Hong, J.-C., Hwang, M.-Y., Szeto, E., Tsai, C.-R., Kuo, Y.-C., & Hsu, W.-Y. (2016). Internet cognitive failure relevant to self-efficacy, learning interest, and satisfaction with social media learning. *Computers in Human Behavior, 55*, 214-222. https://doi.org/10.1016/j.chb.2015.09.010

Jeganathan, S., & Shanmugam, T. (2022). Challenges in Developing 'Insight Learning in the Virtual Learning Environment with Special Reference to Gestalt Theory of Perception. *Journal of Educational and Social Research, 12*(1), 85-85. https://doi.org/10.36941/jesr-2022-0008

Karaca, C., & Ocak, M. A. (2017). Effect of Flipped Learning on Cognitive Load: A Higher Education Research. *Journal of Learning and Teaching in Digital Age, 2*(1), 20-27. https://dergipark.org.tr/en/pub/joltida/issue/55466/760080

Keskin, S. (2019). Factors affecting students' preferences for online and blended learning: Motivational vs. cognitive. *European Journal of Open, Distance and E-Learning (EURODL), 22*(2), 72-86. https://doi.org/10.2478/eurodl-2019-0011

Kirschner, P. A., Park, B., Malone, S., & Jarodzka, H. (2017). Toward a cognitive theory of multimedia assessment (CTMMA). In *Learning, design, and technology: An international compendium of theory, research, practice, and policy* (pp. 1-23). Springer. https://doi.org/10.1007/978-3-319-17727-4_53-1

Korobova, E., Kardovich, I., Konysheva, M., & Mironova, D. (2018). Cognitive Activity: Philosophical Analysis, Psychological and Pedagogical Characteristics. *SHS Web of Conferences, 50*, 01083. https://doi.org/10.1051/shsconf/20185001083

Kuhail, A. A. (2017). *The Effectiveness of Using Interactive Digital Videos on Developing Sixth Graders' English Reading Skills and Vocabulary learning and Retention* (Doctoral Dissertation, The Islamic University of Gaza). https://library.alkafeel.net/dic/details/11202

Lind, G. (2023). The theory of moral-cognitive development: A socio-psychological assessment. In *Moral development and the social environment* (pp. 21-53). Routledge. https://doi.org/10.4324/9781003419273-3

Marchand, T. H. J. (2012). Knowledge in Hand: Explorations of Brain, Hand and Tool. In R. Fardon, T. H. J. Marchand, M. Nuttall, C. Shore, V. Strang, & C. Wilson (Eds.), *The Sage Handbook of Social Anthropology* (pp. 260-269). Sage Publications. https://visa2013.sciencesconf.org/conference/visa2013/pages/Marchand_2012.pdf

Mayer, R. E. (2014). *The Cambridge handbook of multimedia learning* (2nd ed.). Cambridge University Press. https://doi.org/10.1017/CBO9781139547369

Mayer, R. E., & Pilegard, C. (2014). Principles for managing essential processing in multimedia learning: Segmenting, pre-training, and modality principles. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 316-344). Cambridge University Press. https://doi.org/10.1017/CBO9781139547369.016

Oje, A. V., Hunsu, N. J., & May, D. (2023). Virtual reality assisted engineering education: A multimedia learning perspective. *Computers & Education: X Reality, 3*, 100033. https://doi.org/10.1016/j.cexr.2023.100033

Park, E. E. (2022). Expanding Reference through Cognitive Theory of Multimedia Learning Videos. *The Journal of Academic Librarianship, 48*(3), 102522. https://doi.org/10.1016/j.acalib.2022.102522

Puspitarini, Y. D., & Hanif, M. (2019). Using Learning Media to Increase Learning Motivation in Elementary School. *Anatolian Journal of Education, 4*(2), 53-60. https://doi.org/10.29333/aje.2019.426a

Rapp, D. N., & Braasch, J. L. (2023). *Processing inaccurate information: Theoretical and applied perspectives from cognitive science and the educational sciences*. MIT Press. https://doi.org/10.7551/mitpress/9737.001.0001

Resnick, L. B. (2017). Toward a cognitive theory of instruction. In *Learning and motivation in the classroom* (pp. 5-38). Routledge. https://doi.org/10.4324/9781315188522-2

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology, 25*(1), 54-67. https://doi.org/10.1006/ceps.1999.1020

Sala, G., Tatlidil, K. S., & Gobet, F. (2018). Video game training does not enhance cognitive ability: A comprehensive meta-analytic investigation. *Psychological Bulletin, 144*(2), 111-139. https://doi.org/10.1037/bul0000139

Saleem, A. N., Noori, N. M., & Ozdamli, F. (2022). Gamification Applications in E-learning: A Literature Review. *Technology, Knowledge and Learning, 27*(1), 139-159. https://doi.org/10.1007/s10758-020-09487-x

Schunk, D. H., & Usher, E. L. (2012). Social Cognitive Theory and Motivation. In *The Oxford Handbook of Human Motivation* (pp. 13-27). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780195399820.013.0002

Sorden, S. D. (2013). The Cognitive Theory of Multimedia Learning. In B. J. Irby, G. Brown, R. Lara-Alecio, & S. Jackson (Eds.), *Handbook of educational theories* (pp. 155-167). IAP Information Age Publishing. https://www.researchgate.net/publication/267991109

Sweller, J. (2010). Element Interactivity and Intrinsic, Extraneous, and Germane Cognitive Load. *Educational Psychology Review, 22*(2), 123-138. https://doi.org/10.1007/s10648-010-9128-5

Sweller, J. (2020). Cognitive load theory and educational technology. *Educational Technology Research and Development, 68*(1), 1-16. https://doi.org/10.1007/s11423-019-09701-3

Tan, M., Li, N., Mourgues, C., Hart, L., Qataee, A., Grossnickle, M., Errato, C., & Grigorenko, E. (2022). Using Technology for the Efficient and Precise Assessment of Cognitive Skills in Countries with Limited Standardized Assessment Instruments: A Report on the Case of Saudi Arabia. *Applied Sciences, 12*(3), 1617. https://doi.org/10.3390/app12031617

Tomlinson, P. (2008). Psychological theory and pedagogical effectiveness: The learning promotion potential framework. *British Journal of Educational Psychology, 78*(4), 507-526. https://doi.org/10.1348/000709908X318672

Wen, Z., Sparks, R. L., Biedroń, A., & Teng, M. F. (2023). *Cognitive Individual Differences in Second Language Acquisition: Theories, assessment and pedagogy*. De Gruyter Mouton. https://doi.org/10.1515/9781614514749