Cognitive Load Theory in Online Education: Leveraging Interactive Media, Testing, Interaction and to Enhance Engagement and Active Learning

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Abstract— The objective of this research was to enhance content recognition and application among 23 first-year master's degree international students in the Strategic Planning and Evaluation for Integrated Communications Course at the Faculty of Communication Arts. Utilizing tools like myCourseVille Learning Management System, multimedia slides created with Spark, and teleconferencing via Zoom, the study explored the impact of interactive media on short-term memory retention and creative content application. Drawing on the Cognitive Load Theory, the findings suggest that repetitive quizzes and tests stimulate short-term memory, enhancing content recognition. However, the study emphasizes the need for questions beyond mere memory testing to foster long-term retention and deeper understanding. Learner-teacher interaction through Zoom and practical learning activities were found to foster content application. The use of diverse interactive media, tailored to the learners' level, boosted participation but also revealed potential drawbacks such as student fatigue and decreased enthusiasm for excessive memory testing. Recommendations include reducing the frequency of memory-focused tests, incorporating more diverse question types, and utilizing interactive learning exchanges that facilitate conversational knowledge exchange and feedback on student work.

Keywords— Interactive Media, Active Learning, Classroom engagement, Cognitive Load Theory

I. INTRODUCTION

The previous teaching approach in the course 2800575 Strategic Planning and Evaluation for Integrated Communications relied heavily on the technique of lecturing using PowerPoint slides. Students were only involved through observation and listening. Occasionally, there were inquiries to assess students' understanding in the classroom, but student participation was minimal. The instructors evaluated students' performance through group projects at the end of the semester, which posed challenges in assessing individual learning outcomes. Furthermore, it was not possible to measure the comprehension of fundamental principles and theories, which are crucial for applying them in advanced project management [1]. As a result, students were unable to clearly explain how the principles and theories were applied in their creative project, despite it being a vital aspect of graduate-level education [2].

For this academic semester, the COVID-19 pandemic has necessitated the implementation of fully online teaching and examination methods. This has posed significant challenges in fostering student engagement and participation. However, instructors have begun incorporating interactive digital media to address the issues encountered in teaching this course in the past academic year. For instance, they have replaced traditional PowerPoint presentations with the use of Parallax websites, which allow for a more engaging presentation of content. The instructors also link these websites to various learning resources, enabling students to access additional materials such as videos or downloadable documents. Nevertheless, it remains uncertain how effective these linked media resources are in facilitating content retention and practical application, as the literature review revealed only eight research studies on this variable [3]. In previous instances, the instructors employed Kahoot to stimulate the memorization of fundamental principles and theories relevant to project management. The instructors divided the lectures into 2-3 segments in a single session, each followed by a competitive question-and-answer session. However, it remains unclear whether this competition format aids in content retention or simply serves as a recreational activity, relying on guesswork for quick responses rather than thorough consideration to retrieve and respond with learned information. This approach may potentially hinder the desired learning outcomes [4].

After this session, the instructor administers individual knowledge assessments using the myCourseVille platform, which bears similarities to Google Forms. This approach allows students more time for reflection on the content before responding. However, it may not be as enjoyable as Kahoot [5]. The instructor anticipates that the increased awareness of higher levels of interaction, the availability of other interesting learning resources, and continuous feedback in comparison to peers in the same class and at an individual level will enable students to evaluate their learning abilities and make timely improvements [6]. Additionally, it will enhance motivation for attentive listening and critical thinking during the lectures, facilitating the effective application of principles and theories in future projects [7]. Moreover, the instructor will facilitate interactions with the students through post-lecture learning exchanges, both in group and individual formats. These exchanges will focus on practical exercises in planning and evaluating integrated communication strategies, with the aim of increasing student engagement and participation. It is expected that these activities will effectively attract students' active involvement and foster a greater sense of participation.

A. Research Objective

- To develop content retention and application through the use of interactive media, Spark, YouTube, Kahoot, and assessments in myCourseVille in Zoom classes for students in the course 2800575 Strategic Communication Management Planning and Evaluation.

B. Research Hypothesis

- After the class, students will show improvements in content retention and application compared to before the study.

C. Benefits of Instructional Development

- Students will show increased interest and participation in the learning process.
- Providing guidance for instructors to incorporate various techniques to enhance student engagement in instructional management focused on interactive lectures.

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II. Literature Review

The Cognitive Load Theory (CLT), proposed by [8], emphasizes the importance of managing cognitive demands during learning. It suggests that learning is most effective when instructional materials and activities align with learners' cognitive architecture, minimizing extraneous cognitive load and optimizing intrinsic cognitive load. This theory has profound implications for the design of interactive media, periodic testing, and teacher-learner interactions in educational contexts.

Interactive media can have varying effects on knowledge recognition. Some studies [9]-[12] suggest that the impact of interactive media on knowledge recognition is context-dependent and hinges on the specific design of the media.

Periodic testing is suggested to enhance knowledge retention and transfer [13]-[16]. The effectiveness of periodic testing appears to be maximized when feedback is provided or stronger cues are used.

Teacher-learner interaction can influence learning outcomes both positively and negatively [17]-[20]. The effectiveness of teacher-learner interaction seems to depend on various factors, including the nature of the interaction and the use of both verbal and non-verbal communication elements.

Content recognition, the ability to identify and understand presented information [21], is crucial for making connections between new information and existing knowledge, thereby facilitating meaningful learning.

The application of learned content, or the ability to transfer knowledge and skills to real-world contexts, demonstrates the practical utility of acquired knowledge. Studies [22]-[23] indicate that multimodality learning, interactivity, and active application of learned content lead to deeper understanding, improved problem-solving abilities, and increased knowledge retention.

In conclusion, both content recognition and application are vital for effective learning outcomes and the development of expertise. They contribute to the construction of meaningful mental representations and the transfer of theoretical knowledge to practical situations.

Chaiyo and Nokham [5] examined the effects of using Kahoot, Quizizz, and Google Forms on learning, attention, engagement, motivation, and satisfaction in the classroom. The results showed that students learned content through assessments conducted via Kahoot, Quizizz, and Google Forms. However, there were significant differences in the intensity of attention, engagement, motivation, and satisfaction. Furthermore, Kahoot and Quizizz received significantly better feedback than Google Forms when used in the classroom.

Forster, Weiser, and Maur [6] investigated the "impact of voluntary participation in online quizzes on university students' learning outcomes in large classrooms." The study showed that participation in online quizzes had a positive effect on learning outcomes. However, groups with lower participation in online quizzes, such as students with poor academic performance and male students, benefited more from participation compared to groups with higher academic performance and female students. Additionally, the results showed high variability in response effectiveness, indicating that intermediate factors, such as situational factors, task-related factors, and individuals' attitudes and motivations, should be further studied in future research.

Koedinger, Corbett, and Perfetti [1] conducted a literature review in various domains, including science, mathematics, and language learning, to study the framework of knowledge-learning-teaching. The researchers proposed a conceptual framework that integrates knowledge about learning and teaching, which identifies three types of learning processes: (a) memory and fluency processes, (b) inference and adaptation processes, and (c) comprehension processes. The study demonstrated that these processes lead to different types of knowledge transformations and impose limitations on selecting optimal learning and teaching approaches. Understanding the underlying principles of high-level learning processes occurs when there are high-level knowledge components. However, it is contingent upon the ability to memorize information and various rules and criteria.

Moos and Marroquin [3] conducted a study titled "Multimedia, Hypermedia, and Hypertext: Reconsidering and Examining Motivation" to investigate the role of motivation in learning environments that utilize computer-based multimedia. Through a literature review, the researchers synthesized research in the domains of multimedia, hypermedia, and hypertext. The findings from the literature review primarily emphasized the significance of learner interest in multimedia, hypermedia, and hypertext. These factors require learners to make decisions about their own learning paths, and these decisions are facilitated when learners have a high level of interest in the specific topics. The effectiveness of decision-making regarding learning paths depends on learners' prior knowledge. Learners with high interest but limited prior knowledge in a particular topic may find it challenging to make appropriate decisions about their learning paths, which can negatively impact learning outcomes. Additionally, the study highlighted that while the media used may be highly engaging if it is only tangentially related to the content, it can hinder learning effectiveness. This is because learners may become fatigued by focusing on the supplementary media and may not be able to effectively recall the core content as intended.

Nayir [7] examined the participation of students and their interest in the classroom during active learning. The study investigated the relationship between these two variables among approximately 500 high school students. The research findings revealed significant differences in the variables studied among groups differentiated by gender, school type, and grade level. Furthermore, the study indicated that learning focused on expertise development is an important predictor of classroom participation. Therefore, the level of student participation in the classroom is influenced by motivation, with motivation decreasing as grade level increases. Teachers and school administrators need to employ strategies that enhance students' motivation. Additionally, planning classroom activities that encourage increased participation among higher-grade students may be beneficial. Future research should focus on gender-related variables and examine the relationship between the role of teachers in the classroom and students' level of motivation.

Van den Bos and Brouwer [2] conducted a study titled "Teaching and Learning at the Tertiary Level: Bridging Theory and Practice." The research aimed to investigate the learning process of novice teachers in a university setting. The study followed 12 teachers during a 5-month induction program. The teachers were interviewed before and after the experiment, and they were also asked to maintain a reflective journal and submit email reports during the program. The findings revealed gradual changes in teaching practices because of the teachers' attempts to incorporate new teaching methods recommended by educational scholars. These changes were influenced by various factors, including watching instructional videos of fellow teachers, engaging in discussions, and exchanging ideas with colleagues, and experiencing personal success in teaching. These significant motivating factors supported the teachers in adopting new teaching approaches. Overall, the research data indicated that the teachers' instructional ideas and practices developed simultaneously. Therefore, it is recommended to implement suitable processes for facilitating these connections between theory and practice.

Wang and Tahir [4] conducted a study titled "The Effects of Using Kahoot for Learning." The literature review focused on the effects of using Kahoot specifically on classroom engagement, attitudes, perceptions of students and teachers, as well as student anxiety. The review included 93 studies and concluded that Kahoot has a positive impact on classroom engagement, student and teacher attitudes, and student anxiety. However, some studies indicated minimal or no effects of using Kahoot. The main challenges mentioned by students were technical issues such as unreliable internet connectivity, difficult-to-read questions and answers on the screen, inability to change answers after submission, time pressure

leading to insufficient time for responses, fear of failure, and the inability to review and understand incorrect responses. The main challenges mentioned by teachers were setting appropriate difficulty levels for questions and answers, network connectivity issues, awarding points based on response speed hindering thoughtful consideration, some students guessing answers without thinking, incomplete test coverage, and some teachers finding the technology usage challenging.

III. Conceptual Framework, Theory and Literature Review

Independent variables	Dependent variable
Interactive Media Periodic tests Teacher-learner interaction	Content Recognition Content Application

Fig. 1. Conceptual Framework.

IV. Methodology

This research employed a quasi-experimental one-group pretest-posttest design, as the target group was composed of a single group, namely the students enrolled in the course "2800575 Strategic planning and evaluation for integrated communications" in the final semester of the academic year 2021. The participants consist of 23 master's degree students in Communication Arts (International Program). The research methodology utilized a preliminary pre-experimental design to study the outcomes before and after using interactive media in online classrooms. The objective was to promote active participation and experiential learning. The details of the research methodology were as follows: E O1 X O2 where O1 represents the first measurement; O2 represents the second measurement; X represents the use of interactive media in online classrooms to promote active participation and experiential learning.

A. Research Tools

1) Teaching Tools

a) LMS Program: myCourseVille

For the course “2800575 Strategic Planning and Evaluation for Integrated Communications”, the instructor utilized the myCourseVille Learning Management System. The content was organized, including announcements and content notifications on the calendar schedule. After each session, activities were provided to encourage student engagement and post-learning discussions in the Discussions section. These discussions were subdivided into different topics corresponding to the weekly content. Additionally, pre and post learning assessments, project submissions, midterm and final exams were assigned in the Assignment section, arranged according to the weekly schedule.

b) Website: Adobe Spark

The instructor created presentation media to support teaching and learning using the Adobe Spark program, which can be accessed through a web browser. Students were able to access the media through their web browsers. The instructor organized the content into weekly sections, which were announced in the Announcements section for each respective week. Additionally, for the convenience of the students, the instructor captured the aforementioned Adobe Spark presentations by taking screenshots and saved them in PowerPoint format. These presentations were made available for students to download as PDF files, which were provided alongside the presentation link

c) Zoom Program

The course "2800575 Strategic Planning and Evaluation for Integrated Communications" were conducted entirely online, utilizing the Zoom program as the virtual classroom throughout the weeks. The instructor notified the students of the online class schedule on the myCourseVille platform, under the topic "Online meetings." During the designated class hours, both students and the instructor were able to interact with each other. Throughout the online sessions, the instructor recorded videos and saved them in the Zoom Cloud system, allowing students to review the content after the class ended. Subsequently, the instructor uploaded the recorded videos to their YouTube channel and shared them publicly.

2) Teaching Assessment Tools

a) Assessments in myCourseVille

In this teaching and learning context, the instructor designed weekly assessments to measure student learning outcomes. These assessments were announced in the "Assignment" section and in the content announcements for each week. The assessments were divided into three sessions and consisted of multiple-choice questions. The details are as follows:

- Session 1: Pre-learning assessment, including content from the week and the decision guide.
- Session 2: Post-learning assessment, including content from the week and the decision guide.
- Session 3: Pre-final exam assessment, including content from the week and the decision guide for the entire course.

b) Kahoot Quizzes

Kahoot quizzes were used for knowledge review on specific subtopics within each week's learning materials. These quizzes were interactive games played on a web browser and covered content related to the week's lessons. Each quiz had a time limit of 30 seconds per question. The quizzes were conducted in two sessions, with the following details:

- Quiz 1: Review of knowledge for subtopics covered in weeks 1-11.
- Quiz 2: Review of knowledge before the final exam, using the same set of questions as Quiz 2.

V. Results

A. Quantitative Analysis

The entire sample group of 23 participants completed the pre-test and post-test in each week using the myCourseVille assessment. The average scores before and after the use of interactive media were analyzed. The results are presented in Table I.

TABLE I. Comparison of Mean Scores before and after the Use of Interactive Media

Week	Rank	Topic	Test 1				Test 2	
			Before using interactive media		After using interactive media			
			M	*S.D.*	*M*	*S.D.*	*M*	*S.D.*
1	1	Planning weekly test	7.35	1.66	9.10	0.62	9.38	1.19
	2	Decision guide weekly test	4.52	1.59	6.09	1.33	7.36	1.43
2	1	Planning weekly test	6.78	1.32	8.68	0.62	8.67	0.50
	2	Decision guide weekly test	*	*	9.70	1.29	11.18	0.87
3	1	Planning weekly test	6.26	1.44	7.29	2.03	9.00	1.58
	2	Decision guide weekly test	9.26	2.24	10.39	1.39	11.64	1.21
4	1	Planning weekly test	6.17	1.78	6.88	1.80	8.78	0.44
5	1	Planning weekly test	6.29	1.57	6.47	1.50	8.00	1.32
	2	Decision guide weekly test	7.56	1.26	8.13	1.16	9.27	0.65
6	1	Planning weekly test	7.35	1.50	8.47	1.16	9.50	0.71
	2	Decision guide weekly test	5.39	1.72	6.89	1.99	8.47	2.03
7	1	Planning weekly test	7.44	1.97	8.38	1.54	9.50	0.85
	2	Decision guide weekly test	7.71	1.86	8.81	0.96	9.80	0.42
8	1	Planning weekly test	8.13	1.48	8.53	1.17	9.36	0.92
9	1	Planning weekly test	7.82	1.74	9.07	1.00	9.14	0.86

Week	Rank	Topic	Test 1				Test 2	
			Before using interactive media		After using interactive media			
			M	*S.D.*	*M*	*S.D.*	*M*	*S.D.*
10	1	Planning weekly test	6.50	1.34	6.67	1.35	7.45	0.82
	2	Decision guide weekly test	6.55	2.07	8.29	1.20	9.64	0.67
11	1	Planning weekly test	7.63	2.00	8.50	1.61	9.55	0.69
	2	Decision guide weekly test	5.69	2.06	6.36	1.15	7.64	0.67
13	1	Decision guide weekly test	6.36	2.95	8.64	2.29	9.36	1.21
14	1	Decision guide weekly test	6.75	2.70	8.19	1.76	9.08	1.12
	2	Decision guide weekly test	6.94	1.69	8.07	1.53	8.64	1.60

[a.] * tests were skipped.

1) Hypothesis Testing of the Mean Scores for Planning Weekly Tests in Each Week

The H_0 was set to assess whether there was a significant difference between the mean scores before and after the use of instructional media. The Planning Weekly pre-test referred to the test administered before the use of instructional media, while the Planning Weekly post-test referred to the test administered after the use of instructional media.

TABLE II. PAIRED SAMPLE T-TEST ANALYSIS OF THE MEAN SCORES FOR CONTENT RECOGNITION IN PLANNING WEEKLY TESTS

Week	Test	M	n	SD	M difference	SD difference	t	df	p-value
1	Planning weekly pre-test 1	7.16	19	1.71	1.84	1.80	4.453	18	0.000
	Planning weekly post-test 1	9.00	19	0.58					
2	Planning weekly pre-test 2	6.84	19	1.30	2.16	1.17	8.058	18	0.000
	Planning weekly post-test 2	9.00	19	0.58					
3	Planning weekly pre-test 3	6.31	16	1.35	0.81	2.17	1.500	15	0.154
	Planning weekly post-test 3	7.13	16	2.00					
4	Planning weekly pre-test 4	6.07	15	1.75	0.87	1.13	2.982	14	0.010
	Planning weekly post-test 4	6.93	15	1.71					
5	Planning weekly pre-test 5	6.00	15	1.36	0.67	1.88	1.375	14	0.191
	Planning weekly post-test 5	6.67	15	1.45					
6	Planning weekly pre-test 6	7.32	19	1.49	1.16	1.61	3.139	18	0.006
	Planning weekly post-test 6	8.47	19	1.17					
7	Planning weekly pre-test 7	7.21	14	2.01	1.14	1.41	3.040	13	0.009
	Planning weekly post-test 7	8.36	14	1.69					
8	Planning weekly pre-test 8	8.31	13	1.32	0.31	1.03	1.075	12	0.303
	Planning weekly post-test 8	8.62	13	1.19					
9	Planning weekly pre-test 9	7.71	14	1.90	-1.36	2.37	2.140	13	0.052
	Planning weekly post-test 9	9.07	14	1.00					
10	Planning weekly pre-test 10	6.69	13	1.18	0.00	1.68	0.000	12	1.000
	Planning weekly post-test 10	6.69	13	1.44					
11	Planning weekly pre-test 11	7.58	12	2.19	0.83	2.29	1.261	11	0.233
	Planning weekly post-test 11	8.42	12	1.68					

From the table II, it was observed that in each week of the Planning Weekly Test, the mean scores before the use of instructional media were lower than the mean scores after the use of instructional media. This difference was found to be statistically significant at a confidence level of .05 for a total of five weeks, specifically Weeks 1, 2, 4, 6, and 7.

2) Hypothesis Testing of the Mean Scores for Decision Guide Weekly Test in Each Week

The H_0 was set to assess whether there was a significant difference between the mean scores before and after the use of instructional media. The Decision Guide Weekly Pre-test referred to the test administered before the use of instructional media, while the Decision Guide Weekly Post-test referred to the test administered after the use of instructional media.

TABLE III. ANALYSIS OF PAIRED SAMPLE T-TEST FOR THE VARIABLE OF AVERAGE SCORES IN CONTENT RECOGNITION - DECISION GUIDE WEEKLY TEST.

Week	Test	M	n	SD	M difference	SD difference	t	df	p-value
1	Decision guide weekly pre-test 1	4.52	23	1.20	1.57	1.44	5.211	22	0.000
	Decision guide weekly post-test 1	6.09	23	1.12					
3	Decision guide weekly pre-test 3	9.19	16	2.43	1.06	2.08	2.043	15	0.059
	Decision guide weekly post-test 3	10.25	16	1.44					
5	Decision guide weekly pre-test 5	7.64	14	0.93	0.64	0.84	2.857	13	0.013
	Decision guide weekly post-test 5	8.29	14	1.14					
6	Decision guide weekly pre-test 6	5.47	17	1.46	1.35	1.27	4.386	16	0.000
	Decision guide weekly post-test 6	6.82	17	2.01					
7	Decision guide weekly pre-test 7	7.69	16	1.96	1.13	1.96	2.293	15	0.037
	Decision guide weekly post-test 7	8.81	16	0.98					
10	Decision guide weekly pre-test 10	6.90	10	1.79	1.20	1.55	2.449	9	0.037
	Decision guide weekly post-test 10	8.10	10	1.29					

Week	Test	M	n	SD	M difference	SD difference	t	df	p-value
11	Decision guide weekly pre-test 11	5.50	12	2.02	0.67	1.67	1.383	11	0.194
	Decision guide weekly post-test 11	6.17	12	1.11					
13	Decision guide weekly pre-test 13	6.55	11	3.17	2.09	2.17	3.202	10	0.009
	Decision guide weekly post-test 13	8.64	11	2.29					
14	Decision guide weekly pre-test 14.1	6.93	15	2.69	1.20	2.48	1.871	14	0.082
	Decision guide weekly post-test 14.1	8.13	15	1.81					
	Decision guide weekly pre-test 14.2	7.07	15	1.67	1.00	1.31	2.958	14	0.010
	Decision guide weekly post-test 14.2	8.07	15	1.53					

TABLE IV. THE RESULTS OF THE PAIRED SAMPLE T-TEST ANALYSIS FOR THE VARIABLE OF AVERAGE SCORE RETENTION BEFORE AND AFTER THE USE OF INTERACTIVE MEDIA.

Test	M	n	SD	M difference	SD difference	t	df	p-value
Before using interactive media	6.77	23	1.09	-1.42	1.16	5.905*	22	0.000
After using interactive media	8.20	23	0.96					

b. *The statistical significance level was set at .05

From Table IV, it is evident that the average score before utilizing interactive media significantly differs from the average score after utilizing interactive media, with statistical significance at a confidence level of .05. This indicates that the average score of the pre-interaction test is lower than the average score of the post-interaction test, with a difference of 1.42.

3) The post-test result for Test 1, and Test 2

Examining the differences in average scores after utilizing interactive media for Test 1 and Test 2 using the Paired Sample T-Test, with the H0 assuming that there is no difference between the scores of Test 1 (post-interaction) and the average score of Test 2, the analysis yielded the following results (Table V):

TABLE V. THE RESULTS OF THE PAIRED SAMPLE T-TEST FOR THE VARIABLE OF THE AVERAGE SCORE IN CONTENT RETENTION USING MYCOURSEVILLE TEST 1 AND TEST 2

Test	M	n	SD	M difference	SD difference	t	df	p-value
Test 1	8.19	15	1.06	-0.58	1.22	1.850	14	0.085
Test 2	8.77	15	1.14					

According to Table V, it can be observed that the mean score after the first interactive media usage differs insignificantly from the mean score after the second interactive media usage, with a confidence level of .05. Although the average score for Test 1 is lower than the average score for Test 2, the difference is not statistically significant, with a value of 0.58.

4) Kahoot Test

Measurement of content retention using Kahoot Test 1 and Test 2, including the number of participants who took the tests, the average scores, and the standard deviations, are presented in the following table VI.

TABLE VI. COMPARISON OF THE DIFFERENCES BETWEEN THE AVERAGE SCORES OF KAHOOT TEST 1 AND TEST 2.

Week	No.	Topic	Test 1			Test 2		
			N	*M*	*SD*	*N*	*M*	*SD*
1	1	Strategic Communication Framework	20	5.95	1.32	9	5.89	1.36
	2	Directions, Structures, Practices	17	7.76	1.09	8	7.13	1.25
2	1	Issues, Reputation & Leadership	17	7.41	1.46	9	7.67	1.41
	2	High-level Decision making	15	6.60	1.24	7	7.43	1.13
3	1	Elements of a Strategic Communication Plan	15	5.13	1.25	5	6.00	1.00
	2	Market & Non-market environment	11	6.73	0.65	5	7.20	0.84
	3	Aligning political issues	14	5.36	1.01	5	5.60	1.67
4	1	Context & Environmental Scanning	10	6.40	0.70	4	6.75	0.96
	2	Analyzing a situation	10	7.50	0.53	5	7.40	0.55
	3	Research in Strategic Communication	10	7.10	0.99	5	6.60	0.55
5	1	Writing a Situation Analysis	10	6.60	1.58	5	6.80	0.84
	2	Target Publics	15	5.53	1.30	5	5.20	1.64
	3	Segmentation of the Publics	11	7.27	0.79	4	5.00	1.41
	4	Analysis for Setting Goals and Objectives	12	6.42	0.79	4	6.50	1.00
6	1	Writing meaningful Goals & Objectives	15	7.07	0.96	6	7.00	1.10
	2	Goals, Objectives and Intercultural Communication	14	6.00	1.24	6	5.50	1.52
	3	Planning effective messages	14	6.29	1.38	6	5.17	0.98
7	1	Message Theory and types of messages	14	5.64	1.15	5	5.00	1.41
	2	Developing the Message Strategy	15	6.53	0.83	5	5.80	1.92
	3	The Role of Communication Strategies	15	6.80	0.86	5	6.40	0.89
8	1	Types of Communication Strategies	11	6.73	1.35	8	6.75	1.04
	2	Planning Tactics	11	5.91	0.70	7	6.00	1.41
	3	Tactics and Templates	12	5.75	1.36	7	5.71	0.95
9	1	Choosing Tactics	13	6.38	1.39	7	5.86	1.46
	2	Introduction to Implementation	12	6.83	0.94	8	6.75	1.39
	3	Implementation Toolkit	10	6.70	1.34	8	6.25	1.16
10	1	What is Evaluation?	6	6.33	0.82	9	6.11	1.27
	2	Making Evaluation Work	6	6.17	0.98	9	6.00	1.50
11	1	Communication Counselling Theory and Practice	7	5.71	0.95	9	4.89	1.27
	2	Communication Counselling Doing the Job	7	6.71	1.38	10	6.70	1.16

a) Kahoot Test 1 and Test 2

In general, the average scores of the Kahoot Test 1 and Test 2 were calculated. Subsequently, a Paired Sample T-Test was conducted, with H0 stating that there is no significant difference between the scores of Test 1 and the average scores of Test 2. The results of the analysis are as follows (Table VII).

TABLE VII. THE RESULTS OF THE PAIRED SAMPLE T-TEST ANALYZING THE VARIABLE OF CONTENT RETENTION MEASURED BY THE AVERAGE SCORES OF THE KAHOOT TEST 1 AND TEST 2

Test	M	n	SD	M difference	SD difference	t	df	p-value
Test 1	6.46	14	0.49	0.17	0.75	0.830	13	0.422
Test 2	6.30	14	0.55					

According to Table VII, it can be observed that the average score of Test 1 is different from the average score after using interactive media, but this difference is not statistically significant at a confidence level of .05. The average score of Test 1 is higher (0.17) compared to the average score of Test 2.

This difference may be attributed to the fact that some students may have approached Test 2 without intention, not aiming for a high score or competing with their classmates, but rather simply checking the correct answers. Additionally, the large number of tests in the

course led to boredom and decreased motivation among students when taking the tests.

B. Qualitative Analysis

TABLE VIII. SUMMARY OF THE INTERVIEW RESULTS FROM THE STUDENTS WHO USED INTERACTIVE MEDIA.

Question	Answer
To what extent does interactive media assist students in content memorization, and why?	Students perceive interactive media as a beneficial tool for content memorization. However, they recognize that the repetitive nature of learning through various quizzes and tests improves their short-term memory rather than long-term memory.
To what extent does interactive media enable students to apply the content creatively, and why?	Students feel that quizzes and tests are not beneficial for applying the learned content to assigned projects. Additionally, students perceive asynchronous weekly activities, particularly quizzes through myCourseVille and Kahoot, to focus more on repetitive memorization rather than deep learning. They find that these memory-related activities consume excessive time due to multiple repetitions of similar questions. On the contrary, students perceive the most useful form of interactive media for the Final Capstone project to be lectures accompanied by relevant supplementary materials. These materials cover (1) communication strategies, (2) operational communication plans, (3) case study presentations, (4) guidelines for writing communication plans, and (5) direct recommendations from the instructor.
What suggestions do students have to improve interactive media's effectiveness in content memorization?	Students recommend reducing the number of weekly quizzes and consolidating them onto a single platform instead of using multiple platforms to increase convenience. Multiple platforms should only be used when they offer additional features. Furthermore, students specify their preference for interactive media that facilitates interactions with instructors and classmates. They found that engaging in simultaneous Kahoot sessions during the initial weeks enhanced this sense of interaction, compared to accessing materials asynchronously and solely interacting with the media. Additionally, students suggest incorporating traditional learning methods to stimulate content retention and reducing asynchronous learning.
What suggestions do students have to enhance interactive media's ability to facilitate the application of content?	Students suggest that instructors should organize weekly interactive activities to facilitate synchronous learning, which enhances comprehension and application of the content through discussions on real-life scenarios and assigned tasks, rather than focusing solely on memorization. Specifically, students express their expectations of having opportunities to communicate with instructors and classmates, engaging in meaningful discussions regarding knowledge, opinions, and deep experiences. Additionally, students recommend an alternative approach to distributing pre-recorded 30-minute lecture videos. They propose that if instructors deliver weekly content packages through synchronous learning via Zoom and initiate classroom discussions every 30 minutes during the lecture, it would foster greater student participation. Furthermore, they suggest that instructors provide lecture materials and supplementary documents related to (1) communication strategies, (2) communication action plans, (3) case study presentations, (4) sample communication plan writing guidelines, and (5) direct recommendations prior to the First Capstone to ensure a clear understanding of the expected quality and direction from the instructor.

VI. DISCUSSIONS

The findings of this research study have led to discussions on three main topics in the analysis of research results. The details are as follows:

1) The development of content retention through the use of interactive media in Zoom classrooms, including stimulating short-term memory through the implementation of post-tests using myCourseVille and Kahoot platforms.

From the results of measuring students' knowledge before and after using interactive media, it was found that there was a significant difference in the average scores of the tests. The average score after using interactive media was higher, with a mean score of 1.42, compared to the pre-interaction test. This difference was statistically significant at a confidence level of .05.

However, in the Paired Sample T-Test comparing the scores of Test 1 (post-interaction test) and Test 2, it was found that the average score of Test 1 was lower than the average score of Test 2, with a mean score of 0.58. This difference was not statistically significant at a confidence level of .05. This suggests that the Test 1, conducted on myCourseVille with pre and post interaction divisions, effectively helps students improve their short-term memory. These findings align with the interviews conducted with the students, who felt that interactive media was a useful tool for content retention. Furthermore, the researcher believes that the repetitive nature of testing through various formats contributes to better short-term memory. Additionally, while mid-term and final exams assess long-term memory, it was found that students' scores were still related to their weekly test performance. This relationship needs to be further investigated in future research. This belief is supported by previous studies conducted by [24], which found that tests not only measure learning outcomes but also enhance content retention on a weekly basis and are beneficial for final exams. In this study, it was explicitly communicated to the students that the scores obtained from the weekly tests on myCourseVille and Kahoot were not part of their overall evaluation. The students reported feeling less stressed but still found value in using the test results to assess their own abilities and to facilitate content focus on a weekly basis. This finding is consistent with other related studies on the Testing Effect, such as [25]. The application of Cognitive Load Theory (CLT) in this context can further explain these findings. By optimizing the design of interactive media and tests, the study managed to reduce extraneous cognitive load, allowing students to focus more on the intrinsic complexity of the content. This alignment with CLT principles underscores the importance of considering cognitive load in the design of online learning experiences

2) The development of content application, including fostering learning exchanges between students and instructors through Zoom, as well as presenting planning and evaluating communication management through practical exercises.

Based on post-teaching interviews conducted over a 16-week period, it was found that the exchange of learning between students and teachers through Zoom programs in the first week of instruction allowed students to make connections between the content being taught and its real-world applications. The teachers shared their work experiences with the students, while the students shared their experiences related to planning and evaluating communication with the teacher and classmates. At times, the students utilized the vocabulary they had learned during lectures, or the videos selected by the professor and incorporated them into Spark presentations. This indicates that students began to understand the concepts of the content more effectively and were able to link what they had learned to their own experiences. This finding aligns with previous research by [26], which demonstrated that collaborative learning could enhance understanding of complex content, particularly in comprehending the rationale behind different actions. This deep understanding increases the likelihood of applying the content in future real-world contexts. In this study, the teachers assigned three tasks, with the first two tasks being group work, consisting of groups of 6-8 students. This provided students with opportunities to exchange and share their learning experiences while working together. The third task was an individual assignment that required students to draw upon their own knowledge and understanding, with the professor acting as an advisor. Each student was given time to participate in weekly discussions through Zoom meetings. The researchers found that students indicated that group work and individual assignments helped them understand the content more effectively and were particularly beneficial for applying the content in the future. This finding is consistent with [27], who implemented project-based learning and found that it promoted collaboration effectively. Students who engaged in group work demonstrated better educational outcomes compared to those who worked individually, and they were also more successful in accomplishing their project

goals. From the perspective of Cognitive Load Theory (CLT), the collaborative learning approach utilized in this study may have facilitated the management of intrinsic cognitive load by distributing the complexity of tasks among group members. This supports the notion that well-designed collaborative learning experiences can align with CLT to enhance understanding and application of complex content.

3) The development of multimodality, including utilizing diverse and proportionate interactive media that are appropriate and aligned with the learners' levels.

Based on the research findings, it was observed that there was no statistically significant difference at a confidence level of .05 between the average scores of the first and post-interaction tests. However, the average score of the first test was higher (0.17) compared to the average score of the second test. The researchers hypothesize that this might be due to some students revisiting the second test in order to review the correct answers, without aiming for a higher score or competing with their classmates. Additionally, the large number of tests in the course led to boredom and decreased motivation among students when taking the tests. This was further supported by group discussions, where some students expressed negative attitudes toward test-taking, as they believed that memory-focused exams were not suitable for graduate-level learning. Consequently, the students did not attach much importance to the tests or put forth significant effort, as the test scores were not included in the overall assessment for the course. Therefore, it can be observed that the frequency of testing, repetitiveness of exam questions, and students' goals may influence their test-taking behavior. Thus, instructors should actively participate and employ various methods beyond computer-mediated interaction, as multiple test-taking instances may lead to a decline in student engagement. Therefore, online instructors should stimulate student participation by fostering good relationships through frequent face-to-face conversations, even if they are conducted through remote conferencing programs [28].

Furthermore, students requested that the instructor provide teaching materials in the form of static images captured from the slides. This enabled them to take additional notes while listening to the lecture. The instructor fulfilled this request, indicating that although the visually appealing features of Spark presentations, such as embedded videos, linked documents, and relevant websites, were present, students still preferred to record additional notes in PDF files. This preference may be due to the convenience and familiarity of using traditional media, which aligns with the research conducted by [29]. Their study found that the majority of students (56%) continued to prefer instructional media in the form of PowerPoint slides, with only about 1 in 5 students liking to use websites or applications, even when they were designed to be user-friendly. Additionally, since this research involved interactive media for learning purposes, the participants desired media that provided informative content rather than media that merely captured their attention. This finding aligns with the research conducted by [30], which found that multimedia learning media that strongly stimulated interest resulted in a diminished focus on the main content, while media with low-interest levels failed to capture learners' attention effectively. Consequently, instructors need to design media that strike a balance in terms of appealing elements. The findings related to students' preferences for instructional media can be interpreted through the lens of Cognitive Load Theory (CLT). By choosing media that neither overstimulates nor fails to capture attention, instructors can manage extraneous cognitive load, ensuring that students' cognitive resources are directed towards understanding the content. This balance, as suggested by CLT, is crucial for effective learning in a multimedia environment.

VII. Recommendations

This study underscores the importance of interactive media in enhancing content retention and application in educational settings. Recommendations include the strategic use of interactive media in Zoom classrooms, emphasizing group discussions and practical training. Reducing the frequency of memory-focused tests and diversifying questions can enhance learning engagement. Instructors should foster synchronous learning through real-life scenarios and discussions, balancing the use of technology with traditional learning methods. The findings also suggest a need for careful consideration of the frequency and nature of testing, as well as the design of media to strike a balance between interest and focus on content. Future research should explore long-term effects and broader applications of interactive media, considering diverse learning environments and methodologies.

VIII. Conclusion

The present study has provided valuable insights into the role of interactive media in enhancing content retention and application in educational settings, specifically within the context of Zoom classrooms and platforms like myCourseVille and Kahoot. Through the lens of Cognitive Load Theory (CLT), the research findings can be summarized into three main areas, highlighting the importance of managing intrinsic and extraneous cognitive load to optimize learning outcomes.

Firstly, the study underscores the importance of interactive media in enhancing content retention, where the strategic use of tools aligned with CLT principles contributed to improved short-term memory and content focus. Recommendations include the careful design of interactive media to reduce extraneous cognitive load, emphasizing group discussions and practical training.

Secondly, the development of content application through collaborative learning was found to manage intrinsic cognitive load effectively, allowing students to connect content with real-world applications. Reducing the frequency of memory-focused tests and diversifying questions, aligned with CLT, can further enhance learning engagement.

Thirdly, the findings related to multimodality emphasize the need for instructors to strike a balance between interest and focus on content, considering CLT to ensure that students' cognitive resources are directed towards understanding the content. This involves balancing the use of technology with traditional learning methods and fostering synchronous learning through real-life scenarios and discussions.

In conclusion, this study not only highlights the effectiveness of interactive media in educational settings but also illustrates how the principles of CLT can guide the design and implementation of learning experiences. Future research should explore the long-term effects and broader applications of interactive media, considering diverse learning environments and methodologies, and further investigate how CLT can be leveraged to enhance educational outcomes.

IX. Limitations

The study's limitations include potential bias due to the main researcher's dual role as the lecturer in the course under study. The specific focus on platforms like Zoom, myCourseVille, and Kahoot may limit generalizability. The emphasis on short-term memory effects and repetitive testing could affect the insights into long-term retention and student engagement. The lack of a control group and dependence on specific technological tools may introduce additional constraints.

X. Ethical Consideration

The research was approved by reviewers at Chulalongkorn University's Learning Innovation Center. Students were informed of the study's nature and purpose during data collection, and confidentiality was maintained. The researchers and funders have declared no conflicts of interest.

The teacher and research assistants were instrumental in conducting data collection, ensuring fairness, and monitoring report interpretation, adding an essential layer of oversight.

It is acknowledged that potential bias might have occurred since the main researcher was also the course lecturer. Measures, including

the active involvement of the teacher and research assistants, were implemented to minimize this potential bias in the study's analysis and interpretation.

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