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PAPER

# Tech-Enhanced Learning: Assessing the Impact of an Innovative Microlearning Module on Postgraduate Students' Perceptions and Academic Progress

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**ABSTRACT**

The current study uses the lens of Robert Gagne's nine events of instruction and the flipped classroom approach to construct a proposed educational module to teach the instructional technology course for preservice teachers at Al Ain University in UAE. The content was broken down into small parts and presented to students through videos and interactive learning exercises. A quasi-experiment was conducted to study the designed module's effectiveness. The sample involved two groups of 50 female postgraduates from different fields of specialization. The experimental group students were taught through the implementation of the flipped microlearning module, while the control group was taught the same way, except that the educational content was conveyed without chunking. The researcher collected data by administering an achievement test and using the UTAUT questionnaire to determine student acceptance of the module. The result of the ANCOVA test revealed the existence of a substantial difference between the two groups, as $f$ reached 4.427 in favor of the experimental group, with a significance level of 0.038. The questionnaire findings indicated high student acceptance of the module. The findings are of great importance for educational policy and curriculum designers and highlight the advantages of this module in enhancing student performance in different specialist fields.

**KEYWORDS**

instructional technology, Quasi-Experiment, student achievement, flipped classroom, student perceptions, UTAUT

## 1 INTRODUCTION

The Fourth Industrial Revolution is defined by the increased use of advanced technology such as Artificial Intelligence, the Internet of Things, robots, and automation across various businesses [1]. These technologies are rapidly changing the nature of work and the skills required to succeed in the modern economy. The effects

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of IR4 on teaching are significant. As the demands of the modern workplace change, educators must adapt to prepare learners for future work [2].

Furthermore, technology is becoming increasingly crucial in the classroom, as it can enhance the learning experience by providing access to digital resources, personalized learning paths, and interactive tools. Hence, teachers must ensure that students develop the digital literacy skills required for effective navigation in the digital world. Qualifying pre-service teachers from various disciplines emerged as a problem in how to integrate technology into education, given that this vital sector is the main tributary of developing competencies for the labor market, of which technology is a pillar.

Learning an instructional technology course, however, can be challenging for pre-service teachers who have less prior knowledge and technological expertise [3]. These students require additional assistance and resources to properly understand and use technology, as well as familiarize themselves with the process of incorporating technology and digital tools into teaching and learning. Extra training, tutorials, and hands-on activities are involved in integrating technology into the classroom [4].

Moreover, using smaller meaningful chunks for learning has been done for centuries [5]. Publications on microlearning from the past 15 years continued to illustrate the importance of this approach, especially in terms of changes in technology and the needs of students and lifelong learners.

With the continuing international trend toward flexible, online, and blended learning in higher education, more research on this style of learning and its implications for student outcomes and learning experiences is required [6]. The success of learning through videos, however, depends on effective instructional design and production quality to prevent viewer frustration and ensure engagement. Microlearning can be used to maximize learning outcomes through simpler, more accurate instructional designs that can address online learning and face-to-face learning [7]. Further investigation is needed, however, on how the framework of this approach has been 'built' [8], and to evaluate its effectiveness.

In addition, instructional design frameworks offer a systematic method for designing and developing learning experiences, ensuring that each step is carefully considered and executed, so that how students think and their learning capabilities may be predicted and assessed more precisely [9]. A few instructional design paradigms are often utilized in developing educational programs. Gagne's model of nine instructional events [10] is one of the main frameworks for structuring learning material.

In microlearning, which involves delivering bite-sized pieces of information and skills, Gagne's model of nine instructional events can help ensure focused, engaging, and efficient content. It can also ensure that the microlearning lesson aligns with the target audience's needs and preferences and that it is structured to promote effective retention and transfer of knowledge and skills.

Hence, this study aims at designing and developing a module to employ a micro-learning technique based on the Gagne model of instruction, which is expected to provide an educational environment suitable for students in the educational technology course with different specializations and varying background abilities regarding the technology related concepts the course discusses, and how to employ them and transfer them to real contexts. Then the study evaluates the module's effectiveness in improving postgraduate student learning and satisfaction when studying a course from a different field.

Following the theoretical foundation of the study, the parts that follow will describe the research objectives, research methodologies, and key findings. Finally, suggestions for further study will be explored.

### 1.1 Microlearning and learning gains

Big data is crucial in developing microlearning. Human attention span is dwindling in the age of big data. According to a Microsoft poll, the average human attention span has plummeted from twelve to eight seconds, making it lower than that of a goldfish [11]. Because student attention spans are shortening, microlearning is becoming increasingly important since it emphasizes short learning duration. People today expect to learn quickly anytime, anyplace, as opposed to the conventional technique of scheduling face-to-face study periods [12].

Microlearning is an educational technique that employs educational digital resources (EDRs) to break complicated topics down into short-form, stand-alone units of study that may be seen as many times as needed. Microlearning was described by [13] as "a 'catch-all' term for a variety of new technologies and web applications used for learning with digital micro-content" associated with informal learning [5], and object learning and chunking [14].

Now microlearning is considered a type of e-learning because it is centered on interactivity, multimodality, and self-testing by learners in a relatively short time frame of five to seven minutes [15]. Microlearning is the delivery of knowledge and information to learners in small chunks or blocks focused on a specific, very narrow topic [16].

Recent studies have shown that microlearning provides the same benefits as online learning, with the added benefit of dividing the content into smaller units. Microlearning is one of the most innovative teaching methods, with several advantages in the teaching-learning process, including improved concept retention [17], increased learner engagement [18], as well as enhanced learning and performance [19].

Microlearning teaching strategies for the ICT topic in primary school for five weeks were examined [19]; in one group, microlearning approaches were used to teach the lesson, while traditional methods were used in the other. Following the testing and analysis of both groups, the microlearning group recorded around 18% greater learning than the traditional group.

Meanwhile, [15] used microlearning in a pilot study in a first-year computer architecture and operating systems course. On a final exam, the experimental group students outscored those in the control. The study also revealed that microlearning can create opportunities for students to choose resources themselves when taking charge of their learning.

Based on the findings of [20], learning analytics can give data for developing adaptive systems in which relevant microlearning items can be recommended to students to assist their self-directed multimodal learning process. [20] showed that promise exists in a system whereby a large number of films may be indexed using a data mining method with informed suggestions offered to students.

In a university classroom, the chunked content of the videos was studied for its pedagogical benefits. One of the advantages was that teacher educators used shorter YouTube video snippets, ranging from five to ten minutes in length, which might help teacher trainees understand the subject without becoming overwhelmed or losing attention as in longer videos lasting 30 minutes [21]. Even though these studies show microlearning's consequences on student learning, they do not address microlearning in short bursts but rather analyze the contents of the learning context as a whole.

In summary, previous studies suggest that microlearning improves student retention, information recall, and self-directed learning. Hence, it has a positive impact on student learning and achievement. At different stages of study, it is important to note that not all studies have found microlearning more effective than traditional methods in all situations [22]. Hence, much more research is required to completely

comprehend the impact of microlearning on postgraduate student learning and achievement. We also need to build microlearning instructional events based on a theoretical framework and a solid instructional design.

This study seeks to present a proposed educational model based on two theoretical frameworks: Gagne's Events of Instruction Model and the flipped classroom, which have proven effective in education. The study integrates Gagne's instructional approach and microlearning strategy within a flipped classroom setting to enhance student knowledge and skills in instructional technology courses for postgraduates. Gagne's instructional events serve as a framework for designing the learning activities and instructional materials. The flipped classroom involves a pre-class stage where students familiarize themselves with the content, followed by in-class sessions where the teacher provides feedback, discusses key concepts, and assesses student progress. A brief description of each is provided as follows.

## 1.2 Gagne's events of instruction model

Instructional design is the activity of carefully designing educational and training programs to increase student engagement, information intake, and retention. According to Gagne, instructional events can assist in selecting appropriate media for educational program construction. Instructional events are external happenings managed by the instructor and used to promote student learning processes. Gagne's Events of Instruction model is a framework that describes the sequence of events that should occur for learning.

Gagne [10] produced substantial contributions to the body of literature on instructional theory. His research was always a blend of modern learning theory and instructional methods. His events of instruction model have provided instructional designers with a framework for building instructional courses in which each component directly addresses scientifically validated learning principles.

Although the introduction, presentation, and practice steps of the fundamental direct instruction procedure comprise the majority of Gagne's model, the entire model offers clear guidelines for designing technology-driven instruction. Gagne suggested that the events be arranged sequentially as follows: "gain attention, inform learners of objectives, stimulate recall of prior learning, present stimulus, provide learner guidance, elicit performance, provide feedback, assess performance, and enhance retention and transfer".

Gagne's Events of Instruction approach is extensively used in educational settings and has been shown to improve student learning and success. In his study, [23] investigates the impact of Gagne's theoretical model on student achievement and IT course ratings over a semester. The intervention group participant performance test and self-perception surveys show that they have boosted their motivation and productivity.

In his research, [24] examined Gagne's instructional design while teaching procedural and content-based skills in group settings. He found that Gagne's activities give students with various preferred learning styles the requisite actual learning skills and information.

Therefore, due to the positive learning outcomes that Gagne's instructional design achieves, it was incorporated into the current study, to conduct learning experiences in which learning content chunks are presented with multimedia components to enhance student learning and engagement. Microlearning, however, should not be used as the primary form of online training or teaching since online activities are not always the ideal choice for more complex tasks, skills, or procedures [25]. Face-to-face sessions proved more successful, and mixed learning is required to improve

student learning. This can be achieved through one form of blended learning, which is flipped learning.

Details of the instructional events in this study will be presented in the methodology section.

### 1.3 Flipped classroom approach

The flipped classroom is a kind of instruction in which students view video lectures and do assignments outside of class, then use class time for group discussions, problem-solving, and other active learning activities. The basic procedure for a flipped classroom is as follows:

- Before class: Students watch videos or read assigned materials to get a fundamental knowledge of the topic.
- In class: Instead of lecturing, the teacher facilitates group discussions, problem-solving activities, and other interactive activities that build on the material covered in the pre-class assignments.
- After class: Students complete homework assignments or other activities to reinforce what they learned in class and practice applying the concepts to real-world situations [26].

The flipped classroom has been proven to have a favorable impact on student learning since the students are more actively involved in the learning process and are more inclined to retain the material [27]; besides increasing their motivation, the method enables more autonomy over their learning by making class time more interactive and hands-on [28]. This method can help students better understand the material by allowing them to study the concepts before the class, and then apply the concepts during the class; students retain the information more effectively when they interact with the material multiple times and in different ways [29].

Besides that, all kinds of multimedia, watching short instructional videos, and completing associated activities can have a good influence on student learning: animations successfully drive learner attention, hence enhancing the learning experience [30]. Also, students in the game condition had more confidence [31]. These positive research findings indicate that multimedia usage as a sort of blended-learning approach caters to many learning styles and has been proven to produce better results than typical lecture delivery [32]. Educational digital resources (EDRs) used before the class can provide all of the aforementioned if care is taken in choosing or designing them so that they influence student learning.

Although the literature generally supports the use of EDRs such as video and other multimedia in place of lectures, there is no consistency in the duration of these resources or how they work together with other resources such as presentations, book chapters, websites, games, and so on. Also, there is no shared model for the Flipped Classroom (FC) nor consensus among researchers regarding the instructional events it encompasses [33].

The current circumstances require an academic shift in the educational model to include strategies that benefit from the results of previous studies on employing microlearning and presenting it within new contexts according to the unique learning requirements and preferences of each learner.

In summary, this research emphasizes the need to use a practical, theory-based framework to provide educational settings for postgraduates with varying technological backgrounds to study and employ technological concepts during their

learning process. This research contributes to the continuing scholarly conversation about attention spans, emphasizing the critical role teachers play in modifying their instructional approaches to effectively meet students' different needs. Through the use of adaptive and comprehensive methods, the blended learning framework, which will be discussed in detail under methodology, is expected to enhance student readiness, achieve academic excellence, and promote personal growth.

## 2 RESEARCH OBJECTIVES AND QUESTIONS

Based on the above-mentioned theory and literature, we predicted that designing the events of the instructional technology course using a microlearning technique that reflected student requirements and learning styles would have a favorable influence on learning. The purpose of this study was to construct a microlearning module that met these characteristics and assess its qualities, based on student perceptions, and learning gains.

The following are the research questions:

- Does the use of the Flipped Microlearning Module in the teaching-learning process for postgraduates at Al Ain University in instructional technology courses affect their academic achievement?
- What are the postgraduates' levels of acceptance of using the flipped microlearning module in instructional technology courses?

To answer the first research question, pre-and post-tests were employed as data-gathering approaches to track differences between experimental and control class performance. To answer the second question, a learning satisfaction questionnaire was answered by the experimental group.

The following sections discuss the methodology of the study, the research objectives, the research methods, the main findings, and the implications:

## 3 METHODOLOGY

In this study, a microlearning module based on Gagne and flipped learning principles will be designed to teach the instructional technology course to postgraduate students.

### 3.1 Participants

The study was conducted on 100 female graduate students studying an instructional technology course in the faculty of education at Al Ain University. Their majors ranged from Chemistry, Mathematics, and English to Computer Science. Students were randomly and equally assigned to either the experimental group or the control group. Both groups were taught by the same instructor.

### 3.2 The pre and post-test

Procedures outlined here detail a research methodology used to assess the effectiveness of two separate teaching modules, specifically the Flipped Microlearning

course and the Flipped course, in terms of students' grasp of the subject. A pre-test and post-test assessment to gauge students' familiarity with the subject before and after the learning period, involving all students in a pre-test at the beginning to assess baseline knowledge and a post-test at the end of the semester to measure changes in acquired information, are included in the procedures. Furthermore, a validator group comprising two subject experts with 19 and 22 years of instructional technology expertise validated test items for accuracy and relevance. Their job was to ensure that test items were valid and aligned with instructional goals. A Cronbach alpha score of 0.87 was obtained for internal consistency and reliability of the complete test, suggesting a high level of internal consistency and reaffirming the assessment's reliability.

Furthermore, the processes included evaluating the quality of test items as well as their capacity to distinguish between high and low performers; the percentage of test discrimination and difficulty level were 46% and 48%, respectively. This simply implies that it meets the criteria for acceptable internal consistency [34] and may be used to assess student progress in instructional technology courses.

In summary, these procedures provide a complete framework for assessing the impact of various instructional methods on student learning outcomes, while also ensuring the validity, reliability, and consistency of the test used in the study.

### 3.3 Students satisfaction questionnaire

Based on The Unified Theory of Acceptance and Use of Technology (UTAUT), the [35] 7-point Likert questionnaire was adapted to explore the perception of student level of acceptance of using the microlearning module. The questionnaire defines four major constructs: performance expectation, effort expectation, social influence, and facilitating factors (see Table 1).

**Table 1.** Definitions of UTAUT constructs in the context of this study, adapted from [35]

| Constructs | Definition |
|---|---|
| Performance Expectancy (PE) | The degree to which using a module will provide benefits to students in performing certain activities |
| Effort Expectancy (EE) | The degree of ease associated with students' use of the module |
| Social Influence (SI) | The degree to which students perceive that important others (e.g., family and friends) believe they should use the new module |
| Facilitating Conditions (FC) | The degree to which students believe that the resources and support exist to support the use of the module |

Based on the constructions in Table 1, the questionnaire consisted of 16 items divided into four Constructs. Each construction consists of four items. All items were verified and correctly adapted to match the context of this study by three questionnaire professionals (the first expert has 18 years of experience in measurement and evaluation, the second has 21 years in educational psychology, and the third has 17 years in instructional technology).

For the following reasons, the experts eliminated one item from both constructions of Effort Expectancy and Facilitating Conditions during the validation phase:

- The question "Learning to operate the system is easy for me" was removed from effort expectancy, leaving three questions. They believed this question on instructional module management is better for instructors than students.

- The question "The system is not compatible with other systems I use" was removed from the list of facilitating conditions. Because, according to the researcher who teaches at the university research site, the students had not previously been subjected to an instructional module on this topic, so the majority of the replies to this question will be neutral.

Finally, a pilot study was carried out involving 30 students. Following that, a reliability test was performed on all survey questionnaire items, yielding a Cronbach's alpha coefficient of .92.

### 3.4 Development of the instructional events

Based on Gagne's instructional approach, this study employs an educational environment to improve student knowledge and abilities. The microlearning approach is closely related to the individual phases of flipped classrooms, which are focused on the active use of the specialized online educational environment as well as students' active engagement in class (see Figure 1).

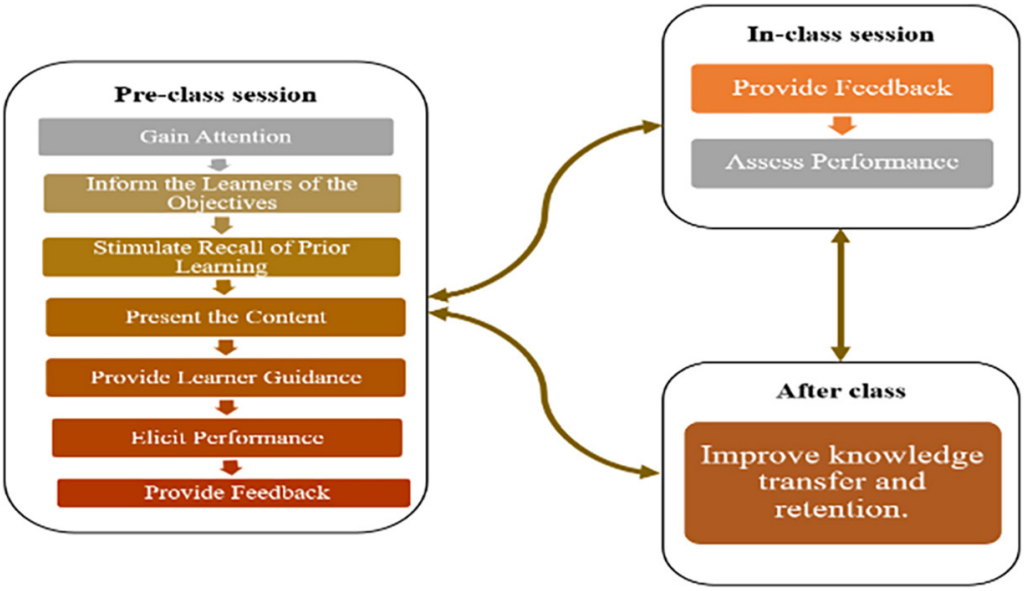


**Fig. 1.** Description of the microlearning module combines the flipped classroom method with Gagne's nine instructional events

The microlearning modules were conceived and developed with the help of three subject matter experts and two electronic content development specialists. On the other hand, the control group received instruction through flipped lectures without chunking of course content. The video duration exceeds 10 minutes in length.

Experimental group students studied in a self-directed learning environment produced by merging Gagne's nine instructional events with the flipped classroom, for teaching five topics in five weeks of instructional technology classes. The sixth week was then devoted to assessing, testing, and receiving feedback. Before implementing the course, the two groups underwent a preparatory week. The pre-test applied to the two groups also had a substantial theoretical component and was established to form a basis for starting teaching and implementing the experiment. In addition, this allowed us to pose a question of shared control, which contributed to demonstrating equivalence between the two groups.

The first topic of the Instructional Technology course is Instructional Design-related Terminology. The second topic is Integrating Instructional Technology into the Curriculum. The third is Communications, Networks, the Internet, and the World Wide Web in education. The fourth is the Application of Productivity Tools for Educators. The final topic is on Evaluating Educational Technology. The events were used to create learning activities and instructional materials for the Microlearning module (see Table 2).

**Table 2.** Arranging the events of the educational module based on Gagne's nine events of instruction through the flipped classroom

| Flipped Classroom Phases | Events for Gagne | Microlearning Instructional Rationales and Features |
|---|---|---|
| Pre-class session | Gain Attention | • Animated or still pictures were presented as the introductory material.<br>• Questions about what links this picture to the topic of the lesson to increase curiosity. |
| | Inform the Learners of the Objectives | • Each session began with a section on Learning Objectives.<br>• Students might use hypertext to return to the Objective section from a certain chapter. |
| | Stimulate Recall of Prior Learning | • Before beginning the learning portion, the "already learned" section was given. Some terms in the classes were hyperlinked to offer pop-ups for more clarification. |
| | Present the Content | • The content is presented in a chunked interactive manner by displaying it within an editable PDF page, where the student reads the content and clicks on the links for clarification.<br>• The student clicks on the video icon to watch 2 2-minute educational videos for more explanation and more visual and audio details. |
| | Provide Learner Guidance | • Displaying the content in a way that includes instructions, with guiding icons to guide the student's path while learning.<br>• To browse different areas of the material, the student was given control and instructions.<br>• Interactive tasks were included to practise newly acquired information. |
| | Elicit Performance | • An interactive video was created, including questions that the student solves at her own pace.<br>• Activities and exercises within the worksheets to give the student feedback on the extent of her understanding. |
| In-class session | Provide Feedback | • After completing the lesson, worksheets, and Kahoot questions, provide comments.<br>• This feedback includes displaying the student's answer, particular assistance, and the proper answer for incorrect tries.<br>• A quick discussion about the concepts that the student was exposed to in the pre-class session and giving comprehensive feedback on student performance. |
| | Assess Performance | • After learning through the microlearning module, students took a performance test to gauge their progress.<br>• A summary of the student's achievement was shown to demonstrate the outcomes.<br>• To encourage students, several additions were made based on the degree of success. |
| After class | Improve knowledge transfer and retention | • Use case studies to help students apply their knowledge in different contexts. This could involve analyzing a real-world scenario and developing solutions based on what they have learned.<br>• Encourage students to think about what they have learned and how they can apply it in different contexts. This could involve journaling, self-assessment, and peer or teacher feedback. |

As indicated in Table 2, students learn fundamental information through asynchronous e-learning. At this stage, student attention is drawn to the lesson topic through multimedia; such as still and moving images; or by telling a short story. The students are then informed of the lesson objectives.

Then the introduction is given by presenting prominent terms about the previous lesson or asking a question so that the student recalls her previous information. They are linked with the current lesson contents. In this stage, students interact with the course material via the Moodle platform and gain their own experiences. The student is a self-learner who interacts with the contents through short videos and

exercises and competes with her peers to solve challenges. Students, however, can discuss and converse in groups as well as with the tutor (see Figure 2).

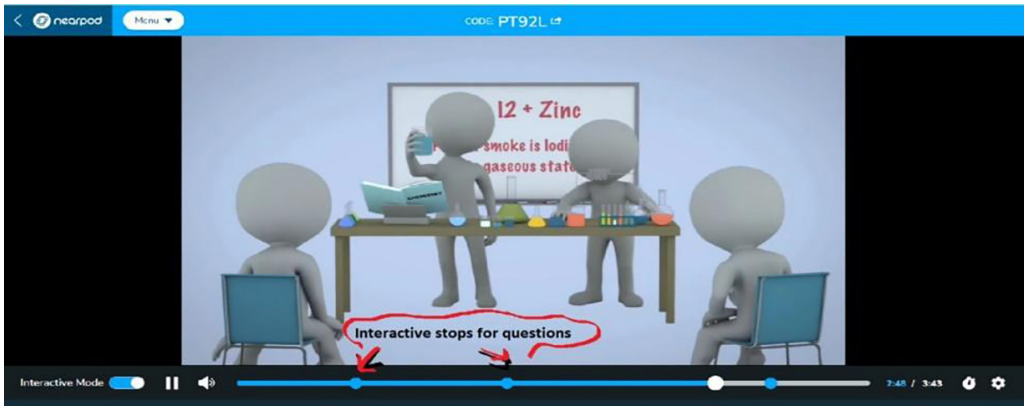


**Fig. 2.** Screenshot of one of the short-duration interactive instructional videos during the pre-class session

In the second stage, in the class, the teacher provides feedback to her students about their work on Moodle, discussing the most important concepts mentioned in the pre-class session, and student progress in the tasks. Several additions are made based on the degree of success. After class, students are invited to explore practical concerns using a case study. (example: you are a teacher in a school who wants to purchase an educational technology application for integration into the fourth-grade science teaching process. You are asked to choose the appropriate application. What criteria do you rely on in your choice?). Encourage students to think about what they have learned and how they can apply it in different contexts.

The Moodle LMS environment and Quiz format were employed, with each participant receiving randomly ordered questions for specific exam items. Multiple choice questions and open questions with a long-written answer (e.g., share and discuss your idea about the factors to be considered when selecting a technological approach for 1st–3rd graders) were utilized. The maximum test score is 20, which is spread over 30 questions. The same test was used for both the pre-test and the post-test but with the questions and alternatives jumbled.

We concentrated our study on developing and validating microlearning (ML) instructional technology lessons in the Moodle LMS. This format was selected primarily since students at the University of Al Ain frequently engage in this setting while teaching the course, both through blended learning and online courses.

At the end of the semester, the experimental group was asked to rate the module, through their responses on the Unified Theory of Acceptance and Use of Technology (UTAUT) questionnaire. The results of the tests and the survey will be discussed later.

## 4 RESULTS

The findings of analyzing the pre-and post-test scores and the results of analyzing student opinions in the experimental group through UTAUT-based questionnaire will be discussed:

### 4.1 Pre-test and post-test findings

To answer the first research question, student results on the pre-and post-tests were analyzed to explore whether the use of the Flipped Microlearning Module

affects the academic achievement of postgraduates in the Instructional Technology course accomplished by using statistical descriptive measures.

**Table 3.** The means and standard deviations of the pre-test and post-test for the experimental and control group

| Group | Pre-test | | Post-test | |
|---|---|---|---|---|
| | Mean | Std. Deviation | Mean | Std. Deviation |
| Experimental | 5.98 | 3.48 | 15.30 | 3.41 |
| Control | 5.78 | 3.43 | 13.98 | 3.32 |

From Table 3, the means of the pre-test results of the control and the experimental group appear different (5.78, 5.98, respectively). Therefore, to determine whether these differences are significant, using the ANCOVA test is considered appropriate. The results of the ANCOVA for testing the significant difference between the experimental and control groups after intervention are shown in Table 4.

**Table 4.** The results of the ANCOVA testing for significant differences between experimental and control groups

| Source | Type III Sum of Squares | Df | Mean Square | f | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Pre | 295.699 | 1 | 295.699 | 35.246 | .000 | .267 |
| Group | 37.144 | 1 | 37.144 | 4.427 | .038 | .044 |
| Error | 813.781 | 97 | 8.389 | | | |
| Total | 22586.000 | 100 | | | | |
| Corrected Total | 1153.040 | 99 | | | | |

Table 4 shows there is a substantial difference between the two groups, as f reached 4.427 in favor of the experimental group, with a significance level of 0.038. Furthermore, the table reveals that the eta square value (0.044) indicates that the Flipped Microlearning Module accounts for 4.4% of the explained variance. The module's application efficiency is rated as moderate. This could be explained by the fact that the experimental and control groups were not taught in the typical manner. The flipped classrooms had a positive effect on student achievement in the control group, while the effect of integrating the flipped classroom methodology with chunked content in the experimental group was slightly stronger. The Type III Sum of Squares for the 'group' variable ($f = 4.427$, $p = 0.038$). However, this suggests that the difference in post-test scores between the two groups was statistically significant.

**Table 5.** The adjusted means of the experimental and control groups

| Group | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| Experimental | 15.250[a] | .410 | 14.437 | 16.063 |
| Control | 14.030[a] | .410 | 13.217 | 14.843 |

*Note:* [a]Covariates appearing in the model are evaluated at the following values: pre = 5.8800.

Based on the results of Table 5, after adopting the Flipped Microlearning Module, the experimental group (mean = 15.25) outperformed the control group

(mean = 14.03). This shows that the module had a beneficial effect on the experimental group's post-test results.

## 4.2 Student Satisfaction

The result of analyzing the UTAUT-based questionnaire, which investigates student acceptance level to using the microlearning module in learning, will be presented. The students responded to a 7-point rating scale ranging from (1) Strongly Disagree; (2) Disagree; (3) Somewhat Disagree; (4) Neither Agree nor Disagree; (5) Somewhat Agree; (6) Agree; (7) Strongly Agree. Four sections assessed are Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions.

**Table 6.** Means and standard deviations of students' acceptance level for use of the microlearning module according to UTAUT domains

| Item No. | Domain | Number | Mean | Standard Deviation | Level of Acceptance |
|---|---|---|---|---|---|
| **Performance Expectancy** | | 50 | 6.70 | 0.75 | High |
| 1 | The Microlearning module is useful in my learning. | 50 | 6.68 | 0.76 | High |
| 2 | Using the module enables me to accomplish my tasks more quickly. | 50 | 6.69 | 0.75 | High |
| 3 | Using the module increases my productivity. | 50 | 6.80 | 0.74 | High |
| 4 | The module increases my chance of getting better grades in my instructional technology course. | 50 | 6.36 | 0.75 | High |
| **Effort Expectancy** | | 50 | 6.93 | 0.84 | High |
| 1 | My interaction through the Microlearning module was clear. | 50 | 6.92 | 0.86 | High |
| 2 | It is easy for me to become skillful at using the Module. | 50 | 6.92 | 0.85 | High |
| 3 | I find the module easy to use. | 50 | 6.94 | 0.83 | High |
| **Social Influence** | | 50 | 6.91 | 0.79 | High |
| 1 | People who influence my behavior think that I should use the Microlearning Module. | 50 | 6.92 | 0.78 | High |
| 2 | People who are important to me think that I should use the Module. | 50 | 6.84 | 0.78 | High |
| 3 | My lecturer has encouraged and convinced me to use the Module. | 50 | 6.96 | 0.79 | High |
| 4 | In general, my school has supported the use of the Module. | 50 | 6.9 | 0.79 | High |
| **Facilitating Conditions** | | 50 | 6.88 | 0.95 | High |
| 1 | I have the necessary tools and resources to use the Microlearning module (e.g. smartphone, PDA, laboratory tools, etc.). | 50 | 6.96 | 0.96 | High |
| 2 | I know what is necessary to use the module. | 50 | 6.9 | 0.97 | High |
| 3 | I have a specific person/group to assist me with module difficulties. | 50 | 6.78 | 0.93 | High |
| **Total** | | 50 | 6.85 | 0.83 | High |

As shown in Table 6, the mean of every aspect of UTAUT is distributed in a range (6.70–6.93), which suggests that students accept the module's usage as a supplement to their learning at a high level, referred to [36]. Findings also show a positive perception that using the microlearning module would encourage students to build great hopes for the module's role in improving their performance. Based on effort expectancy data, students found the microlearning module to be convenient and straightforward to execute. According to student perceptions of social influence, students believed that the participation of all parties involved is significant for them as it is the motivating element in pushing them to apply microlearning modules in learning. Finally, findings indicate that the students were highly positive in using the module where they believed that the support and facilities needed were available.

## 5 DISCUSSION

This study aimed at developing and evaluating the impact of a microlearning module on postgraduate student academic achievement in an instructional technology course in comparison with the flipped environment without chunking the delivered course content and measuring student satisfaction with the designed Flipped Microlearning Module. The findings revealed that incorporating microlearning techniques led to improved learning outcomes for postgraduate students.

Following the flipped class sequence gives students the possibility to get a head start on the content to be covered in class by reviewing it at home. Some students have the confidence to ask and work on questions posed by instructors in front of the entire class. These results are consistent with previous research conducted by [37] and [38]. Furthermore, the study demonstrated that repeated exposure to short instructional videos and exercises significantly influenced student learning experience in the instructional technology field. This finding can be justified by the idea that college students can only pay attention for about 10–15 minutes of a 50-minute presentation [39].

Reintroducing lessons in smaller chunks can help students retain knowledge and prevent forgetfulness, leading to long-term memory retention. A study [40] concluded that a combined teaching approach involving videos and other visual information is easier for learners to memorize or internalize in short durations, and greatly impacts student learning outcomes. Simultaneously teaching theoretical and practical instructional technology content using instructional aids resulted in greater subject comprehension and more sustainable learning. [41] discovered that, in comparison to conventional expository learning, this has a significant influence on how students learn and gives them the chance to study individually and address difficulties in class.

This kind of instruction has made it unnecessary for teachers and students to be present in the classroom physically and has allowed for learning to take place in unstructured settings. Watching instructional films allowed oral hygiene students to learn more and develop their cognitive and motor abilities [42]. Applying instructional techniques that encourage the active participation of students is a successful way to improve their learning, especially in computer and technology courses [15].

The inclusion of Gagne's 9 events of instruction changed how students learned favorably. The nine events of teaching gave a framework and allowed instructors to develop their pedagogical competence while maintaining a student-centered approach. The occasions offered a foundation upon which to build each week, thus improving the student learning environment [23].

Furthermore, the results of the questionnaire indicated that students found the flipped microlearning module useful for their course and it encouraged them to continue their learning. These findings are significant and support the two-year investigation of [15] who found the students had general satisfaction with higher education in technical and humanities fields.

This module worked on presenting the short content to students at their own pace, which improved their productivity and increased their self-efficacy to gain more understanding and thus foster better achievement. While microlearning, however, efficacy may be compromised if the learner lacks the required background to connect with the learning objective [43].

Despite the scarcity of empirical studies on flipped microlearning instructions, the findings of this study suggest that the flipped microlearning module increased learning more than conventional FC instruction, which was consistent with prior studies such as [44] and [45]. However, microlearning content or tasks should be balanced, thought-activating, investigative, disputable, and valuable, not just in small and sweet bits.

## 6 CONCLUSION

The major contribution of this study is to prove that students in the class taught using flipped micro-lectures outperformed their counterparts who were taught through traditional flipped classes. Teachers must use a learning strategy that fits the learning outcomes and student needs. According to this study, learning outcomes are significantly impacted by utilizing micro-lectures as supplemental learning media in instructional technology classes. The students also showed general satisfaction with using the module during their learning

Our flipped microlearning courses, which show educational videos, games, assignments, and quizzes posted to a module, let students improve by trying again after failing an attempt to learn the material and enabling them to develop skills connected to the instructional technology course.

In summary, the findings contribute greatly to the field of instructional technology by giving empirical evidence of the Flipped Microlearning Module's effectiveness in improving academic attainment and generating good student attitudes. The findings add to previous knowledge by highlighting the potential of creative teaching approaches to improve learning outcomes and student satisfaction in higher education.

According to the author, very few studies have compared student outcomes in flipped microlearning and the traditional flipped learning methodology. Future research should keep examining this learning method and its effects on student outcomes and learning experiences as flexible, blended, and online learning continues to gain traction in higher education. This work allows teachers and educators from different schools to follow such a microlearning framework; it also serves as a guide to help content creators consistently develop microlearning content in other educational courses to save time. It also provides decision-makers with an educational framework that recommends conducting other studies on its effectiveness and the extent to which students and teachers accept it.

The study's shortcomings point to certain areas that need more investigation. First of all, this study only looked at a small portion of instructional technology courses for postgraduate students, whereas other resources may provide different outcomes. As a result, it is necessary to examine how micro-lectures affect other subjects and educational levels. Second, because it only comprises a brief

intervention—six weeks—the utilization of micro-lectures may be limited by the learning media's novelty. It is advised that a longitudinal study be conducted with a bigger sample size to determine the impact of this strategy and investigate other teaching frameworks for enhancing student learning outcomes.

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