

ผลการจัดการเรียนรู้แบบผสมผสานด้วยเทคโนโลยีเมตาเวิร์สร่วมกับเทคนิคเสริมต่อการเรียนรู้เพื่อส่งเสริมสมรรถนะการเรียนรู้รายวิชาศิลปะการประกอบอาหารของนักศึกษาระดับปริญญาตรี

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บทคัดย่อ

การศึกษาวิจัยครั้งนี้มีวัตถุประสงค์เพื่อ 1) ศึกษาคุณลักษณะของสื่อสนับสนุนการเรียนรู้แบบผสมผสานด้วยเทคโนโลยีเมตาเวิร์สร่วมกับเทคนิคเสริมต่อการเรียนรู้ในการจัดการเรียนรู้รายวิชาศิลปะการประกอบอาหารของนักศึกษาระดับปริญญาตรี กลุ่มตัวอย่างเลือกจากอาสาสมัครนักศึกษาระดับปริญญาตรีชั้นปีที่ 3 สาขาศิลปะการประกอบอาหาร วิทยาลัยดุสิตธานีจำนวน 60 คนมาร่วมกิจกรรมและวัดระดับสมรรถนะการเรียนรู้ทั้งสามด้านคือ 1) ด้านพุทธิพิสัย 2) ด้านทักษะพิสัย 3) ด้านจิตพิสัย โดยเครื่องมือที่ใช้ในงานวิจัยแบ่งออกเป็น 2 ระยะ ระยะที่ 1 พัฒนาสื่อสนับสนุนการเรียนรู้แบบผสมผสานด้วยเทคโนโลยีเมตาเวิร์สร่วมกับเทคนิคเสริมต่อการเรียนรู้เครื่องมือที่ใช้คือ 1) แบบสัมภาษณ์แบบกึ่งโครงสร้างข้อคำถามสัมภาษณ์ความคิดเห็นของผู้ทรงคุณวุฒิต่อการเลือกใช้เทคโนโลยีสื่อสนับสนุนการเรียนรู้ 2) แผนการจัดการเรียนรู้รายวิชาศิลปะการประกอบอาหารร่วมกับสื่อสนับสนุนการเรียนรู้ 3) สื่อสนับสนุนการเรียนการสอนรายวิชาขนมไทยด้วยเทคโนโลยีเมตาเวิร์สร่วมกับเทคนิคเสริมต่อการเรียนรู้ ระยะที่ 2 ศึกษาผลการใช้สื่อสนับสนุนการเรียนรู้แบบผสมผสานด้วยเทคโนโลยีเมตาเวิร์สร่วมกับเทคนิคเสริมต่อการเรียนรู้เครื่องมือที่ใช้คือ 1) สื่อสนับสนุนการเรียนรู้ด้วยเทคโนโลยีเมตาเวิร์สร่วมกับเทคนิคเสริมต่อการเรียนรู้ 2) แบบประเมินสมรรถนะการเรียนรู้ การศึกษานี้ใช้การวิเคราะห์ผลทางสถิติ Dependent t-test ในการเปรียบเทียบผลการเรียนรู้ด้านพุทธิพิสัยก่อนและหลังและผลสมรรถนะการเรียนรู้ด้านทักษะพิสัยกับจิตพิสัยใช้สถิติทดสอบ One sample t-test วิเคราะห์ผลสมรรถนะการปฏิบัติงานเปรียบเทียบกับเกณฑ์คะแนนผ่านที่ร้อยละ 80

ผลการศึกษาพบว่า คุณลักษณะของสื่อสนับสนุนการเรียนรู้ด้วยเทคโนโลยีเมตาเวิร์สร่วมกับเทคนิคเสริมต่อการเรียนรู้ได้แก่ 1) ด้านเนื้อหาของบทเรียน 2) ด้านการจัดการเรียนการสอน 3) ด้านสื่อและกิจกรรม 4) ด้านเทคโนโลยีทางการศึกษา โดยใช้ควบคู่กับฐานการให้ความช่วยเหลือของเทคนิคเสริมต่อการเรียนรู้ ผลระดับสมรรถนะด้านพุทธิพิสัยของผู้เรียนหลังเรียนสูงขึ้นอย่างมีนัยยะสำคัญทางสถิติที่ระดับ 0.05 ผู้เรียนผ่านผลทดสอบด้านทักษะพิสัยที่ค่าเฉลี่ยร้อยละ 89.36 ($Mean=4.47$, $S.D.=2.51$) และผ่านผลทดสอบด้านจิตพิสัยที่ค่าเฉลี่ยร้อยละ 84.94 ($Mean=4.25$, $S.D.=4.14$) จากเกณฑ์มากกว่าหรือเท่ากับร้อยละ 80 ของคะแนนการปฏิบัติการทั้งหมด การศึกษานี้สรุปคุณลักษณะของสื่อสนับสนุนการเรียนรู้ที่พัฒนาได้ดังนี้ 1) เป็นสื่อให้ความรู้แบบย่อยส่วน 2) มีกิจกรรมที่ผู้เรียนมีส่วนร่วม 3) มีกิจกรรมที่สร้างปฏิสัมพันธ์ระหว่างผู้เรียนและผู้สอน

คำสำคัญ: เทคโนโลยีเมตาเวิร์ส เทคนิคเสริมต่อการเรียนรู้ การจัดการเรียนรู้แบบผสมผสาน สื่อสนับสนุนการเรียนรู้ สมรรถนะการเรียนรู้

The Effect of blended learning with Metaverse technology and Scaffolding technique to enhance learning competency of undergraduate students in Culinary Arts course

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Abstract

This research investigated the effect of blended learning with metaverse technology and scaffolding technique. The study aimed to (1) identify the features of metaverse classroom that promote student learning competency and (2) Evaluate the effect of blended learning with Metaverse technology and Scaffolding technique on the learning competency of undergraduate students. The sampling group comprised of 60 volunteer third-year undergraduate students from the Culinary Arts program at Dusit Thani College. Their learning competence was assessed across three domains: cognitive, psychomotor, and affective. The research was conducted in two-phases. Phase 1 developing the blended learning support media, by using 1) semi-structured interviews with experts on technology selection, 2) Thai dessert art lesson plans integrated with the support media, and 3) the instructional media incorporated with metaverse technology and scaffolding techniques. Phase 2 evaluated the effectiveness of the developed media by using a quasi-experimental on a participant group, using 1) the blended learning support media (metaverse technology with scaffolding techniques), and 2) a learning competence assessment form. The cognitive performance before and after was compared by using a Dependent t-test. Psychomotor and affective performance was analyzed using a One-sample t-test against a criterion score of $\geq 80\%$.

The findings revealed that the characteristics of effective learning support media integrating metaverse technology and scaffolding techniques, included: 1) lesson content, 2) learning and teaching management, 3) media and activities, and 4) educational technology with a scaffolding framework. The results showed a statistically significant increase in students' post-learning cognitive domain scores ($p < 0.05$). Students passed the psychomotor domain test with an average of 89.36% (Mean = 4.47, S.D. = 2.51) and the affective domain test with an average of 84.94% (Mean = 4.25, S.D. = 4.14), both exceeding the 80% passing criterion for total practical scores. This study concludes that learning support media should be characterized by: 1) Micro-learning unit, 2) learner-participatory activities, and 3) activities fostering interaction between learners and instructors.

Keyword: Metaverse, Scaffolding, Blended Learning, Learning Support Media, Learning Competency

Introductions

The pervasive influence of technology on daily life has driven a significant shift in education, particularly with the transition from Society 4.0 to Society 5.0. This evolution has prompted the widespread adoption of technology for instructional delivery, communication, and collaborative learning, aiming to enhance the efficiency and effectiveness of achieving educational goals. The global upheaval caused by the COVID-19 pandemic and subsequent social distancing protocols further accelerated this trend. This "New Normal," defined by Pacheco (2021) as a technologically integrated lifestyle, necessitated a radical overhaul of educational paradigms. The result of this change is making the education move toward Blended Learning (BL), where traditional classroom instruction was supplemented or replaced by online platforms (Adedoyin & Soykan, 2023), utilizing tools like Zoom and Google Meet for interaction and Learning Management Systems (LMS) such as Moodle and Google Classroom for content delivery. While this digital transformation has offered new avenues for learning, it has also exposed significant challenges, particularly in vocational fields like the culinary arts. During an online learning situation, data from Dusit Thani College reveals that students struggled to adapt to online learning, citing the lack of interactive and engaging content on the LMS as a major barrier. Furthermore, the shift hindered effective group collaboration and led students to rely on unverified online sources, undermining learning objectives. This aligns with findings from Din, Haron, and Rashid (2016), who highlighted the critical link between a supportive learning environment and a student's capacity for self-directed learning. A separate graduate survey at Dusit Thani College indicated that while graduates excelled in practical skills (S) and professional attitudes (A), their performance in academic knowledge (K) was notably weaker. This discrepancy suggests a fundamental imbalance in the culinary curriculum, which, as Jonathan Deutsch (2018) argues, remains rooted in the traditional culinary study, practice-heavy models of Auguste Escoffier, who himself advocated for the constant evolution of culinary education to avoid becoming an "illogical" practice. The current curriculum's emphasis on hands-on practice often limits the time available for crucial theoretical instruction, which encompasses scientific, historical, and economic principles, thus leaving graduates with a deficit in foundational knowledge.

To address these multifaceted issues, this study proposes an innovative approach that combines Metaverse technology with the Scaffolding technique to create a more effective and engaging blended learning environment. The Metaverse offers an immersive, virtual space where students can interact and practice skills in a simulated reality, while the Scaffolding technique, based on Vygotsky's Zone of Proximal Development (ZPD) (Çelik & Ersanlı, 2025), provides structured, guided support. This approach involves three key steps: Modeling to inspire and demonstrate concepts, Breaking Down complex tasks into manageable parts, and encouraging and providing continuous feedback to support student progress.

This research will apply this innovative framework to the subject of Arts of Thai Dessert. As a vital part of Thailand's cultural heritage, the preservation and promotion of this culinary art form are mandated by the National Education Act of 1999. However, teaching resources for Thai desserts are often static, lack interactivity, and fail to capture the invaluable, often unrecorded, knowledge of local artisans. Therefore, this study aims to develop and evaluate a Metaverse-based blended learning tool using Gather.town application, augmented by Scaffolding, to enhance students' learning competencies across all three domains: knowledge, skills, and attitude. This initiative seeks to provide a dynamic, interactive, and culturally rich learning experience that not only preserves a traditional art form but also equips students with the self-directed learning skills essential for success in the 21st century.

Research Objectives

1. Identify features of Metaverse classroom that promote student learning competency
2. Evaluate the effect of blended learning with Metaverse technology and Scaffolding technique on the learning competency of undergraduate students.

Scope of the Study

The population of this study has been divided into two phases. Phase 1: consisted of a sample group comprising three experts in culinary arts education and three experts in educational technology. These experts were purposively selected based on their qualifications and professional experience relevant to the objectives of developing instructional media and blended learning models. Phase 2: the sample group comprised undergraduate students majoring in Culinary Arts at Dusit Thani College. A purposive sampling method was employed, selecting 60 third-year international program students who voluntarily participated in the experimental activities.

The content used in developing the blended learning with Metaverse technology and scaffolding techniques included topics such as the development of learning models, Learning with metaverse technology, and instructional strategies using scaffolding techniques and the detailed content related to Thai dessert culinary arts, on the topic of Thai dessert from rice and rice products.

Literature Review

A systematic review of pertinent literature was undertaken to inform and guide the development of this study. The study of Kim & Lee (2021) examined factors influencing self-directed learning in culinary practice courses and found that although multiple variables contribute to learning outcomes, the two most critical foundations for effective online instruction are the quality of instructional content and the design of the learning environment. High-quality materials and well-structured digital spaces were shown to enhance learners' motivation, immersion, and satisfaction in online culinary education. The development of learning tools that support the student in self-directed

learning and doing activities outside the classroom by creating a virtual classroom where students and facilitators can meet and share information outside the classroom.

Similarly to the study of Lee & Hwang (2022) demonstrated that technology-enhanced instruction, particularly through VR creation and Metaverse learning environments, can strengthen sustainable learning practices when instructors clearly define learning objectives and design purposeful digital experiences. Their findings highlight the potential of immersive technologies to promote autonomy and long-term engagement in learners.

The study by Junsheng Huang (2022) applied scaffolding techniques to develop learning media for teaching Teochew fermented soybean cuisine. A “Construction and Practice of Online Course Resources Based on Information Processing Theory: Taking ‘A Bite of Teochew Cuisine,’ a Guangdong First-Class Course, as an Example” found that scaffolding not only helped learners understand the ingredients and cooking processes unique to Guangzhou’s local fermented soybean dishes, but also supported cultural preservation by making this culinary knowledge accessible to interested learners through online platforms.

From the concept of the literature review, researchers develop a Metaverse classroom as a space to provide learners with Thai dessert information, an online practical and group work space by using the scaffolding technique in guiding the students' self-learning in this developed virtual classroom.

Research Methodology

This study employed a quasi-experimental research design with a one-group pretest-posttest design. The sample was selected from third-year students enrolled in the academic year 2024 at Dusit Thani College. The study using one topic of Arts of Thai Dessert class, Thai desserts from Rice and Rice products to develop a learning tool and conducted a week experiment to test the effectiveness of learning tool at Dusit Thani College, Thailand. The research was conducted in two distinct phases:

Phase 1: Development of the Blended Learning Tool

In this phase, the blended learning tool, integrating Metaverse technology with scaffolding techniques, was developed. A purposive sample of six experts was selected to provide input and evaluate the tool: three experts in culinary arts instruction and three in educational technology. The qualification of Culinary arts experts are those experts with at least ten years of experience teaching culinary arts in higher education and involvement in curriculum planning. Those experts were provided insights on the integration of Metaverse and scaffolding for the Arts of Thai dessert class and evaluated the lesson plans. Educational Technology Experts are those experts holding relevant qualifications and academic positions. Those experts assessed the quality of the learning tool.

Phase 2: Evaluation of the Blended Learning Tool's Effects

The second phase focused on evaluating the effectiveness of the developed tool. The population for this phase consisted of all 69 third-year undergraduate students in the Culinary Arts

program at Dusit Thani College, enrolled in the 2024 academic year. The sample size was determined using the Krejcie and Morgan sample size table, with a 95% confidence level and a 5% margin of error, resulting in a required sample size of 60 participants. A volunteer sampling method was used to recruit third-year students who had completed all foundational culinary arts and practical kitchen courses from their first and second years. The study focused on a specific module within the course IFM4316 Arts of Thai Dessert, concentrating on the lesson of "rice and rice products." The experiment involved participants in a blended learning activity centered on making "Khao Tom Mat" (steamed sticky rice with banana). The intervention spanned one week, with a total of 15 hours of blended learning. This included 10 hours of online self-study in the Metaverse classroom and 5 hours of in-person practical instruction in a kitchen laboratory. The in-person sessions were divided into 2 hours for theoretical and demonstration lectures and 3 hours for hands-on practice. The research instruments using multiple-choice questions for knowledge competency evaluation and Kitchen operation observation rubric for skills competency evaluation and attitude questionnaire question for affective competency evaluation. The results were statical analyzed using a dependent t-test to compare the learning performance in the cognitive domain before and after instruction. The statistical measures employed included the Mean and Standard Deviation (S.D.). For the analysis of psychomotor and affective domains, a One-sample t-test was applied. The performance outcomes were analyzed by comparing them against the accepted criterion score of greater than or equal to 80 percent.

Research Results

Phase 1: Development of the Blended Learning Tool

Based on interviews with three experts in culinary arts instruction, a consensus was reached on the essential characteristics for a blended learning tool utilizing Metaverse technology and scaffolding techniques. The experts' feedback was crucial for guiding the development of the learning resource. The experts' recommendations on the use of a Metaverse-based tool for Thai dessert making can be summarized into four key areas:

1. Content: The tool should offer a combination of theoretical knowledge and practical skills, covering both the history and techniques of Thai dessert making.
- 2 . Instructional Approach: It should support a blended learning model, leveraging educational technology to enhance student learning beyond the traditional classroom.
3. Media and Activities: All learning materials and activities must be concise, easy to understand, and varied to effectively motivate and stimulate self-directed learning.
4. Technology: The chosen technology must facilitate and promote interaction between students and instructors during learning activities.

The experts also highlighted several limitations of traditional Thai dessert instruction. They noted that in-class time is often insufficient to cover theoretical content and supplementary learning activities. Moreover, students frequently access inaccurate information from external sources prior to class, which can hinder the learning process. After presenting various Metaverse applications, all three experts unanimously recommended using Gather.town. They agreed that its features best aligned with the desired characteristics for a supportive learning environment. Following this recommendation, the researcher developed the blended learning tool using Gather.town, incorporating scaffolding techniques to structure the selection of media and activities within the virtual classroom.

The learning activity plan for the Thai Dessert Making course, which integrates Metaverse technology and supplementary learning media, was evaluated by experts in culinary arts instruction. The plan, specifically for the lesson on rice and rice products, was found to be highly appropriate and consistent with the learning objectives.

The experts' consensus was reflected in a high average opinion score of 4.94 out of 5 (*Mean* = 4.94, *S.D.* = 0.13), indicating a very high level of agreement.

Table 1 Level of opinion on the learning activity plan integrated with learning media supported by Metaverse technology in relation to the learning objectives of the subject Arts of Thai Dessert: Rice and rice product in Thai dessert preparation lesson (n=3)

Criteria	Mean	S.D.	Level of agreement
1. The Learning plan aligns with the learning objectives	5.00	0.00	Strongly agreement
2. The Learning objective aligns with the lesson content	5.00	0.00	Strongly agreement
3. The Learning objective aligns with the learning activity	5.00	0.00	Strongly agreement
4. The Learning objective aligns with the assessment method	5.00	0.00	Strongly agreement
5. The Learning activity can assess student cognitive competency	5.00	0.00	Strongly agreement
6. The Learning activity can assess student skill competency	5.00	0.00	Strongly agreement
7. The Learning activity can assess student affective competency	5.00	0.00	Strongly agreement
8. The learning activity in the Metaverse classroom supports soft skills development	4.67	0.47	Agree
9. The media, innovations, and learning resources used in each activity are appropriate for the allotted time and can be practically applied	5.00	0.00	Strongly agreement

Criteria	Mean	S.D.	Level of agreement
10. The evaluation criteria and indicators effectively reflect learner quality in accordance with learning standards, benchmarks, and learning outcomes	4.67	0.47	Agree
11. The evaluation method is suitable for the learning activity provided	5.00	0.00	Strongly agreement
Total Mean	4.94	0.13	Strongly agreement

The Metaverse-based learning media for the Thai Dessert Making course, developed on the Gather.town platform, was evaluated by three educational technology experts to evaluate the quality of development virtual classroom. The experts' consensus was that the media was of the highest quality, with an average rating of 4.58 ($Mean = 4.58$, $S.D. = 0.19$) on a 5-point scale. The agree rating results on criteria 8 and 10 were commented with added more learning activities to stimulate soft skills development and evaluation criteria should related to learning outcome of the topic. The highest-rated aspects of the media included:

- **Accessibility:** The learning media is easy to access.
- **Usability:** The user interface is intuitive and easy to understand.
- **Design:** The screen layout and overall design are appropriate.
- **Aesthetics:** The color scheme and background are suitable for presenting information.
- **Personalization:** The media is responsive to individual differences among learners.
- **Flexibility:** The lesson structure is flexible, allowing students to control their learning pace.

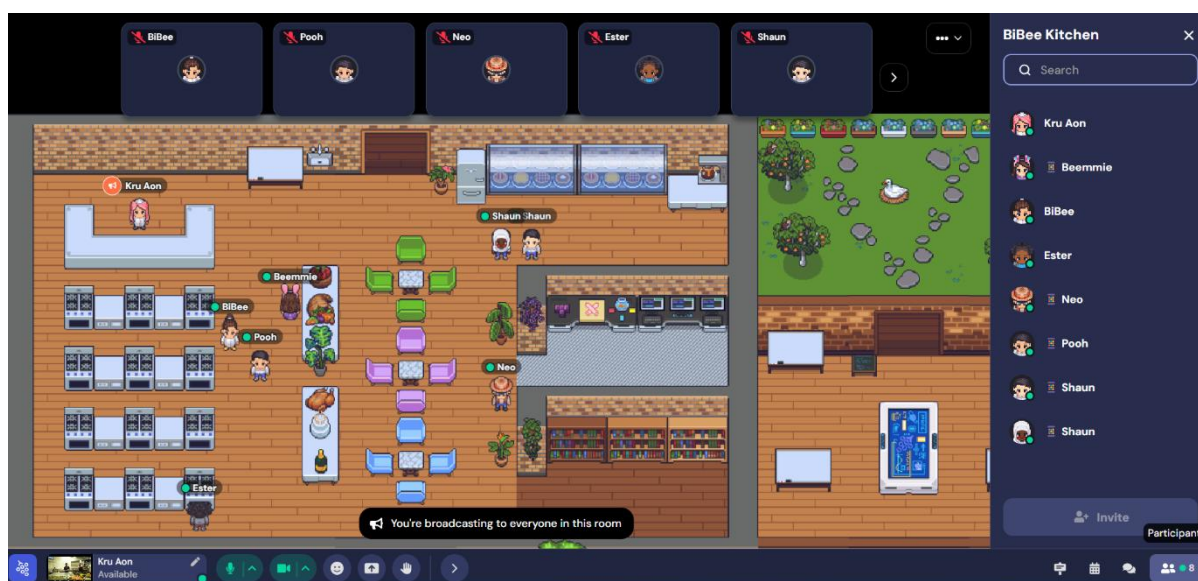


Figure 1 The Gather.town metaverse classroom application

Phase 2: Evaluation of the Learning Tool

The second phase of the study evaluated the effectiveness of the blended learning media on the learning competencies of undergraduate culinary arts students. The experimental group consisted of 60 third-year students from the International Professional Culinary Arts program at Dusit Thani College, none of whom had prior experience with the Thai dessert course. To measure the impact of the intervention, the following methods were used:

Cognitive (Knowledge) Domain: This was assessed using a pre- and post-test of a 20-question multiple-choice test, with a total score of 20 points.

Psychomotor (Skill) Domain: An instructor-led observation was used to evaluate practical kitchen skills. A rubric scoring system with 10 criteria was used for assessment, each of criteria have value from 1-5 points for a total score of 50 points.

Affective (Attitude) Domain: The students' professional attitudes were also assessed by the instructor through observation using a rubric scoring system with 6 criteria, each of criteria have value from 1-5 points for a total score of 30 points.

The results, as presented in the upcoming table, will detail the students' performance across these three competency domains.

Table 2 The result of learning competency domains

Learning Competency	Average Score	Mean	S.D.	Criteria
Cognitive Competency (Passing criteria ≥ 10 marks)				
- Pre-test	4.93	4.93	1.96	Fail
- Post-test	10.37	10.37	2.07	Pass
Skill Competency (Passing criteria $\geq 80\%$ of total practical mark)	89.36	4.47	2.51	Pass
Affective Competency (Passing criteria $\geq 80\%$ of total practical mark)	84.94	4.25	4.14	Pass

Following an intervention that utilized a blended learning model with Metaverse technology and scaffolding techniques, students showed a notable improvement across all three learning domains. In the cognitive domain, the mean pre-test score of 4.93 ($S.D. = 1.96$) more than doubled to 10.37 ($S.D. = 2.07$) on the post-test, meeting the passing criteria. In the psychomotor (skill) and affective (attitude) domains, students also performed well, achieving average scores of 89.36% ($Mean=4.47$, $S.D.=2.51$) and 84.94% ($Mean=4.25$, $S.D.=4.14$) respectively. These results indicate the model's effectiveness in enhancing students' knowledge, practical skills, and professional attitudes.

Table 3 Comparison of the Mean Scores of learning performance in the cognitive domain before and after instruction in the learning activity Thai Dessert-making Arts: Lesson on Rice and Rice Products (Passing criterion ≥ 10 points) ($n = 60$)

Score	Mean	S.D.	Std. error mean	Sig.
Before	4.93	1.96	.253	0.031*
After	10.37	2.07	.267	

* $p < 0.05$

From Table 3, The study found that the level of learning performance in the cognitive domain, specifically knowledge related to Thai dessert-making arts, of learners after participating in the learning activity on Thai dessert-making (Lesson on Rice and Rice Products), supported by Metaverse-based learning media combined with scaffolding techniques, showed post-test scores significantly higher than pre-test scores.

Table 4 Comparison of the Mean Scores of learning performance in the psychomotor domain after instruction in the learning activity Thai Dessert-making Arts: Lesson on Rice and Rice Products (Criterion $\geq 80\%$) ($n = 60$)

Criteria	Score Percentage	Mean Score	S.D.	t
1) Ingredients mise en place	87.6	4.38	0.67	87.86
2) Selection of the ingredients for cooking	100.0	5.00	0.00	0.00
3) Working station and equipment mise en place	86.4	4.32	0.57	86.96
4) Banana work preparation	100.0	5.00	0.00	0.00
5) Cooking sticky rice for Khao Tom Mud	79.4	3.97	0.55	-8.45
6) Wrapped Khao Tom Mud with banana leaf	81.6	4.08	0.59	21.03
7) Correction of cooking process	97.4	4.87	0.50	269.77
8) Correction of flavor profile	97.0	4.85	0.44	299.65
9) Food presentation	81.6	4.08	0.59	21.03
10) Hygiene and food sanitation	82.6	4.13	0.50	40.31
Total Score (Mean)	89.36	4.47	2.51	28.89

* $p < 0.05$

From Table 4, the results of measuring the level of learning performance in the psychomotor domain revealed that most learners achieved an average level of performance exceeding or equal to 80 percent. The mean score was 89.36% ($Mean = 4.47$, $S.D. = 2.51$) of the total practical scores, which was statistically significant at the 0.05 level.

Table 5 Comparison of the Mean Scores of learning performance in the affective domain after instruction in the learning activity Thai Dessert-making Arts: Lesson on Rice and Rice Products (Criterion $\geq 80\%$) ($n = 60$)

Criteria	Score Percentage	Mean Score	S.D.	t
1) Teamwork attitude	77.40	3.87	0.60	-33.55
2) Culinary professionalism	76.40	3.82	0.47	-59.41
3) Ethical conduct in kitchen work	88.00	4.40	0.64	96.86
4) Operation responsibility	90.00	4.50	0.54	143.45
5) Food and waste management	88.00	4.40	0.59	104.97
6) Time management	90.00	4.50	0.50	155.04
Total Score (Mean)	84.94	4.25	4.14	9.24

* $p < 0.05$

From Table 5, it can be concluded that after learners participated in the instructional activity on Thai Dessert-making Arts: Lesson on Rice and Rice Products, supported by Metaverse learning media combined with scaffolding techniques, their average level of learning performance in the affective domain met the evaluation criterion, with a mean score of 84.94% ($Mean = 4.25$, $S.D. = 4.14$), which was statistically significant at the 0.05 level.

Conclusion and Discussions

The blended learning model demonstrated its potential to replicate the learning benefits of a physical classroom. The use of the Metaverse as a learning tool, combined with scaffolding, was crucial for promoting active learning and student engagement. This integrated approach, which included electronic resources and preparatory activities, effectively improved knowledge, practical skills, and social interaction. This is in line with Jomah, Masoud, Kishore and Aurelia's (2016) work on micro-learning as a modern educational system.

The Metaverse allowed for rich instructor-student interaction, mirroring the classroom experience. Instructors were able to provide telementoring and offer personalized guidance as students practiced independently. Activities like virtual field trips and guest speaker seminars further enriched the learning experience and reinforced competencies. The design of the platform, which required students to interact with hidden content, also aligned with Mucundanyi's (2020) systematic review, identifying strategies such as timely instructor feedback, active participation, and pre-class communication. These approaches significantly improve student satisfaction and engagement in online courses. The strategic use of scaffolding facilitated students' self-directed learning and problem-solving skills, leading to significant improvements in analytical thinking, decision-making, and positive attitudes. This aligns with the findings of Dutta (2024) on the importance of reflective activities in promoting self-

directed learning. The effect of developed blended learning media on competency can be discussed in individual aspects below.

1. Cognitive Domain

The study found a significant improvement in students' cognitive competency after the blended learning intervention. A comparison of pre- and post-test scores on Thai dessert knowledge revealed that students performed significantly better after the intervention. This increase in knowledge is consistent with research by Khlaisang (2015), which highlights the effectiveness of the E-Learning system in Blended Learning Environment to enhance cognitive skills in fostering higher-order thinking skills, and examines the impact of e-learning environments on cognitive development in adult learners by Kassymova (2020).

The Metaverse classroom positively influenced cognitive development. Students found that infographics and other visual media helped them grasp complex scientific and material-related information more easily than traditional textbooks. This is consistent with Diaz Redondo's (2021) findings on the effectiveness of micro-learning in e-learning environments. The ability for students to revisit video demonstrations and practice independently before class not only boosted confidence but also freed up valuable class time for instructors to facilitate in-depth discussions and provide more individualized guidance. This approach fostered active learning and soft skill development, a result also supported by Dorodchi's (2020) research.

2. Psychomotor Domain

Following their self-directed learning in the Metaverse, students demonstrated a high level of practical skill in the hands-on kitchen lab. Their average performance was 89.36% ($Mean = 4.47, S.D. = 2.51$), which significantly exceeded the 80% passing threshold for practical skills ($p < 0.05$). This success is attributed to students' ability to review demonstration videos and practice virtually with the instructor before the in-person class. This finding aligns with Skalizky's (2023) research, which showed that e-learning during the COVID-19 pandemic boosted students' confidence in their culinary skills.

The psychomotor competency, which does not meet passing criteria is on “cooking sticky rice for Khao Tom Mud” may reflected on the quality of cooking video clip that might not be focused enough detail on this aspect.

3. Affective Domain

Students also achieved a high level of affective competency, with an average score of 84.94% ($Mean = 4.25, S.D. = 4.14$), exceeding the 80% passing standard ($p < 0.05$). This result is supported by Sergeyeva's (2022) work on integrating educational components with Metaverse technology to foster ethical and other developmental learning. The use of online seminars with guest speakers, group activities, and virtual exhibitions played a key role in developing students' work ethic and positive attitudes toward Thai dessert making. The affective domain score observed by instructor during the practical class using rubric criteria scheme for kitchen operation attitude in summative assessment at

the end of intervention might not be cover overall affective criteria for the learning outcome, design of other affective domain formative assessment method would help in deep understanding of attitude changed by self-directed learning through blended learning with metaverse learning media combined with scaffolding techniques. The affective domains, which are involved in hands-on practical experience like teamwork and culinary professionalism, can only be achieved by learning in a practical classroom. The students' performance does not reflect the effectiveness of the developed learning media, but it's the performance of the students in the practical classroom only. Creating more group work in the Metaverse classroom might help the students' coworking attitude toward the practical classroom.

In conclusion, integrating Metaverse technology with scaffolding techniques offers a flexible and powerful learning environment. It effectively boosts student engagement and motivation while comprehensively developing competencies in the cognitive, psychomotor, and affective domains. This approach offers a promising way to elevate the quality of instruction, equipping students with the skills and attributes necessary for 21st-century learning.

Recommendations

This study successfully demonstrated the efficacy of a blended learning model that integrates Metaverse technology with scaffolding techniques to enhance student competencies in culinary arts education. The intervention resulted in significant improvements across the cognitive, psychomotor, and affective domains, validating the model's potential to address the limitations of traditional instruction. By providing an engaging and interactive virtual environment, the approach not only boosted students' foundational knowledge and practical skills but also fostered positive professional attitudes and self-directed learning. The findings suggest that this innovative integration of technology and pedagogical strategy is a highly effective way to elevate the quality of culinary arts education, preparing students with the comprehensive skills and dispositions required for the 21st-century workforce.

The study employed a one-group pretest-posttest design that suits a quasi-experimental study to focus on the effectiveness of developed teaching methods on classroom format participant. It provides a practical way to establish cause-and-effect relationships in real educational settings while maintaining a balance between rigor and feasibility. However, for further study on the different between conventional teaching methods and blended learning with metaverse learning media and scaffolding techniques, using two group comparison will show more specific viewpoint of improvement between two groups and giving more detail of effective of developed learning media on student competencies.

To build on this success, instructors should focus on two key areas. First, they must properly prepare students for this blended learning format by explaining its importance, how to use the Metaverse platform, and how to access telementoring and learning materials. Content should also be strategically structured, assigning simpler recipes for self-study and reserving complex ones for in-class

demonstrations, in line with scaffolding principles. Second, future research should explore the model's application to novice students and leverage more advanced virtual reality technologies as they become more accessible. By continuing to refine this approach, we can ensure that culinary education remains at the forefront of pedagogical innovation.

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