

A Micro-Learning Approach with Artificial Intelligence for Improving Skills in Designing the Movement of In-Game Characters and Using Mixed Reality

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Abstract—This research aims to use artificial intelligence technology to create micro-learning approach. The goal is to develop students' skills in designing character movements to look more realistic and interesting, as well as in using Mixed Reality (MR). This research was conducted in the form of a cross-sectional study and a literature review. During October–December 2024, the sample population were recruited from among undergraduate students at the Faculty of Mass Communication Technology, Multimedia Technology, and Rajamangala University of Technology Thanyaburi. The research data were collected from a total sample of 30 students through a questionnaire to assess whether micro-learning approach with artificial intelligence technology can be used to develop skills in character movement design in game design and utilizing mixed reality. The research results found that this learning format is very effective. In terms of the quality of the content and learning media, it has an average score of 4.85 ± 0.03 (the highest quality). As a result, learners can effectively develop important skills and engage strongly in the learning process. The use of mixed reality technology enhances the immersive and engaging learning experience for learners. This learning style is extremely effective and suitable for developing movement design skills for in-game characters.

Keywords—micro-learning, Artificial Intelligence (AI), skills in designing character movements, Mixed Reality (MR)

I. INTRODUCTION

Education and learning must adapt to keep pace with changes in technology, especially in the game design industry, which is a highly competitive field requiring specialized skills to create quality work. In game design, characters and their movements are crucial elements that impact the player's experience and require specialized skills to create. Artificial Intelligence (AI) technology can help students and game designers develop the skills needed to design the movement of game characters. It is used in micro-level learning approaches [1, 2] and is considered one of the significant developments in modern educational strategies. In addition, mixed reality also has the potential to create a lively and useful learning experience [3]. This research focuses on exploring micro-learning approach using artificial intelligence and mixed reality technologies. It is expected that the research will help create a lively learning experience and offer new solutions to prepare game designers for the digital age. The data obtained from the study may also be beneficial in developing future educational programs.

This research aims to explore micro-level learning patterns using artificial intelligence technology and the integration of

mixed reality in developing skills for character movement design in games. This will involve analyzing the effectiveness and impact on learners, with the expectation that this research will provide a new approach to studying and developing skills in the game design industry and serve as a valuable database for developing future educational programs. This will help us see the opportunities and challenges in using new technologies. In terms of the development of appropriate solutions to better prepare game designers in this digital age, the use of artificial intelligence technology to help develop a new learning system allows those interested in game design to learn and improve their character creation skills more effectively. Additionally, the incorporation of mixed reality technology aids in learning and creating characters with greater realism. The researcher has conducted a study on the micro-learning approach using artificial intelligence technology to develop skills in character movement design in game design and utilizing mixed reality and evaluated their effectiveness in these areas.

II. LITERATURE REVIEW

This section provides a literature review on the application of artificial intelligence technologies to create a micro-learning approach for improving skills in character movement design, game design, and mixed reality technology. It discusses data analysis with a focus on the potential benefits and challenges of real-world use, combined with relevant references to support the research.

A. Micro-Learning

Micro-learning has become an increasingly popular approach to learning in recent years. It focuses on learning in small amounts through short-term modules or activities that are easily accessible and convenient. This approach is used in a wide variety of fields, including education, in-house training, and personal skills development linked to technology. Micro-learning or bite-sized learning facilitate the acquisition of knowledge by targeting external cognitive loads, increasing working memory, and transmitting content through educational technologies [4]. Micro-learning refers to a short-term learning approach that allows learners to access information in a need-oriented and situation-specific manner. It is effective in developing certain competencies, including tactical, professional, language, self-learning, social, and digital competencies, especially in organizations [5]. Micro-learning is an educational strategy

that uses short, interconnected learning activities to teach small pieces of content [6]. It consists of brief, focused learning sessions, each typically lasting four to six minutes. Designed to effectively present specific content, this approach enhances personalization by adapting to the learner's background, preferences, and progression, facilitating better engagement and understanding of programming education [7]. Micro-learning focuses on presenting multimedia content scattered into small pieces that are easily fused, making it possible to access information quickly. It enhances engagement and learning, making it ideal for mobile learning and tackling complex topics through the sequential organization of content [8]. Micro-learning consists of short, informal web-based learning modules that can be accessed at the convenience of the learner. It leverages cognitive science insights to enhance memory integration through focused and repetitive learning units and caters to individual preferences on the topic in terms of place and time [9]. Micro-learning is the process of learning in smaller portions, using short lessons in different formats such as text, audio, or video [10]. In summary, micro-learning is a learning approach that responds to the needs of learners in the digital age. It helps to increase learning efficiency and skill development in a short period of time. However, it is still necessary to consider the limitations and challenges that arise in order to make the most effective use of micro-learning in the future.

B. Artificial Intelligence

Artificial intelligence refers to the concept of computers that simulate human sensory abilities and mimic cognitive functions such as learning and problem-solving [11]. Artificial intelligence is a rapidly advancing technology with the goal of creating intelligent agents that surpass human capabilities and has the potential to make significant social and military impacts, including the differentiation of general and narrow AI [12]. Artificial intelligence uses technology to perform tasks that are traditionally done by humans. It is transforming various industries and could boost Gross Domestic Product (GDP) growth in both advanced and emerging markets [12]. AI is a multidisciplinary field that aims to automate tasks that require human intelligence [13]. Jiang [14] discusses the techniques and applications of artificial intelligence in various fields of engineering, including problem-solving. Artificial intelligence consists of Machine Learning (ML) and technology, such as natural language processing. Neural networks and inference algorithms aim to mimic human thought and behavior [15]. AI has had a significant impact on various sectors, elevating technologies such as automobiles, design languages, and robotics, as well as smartphones and medical devices [16]. AI involves the creation of intelligent machines with complex task capabilities, including ML and Deep Learning (DL), which move towards Artificial General Intelligence (AGI) [17]. Artificial intelligence has become an important technology employed in daily life and across many sectors, with rapid development in both theory and application. Current research continues to focus on improving performance, as well as reducing restrictions and using AI ethically while benefiting society in a sustainable manner. This study provides a summary of how artificial intelligence

is used to support this research. The mentioned study employs artificial intelligence to aid in research on micro-learning approach focused on developing skills in character movement design in games. By applying AI, this approach utilizes technologies such as machine learning, natural language processing, and possibly deep learning to provide an effective learning experience. The goal is to create an intelligent system that promotes the development of skills in character movement design in mixed reality environments, which will enhance both the educational process and technical outcomes in game design.

C. Skills In Designing Character Movements

Designing character movements is an essential part of creating various gaming experiences and digital media to make players feel connected and engaged with the characters. Studies on this topic have reflected on the skills, techniques, and procedures needed to design high-quality movements. Character movements not only make the characters look interesting, but also affect the narrative and mood of the game or digital media. Eom *et al.* [18] considers an optimization framework that generates a variety of character movements for tasks such as jumping and flipping, emphasizing movement and shape variety through parameterized controls, constraints, and distance measurements. Two key skills in designing character movements are movement and manipulation. One paper offers a method that separates the planning of these movements while coordinating them. It uses motion graphs for movement and cyclic kinematic methods for management modifications [19]. Another work involves the development of controllers for simulating real-time movement skills such as standing, walking, and rolling balance, with an emphasis on using common component sets and optimizations to effectively model the movement skills of various characters in animation. High-level task objectives for character movements can be specified using a simple reward function, while low-level styles are obtained from unstructured animation clips. This eliminates the need for manual design and enables automatic skill elements through learning to mimic opponents [20]. Traditional writing tools require programming skills. This makes designing character movements challenging for beginners. A proposed gesture writing system simplifies this process. It allows users to easily create and modify character behavior without having to learn in detail beforehand [21]. Character movement design requires an understanding of mannequin control mechanisms, limitations in detecting hand movements, and the adoption of kinematic-based methods [22]. Designing character movements through a data-driven deep reinforcement learning framework allows characters to imitate a variety of motion clips. This method (Skills From Videos, SFV) allows physically simulated characters to learn movements from videos, leveraging deep posture estimation and reinforcement learning. This approach allows for quick character control design [23]. This involves skills in synthesizing movements according to physics and using spacetime optimization and dynamic constraints to create complex multi-character movements. It emphasizes the ability to adapt limited input movements to a variety of interactions, demonstrating the versatility of character movement design [24], and the importance of creating a motion field that allows for real-time user control and

operation within a continuous configuration area. It allows for streamlined and realistic character movements, which effectively respond to user commands and external interference [25]. Character movement design is a skill that requires practice and understanding in many areas, including movement mechanics, emotional expressions, and the use of modern technology. Developing high-quality motion design skills is therefore essential to create memorable and valuable play experiences in the digital media and gaming industry.

D. Mixed Reality

MR involves a combination of virtual content and real-world elements. It can create experiences that allow users to see and interact with virtual objects in the context of what is around them. Mixed reality merges the real world and the virtual one. It uses technologies such as augmented and Virtual Reality (VR) [26], which facilitate natural social interaction and nonverbal communication, as shown in the Martian collaboration simulation [27]. MR allows physical objects to interact with virtual objects and can increase immersion by combining real-world environments with virtual environments, as demonstrated in the development of the mixed reality real-time strategy [28]. Mixed reality allows users to interact with digital models of objects, such as robots, in a seamless manner. This improves user interaction and management in dynamic situations. This is especially true in industrial environments [29]. It improves design, education, and healthcare by simulating experiences, enhancing usability, and providing immersive learning and training opportunities [30]. It allows users to interact with both physical and digital elements [31]. Mixed reality involves the combination of physical and digital environments to create immersive experiences, including Augmented Reality (AR), VR, and other mixed realities. It opens up new opportunities to improve experiences in many areas and is a potential tool for transforming learning. It will greatly improve design and collaboration in the future. It is also important in the field of education, allowing learners to undergo immersive learning experiences, such as classroom simulations created by this technology, which enable students to learn better from hands-on experience [32]. This study uses MR technology to help research on micro-learning approach aimed at improving the skills to design the movements of in-game characters. Using MR with AI will help students learn better by letting them better understand and control how characters move in games. This will also make learning more realistic and meaningful in a variety of settings, such as using this technology to create classroom simulations.

E. Objectives of the Research

- 1) To synthesize relevant elements and micro-learning approach with artificial intelligence technology to improve the skills of designing in-game character movements and using mixed reality.
- 2) To create a micro-learning process with artificial intelligence technology to improve the skills of designing the movements of in-game characters and using mixed reality.
- 3) To evaluate the process and the use of micro-learning approach with artificial intelligence technology to improve the skills of character movement design in games and using mixed reality.

F. Research Framework

This research has a conceptual framework as shown in Fig. 1. From character movement design in games, micro-learning, AI, and platforms, micro-learning and AI develop intelligent micro-learning and smart platforms. These components increase gaming character movement design skills utilizing micro-learning and artificial intelligence. A mixed reality blend improves skills. The abilities taught include game industry expertise, virtual reality technology, real-time responsive character movement design, continuous learning, problem-solving, and originality in character movement design. This paradigm promotes modern game design flexibility and skill development.

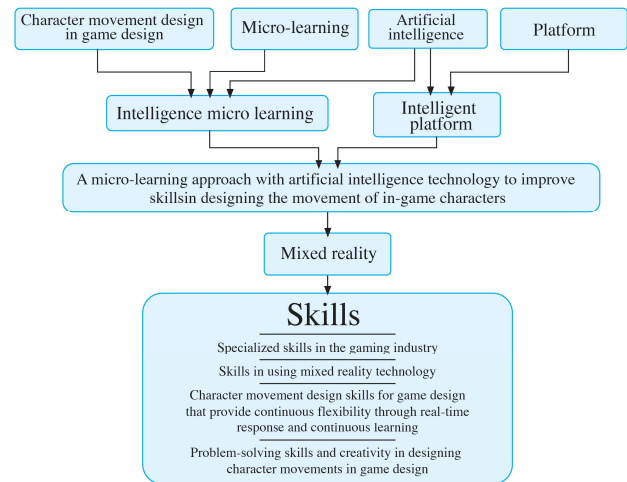


Fig. 1. Research framework.

III. METHODS

The study was divided into three phases, as follows:

Phase 1: Synthesize elements and micro-learning approach with artificial intelligence technology to improve skills in designing in-game character movements and mixed reality engagement. The operation process is as follows: Synthesize elements of using artificial intelligence technology to improve skills in designing the movement of in-game characters and the participation of mixed reality. We conducted searches in the ScienceDirect, SpringerLink and Scopus database, using the search terms Micro-learning, artificial intelligence, skills in designing character movements, mixed reality, and then the results from the synthesis of elements and evaluation results are used to the micro-learning approach using artificial intelligence technology to improve the skills in designing the movement of characters in the game and the participation of mixed reality.

Phase 2: Design the micro-learning approach process using artificial intelligence technology to develop skills in character movement design in games and mixed reality engagement. Then, evaluate the micro-learning approach process using artificial intelligence technology to develop skills in character movement design in games and mixed reality engagement. This will involve three experts in artificial intelligence technology, three experts in character movement design in games, and three experts in mixed reality engagement, totaling nine participants for the evaluation. Subsequently, create video scripts for use in micro-learning with artificial intelligence technology to develop skills in

character movement design in games and mixed reality engagement through applications such as Chat GPT, Gemini, etc. The result was a jpg file using the Meshy AI method to generate character movements by converting text to 3D. The outcome was an MP4 file that uses an animation image file to create a movement using a blender. The micro-learning materials with artificial intelligence technology to improve skills in designing in-game character movements and mixed reality were then published for engagement through a smart platform. These used mixed reality technology glasses to create virtual images that can interact with the real environment. Real-time audio-visual processing was available.

Phase 3: The use of micro-learning approach with artificial intelligence technology to improve skills in designing character movements in games and using mixed reality was then evaluated.

A. Research Format

A cross-sectional study of the results of utilizing a micro-learning approach with artificial intelligence technology to improve skills in designing the movement of characters in the game and using mixed reality was generated from a sample of 30 students. During October–December 2024, the population and sample population were recruited from among undergraduate students at the Faculty of Mass Communication Technology, Multimedia Technology, and Rajamangala University of Technology Thanyaburi. These included bachelor students studying science and technology from the Faculty of Mass Communication Technology, Multimedia Technology, and Rajamangala University of Technology Thanyaburi who met the following criteria: 1) they were undergraduate students who were over 18 years old and registered for the character design course in game design; and 2) consented to participate in the research. The exclusion criteria encompassed: 1) incomplete response to the research questionnaire.

B. Tools Used

This research used a quality assessment form to assess the usage of micro-learning approach with artificial intelligence technology to improve skills in designing the movement of characters in the game and using mixed reality. Part 1 included general information about the respondents. Part 2 involved a questionnaire to evaluate the use of micro-learning approach with artificial intelligence technology to improve skills in designing character movements in games and using mixed reality by presenting data on the approach, mean, and Standard Deviation (SD) where 4.51–5.00 means the highest quality, 3.51–4.50 means very high quality, 2.51–3.50 means medium quality, 1.51–2.50 means low quality and 1.00–1.50 means the lowest quality. The total average of the mean and standard deviation was utilized to analyze the quality against the established evaluation criteria.

C. Instrument Test

The instrument was tested to evaluate the accuracy of the questionnaire using a total of five experts, with an Item-Objective Congruence (IOC) value of 0.89.

D. How We Collected Information

We clarified the details of the project to the participants about the purpose and method of conducting the research. 2) We described how to utilize the micro-learning approach with artificial intelligence technology to improve the skills of designing the movements of in-game characters and using mixed reality with the samples. 3) We collected data to evaluate the usage of the micro-learning approach with artificial intelligence technology to improve these skills through Google Forms. 4) We analyzed the results. Data analysis: 1) We analyzed the descriptive statistics presenting general data on the study participants and micro-learning outcomes using artificial intelligence technology to improve skills in designing the movements of characters in the game and using mixed reality.

Table 1. Content elements for learning the movement skills of the characters in the game

Content elements for learning the movement skills of the characters in the game	[33–35]	[36]	[37]	[38]	[39]	[40, 41]	[36]	Researchers
In-game character movement design skills	✓	✓		✓	✓	✓	✓	✓
Movement control skills of the characters in the game	✓	✓	✓	✓		✓		✓
The game character's environmental response skills	✓		✓	✓	✓	✓	✓	✓
In-game character design skills	✓		✓		✓	✓	✓	✓
Animation skills of in-game characters	✓	✓		✓		✓	✓	✓
The game character's environmental response skills	✓	✓	✓	✓	✓		✓	✓

IV. RESULT

The researchers synthesized the elements and modeled the micro-learning model with artificial intelligence technology to improve the skills of designing the movement of in-game characters and using mixed reality. The micro-learning model consists of five components: 1) the content element of

learning the movement skills of the characters in the game; 2) the artificial intelligence technology to develop the movement design skills of the characters in the game; 3) the platform for learning the movement design skills; 4) the mixed reality technology to learn the movement skills; and 5) the skills gained from the use of the micro-learning model, as shown in Tables 1–5.

Table 2. Artificial intelligence technology elements to improve the movement design skills of the characters in the game

Artificial intelligence technology elements to improve the movement design skills of game characters	[41]	[42, 43]	[44]	[45]	[46, 47]	[47]	[48, 49]	Researchers
Data analysis to learn the movement design skills of characters in the game	✓		✓		✓		✓	✓
Creating in-game character movements	✓	✓	✓	✓		✓		✓
Using artificial intelligence technology to create learning materials for in-game characters	✓	✓		✓	✓	✓	✓	✓

Table 3. Platform elements to learn the skills of designing the movement of the characters in the game

Platform elements to learn the skills of designing the movement of the characters in the game	[50, 51]	[52]	[53, 54]	[55]	[56, 57]	[58, 59]	[60, 61]	Researchers
Intelligent platform	✓	✓	✓	✓	✓		✓	✓
Intelligent interactive learning	✓		✓	✓		✓		✓
Intelligent user integration	✓	✓		✓	✓	✓		✓
Intelligent virtual learning platform	✓	✓	✓		✓	✓	✓	✓

Table 4. Mixed reality technology elements to learn the movement skills of the characters in the game

Mixed reality technology elements for learning the movement skills of in-game characters	[62, 63]	[64]	[65, 66]	[67, 68]	[69]	[70]	[71]	Researchers
Display		✓		✓	✓	✓	✓	✓
Tracking		✓	✓		✓		✓	✓
Virtual content creation		✓	✓		✓	✓		✓
Interaction		✓	✓	✓	✓	✓	✓	✓

Table 5. Skills gained from utilizing micro-learning approach with artificial intelligence technology to develop skills in motion design of characters in game design and using mixed reality

Skills gained from utilizing micro-learning approach with artificial intelligence technology to develop skills in character movement design, game design, and using mixed reality	[72, 73]	[74–76]	[77, 78]	[79, 80]	[81]	[82]	[83]	Researchers
Specialized skills in the gaming industry.		✓	✓		✓			✓
Skills in using MR technology for character movement design in game design.	✓	✓		✓		✓	✓	✓
Designing character movements for game design that provides sustained flexibility through real-time responses and continuous learning.	✓	✓	✓		✓	✓	✓	✓
Problem-solving skills and creativity, character movement design in game design.	✓		✓	✓	✓		✓	✓

Description of a micro-learning approach with artificial intelligence technology to improve skills in designing in-game character movements and using mixed reality.

This approach describes the elements to be used to A micro-learning approach with artificial intelligence for improving skills in designing the movement of in-game characters and using mixed reality. There are four elements, as shown in Fig. 2.

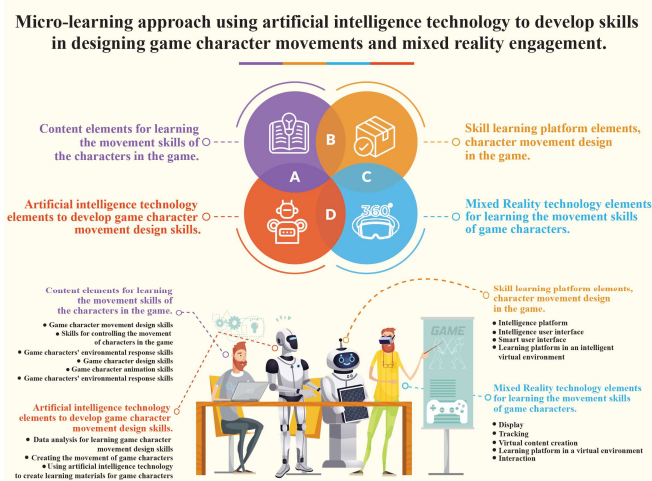


Fig. 2. Micro-learning approach with artificial intelligence technology to improve skills in designing of game character movements and using mixed reality.

A. Content Elements to Learn the Movement Skills of the Characters in the Game

Designing character movement in games is an important skill that game designers and developers need to have. The learning content starts with anatomical movement analysis, which helps to understand the muscles and joints that work together. Once they have a basic understanding of movement, designers need to be able to create and design natural gestures for characters using animation software like Blender, Maya,

or 3ds Max. Another aspect of the design is that the character must be able to respond effectively to the environment. This can be enhanced by integrating physics principles such as gravity and friction. The learning process does not stop at creating, but also includes regularly testing and improving the movement of characters, using feedback from testers to continuously improve the player experience.

B. Skills Learning Platform Elements, Characters Movement Designing the Game

Designing the movement of the characters in the game requires an effective learning platform. This should include a wide range of learning content, such as videos and documents, and a Learning Management System (LMS) that tracks progress. This should involve interactive learning features such as online quizzes and a user-friendly interface for content creation technology, accessible support and services, and the promotion of group work to build a learning network. The inclusion of these elements helps students develop their movement design skills in a high-quality and engaging way.

C. Artificial Intelligence Technology Elements to Develop Game Character Movement Design Skills

AI plays an important role in improving the motion design skills of in-game characters, helping to analyze data from motion capture to create complex and realistic animations. AI can also simulate physics, react to the environment, and make the characters move quickly and efficiently. In addition, AI provides real-time feedback and supports automatic animation generation, which enhances the quality of the game and the playing experience for users.

D. Mixed Reality Technology Elements for Learning the Movement Skills of Game Characters

MR technology combines VR and AR to create an immersive and interactive experience for learning the movement skills of in-game characters. This makes it easier

to understand complex movement mechanisms. MR also allows for 3D modeling and instant feedback. This makes learning more efficient and enjoyable.

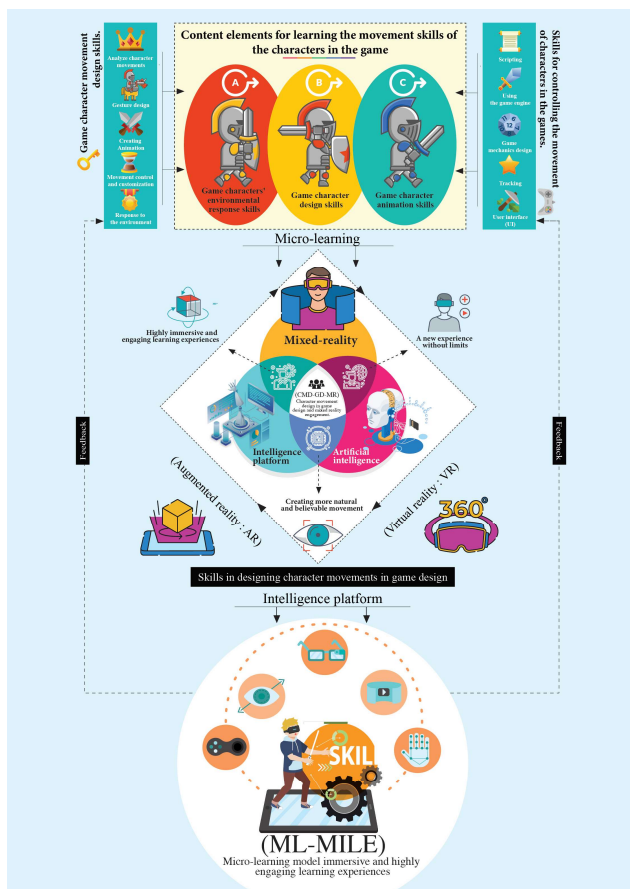


Fig. 3. Micro-learning process with artificial intelligence technology to improve skills in character movement design, game design, and using mixed reality.

To summarize, a micro-learning approach with artificial intelligence technology was developed to improve the skills of designing the movement of in-game characters and using mixed reality. Designing the movement of characters in games is a skill that game designers and developers must have. They must be able to create natural gestures with animation software such as Blender or Maya and make the characters respond effectively to the environment and be ready to use physics to add realism. AI plays an important role in improving design skills by helping to analyze data from motion capture and provide real-time feedback. In addition, AI helps to generate automated animations, increasing the quality of the game. Motion design requires an effective learning platform, which includes a wide range of content. A LMS should involve interactive learning features, user-friendly interfaces, and support for group work. This allows learners to practice movement in an interactive virtual environment and enables them to better understand movement mechanisms and can make learning effective and enjoyable.

A micro-learning process with artificial intelligence technology to improve skills in designing the movement of in-game characters and using mixed reality. This section discusses the results of the design process of creating a micro-learning approach using artificial intelligence technology to improve the skills of character movement design in game

design and using mixed reality. The researcher designed a micro-learning process with artificial intelligence technology based on the results of the element synthesis and the obtained data, as shown in Fig. 3.

1) Explanation of the micro-learning process with artificial intelligence technology to improve skills in character movement design, game design, and using mixed reality

This study explores process of using micro-learning with artificial intelligence technology to improve skills in designing the movement of in-game characters and using mixed reality. The work is divided into three main parts as follows:

Part 1. Input data: The elements of the content for learning the movement skills of the game characters include movement design and control, environmental response, character design, and animation creation skills.

Part 2. Process: The researcher chose to use the micro-learning process with artificial intelligence technology to develop skills in character movement design in game design and using mixed reality with the following elements:

1) Learning process in micro-level learning with artificial intelligence technology: Start by setting learning objectives and goals.

Collect and prepare the data: Define the course to meet the results of the analysis and identify the necessary content and skills, such as gesture design.

Animation and environmental response: A variety of data must be collected, such as character animation, motion capture from real actors, human and animal movement data, and character data covering physical characteristics. In addition, environmental information such as scenes, objects, and interactions must be included and formatted appropriately for use in coaching. AI will enhance the design and development of in-game movement skills effectively.

2) The process of using artificial intelligence technology for the creation of micro-learning materials with artificial intelligence technology to improve movement design skills.

Learning to design the movement of the characters in the game: Automated animation content creation with AI can make animations realistic. By selecting types of AI such as reinforcement learning, Generative Adversarial Networks (GANs), and neural networks, they can help create powerful models.

The learning algorithm: The model training uses the collected data. AI can be used to create exercises, such as allowing learners to create animations as specified by the model or customizing motion capture and creating scenes and theatrical movements, with immediate feedback so that learners can continuously improve their work.

3) The process of using the intelligent platform platform with artificial intelligence technology: The implementation of the LMS system must include the curriculum.

Effective dissemination of learning materials and evaluation: Interactive learning features can be created that include learner engagement functions, such as online forums and quizzes. In addition, the right tools must be chosen, such as Unity, Unreal Engine, or an online course creation platform to develop content. It is also important to design the interface to be intuitive and understandable, to integrate AI to

help evaluate learners' performance and provide appropriate recommendations.

- 4) The process of using mixed reality technology to increase learning engagement, creating virtual environments, and creating virtual reality environments: Create realistic models and animations for learners to practice in a context that is close to reality. This can include physical interaction, using devices such as MR glasses so that learners can interact with characters and the environment in real time. In an educational virtual environment, realistic models and animations are created so that learners can practice realistic movements.

Part 3. Output: As a result, the skills to design character movements in game design and use mixed reality have the following components: specialized skills in the game industry, skills in using MR technology for character movement design, and designing character movements for game design that provides sustained flexibility through real-time responses and continuous learning, problem-solving skills, and creativity, as shown in Table 5.

Table 6. Evaluating the process of creating micro-learning models with artificial intelligence technology to develop skills in character movement design in game design and mixed reality engagement

Factor	Mean $\pm$ SD
1) Input	
1.1 Content elements to learn the movement skills of the characters in the game.	4.48 $\pm$ 0.42
2) Process	
2.1 Artificial intelligence technology for analytics in content creation	4.38 $\pm$ 0.04
2.2 Artificial intelligence technology to create learning materials	4.68 $\pm$ 0.37
2.3 Intelligent platform with artificial intelligence technology	4.87 $\pm$ 0.03
2.4 Mixed reality technology	4.63 $\pm$ 0.44
3) Output	4.69 $\pm$ 0.28
4) Feedback	4.83 $\pm$ 0.03
Total	4.65 $\pm$ 0.23

Part 4. Feedback: responding to the system function back to the first step in the process of this research system is objective.

The evaluation results of the process utilizing a micro-learning approach with artificial intelligence technology to improve the skills of character movement design, game design, and using mixed reality.

The researcher evaluated the process of designing micro-learning approach with artificial intelligence technology to improve skills in designing character movements in game design and using mixed reality. The overall value of all the processes (input, process, output, feedback) was 4.65 ± 0.23 , indicating that the learning style is appropriate and effective, as shown in Table 6.

The effect of utilizing micro-learning approach with artificial intelligence technology to improve the skills of character movement design in game design and using mixed reality.

Based on the model design results, the micro-learning process with artificial intelligence technology can improve the skills of character movement design in game design and utilizing mixed reality. Therefore, the researcher has created micro-learning communication using artificial intelligence technology to improve these skills. There are five elements, each using communication to learn: 1) the movement design of characters in the game; 2) to control the movement of

characters in the game; 3) the response of the characters to the environment in the game; 4) to create animations of characters in the game; and 5) to integrate movement skills in games with mixed reality, as shown in Fig. 4–7.

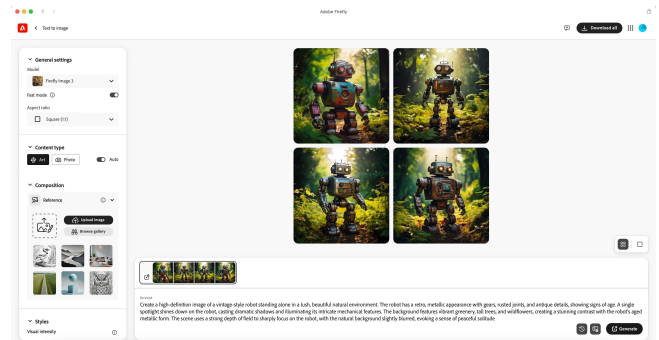


Fig. 4. The image shows a user interface for Adobe Firefly's "Text to Image" feature.

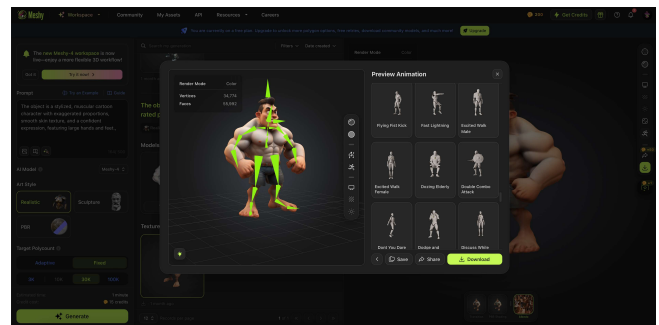


Fig. 5. The image highlights Meshy AI's ability to design characters, character movements, and 3D models of characters show highlighted joints.

The results show that using micro-learning approach with artificial intelligence technology can improve the skills of character movement design in game design and using mixed reality. A total of 30 individuals participated in the study. The micro-learning approach with artificial intelligence technology and the evaluation form were used with tools to improve these skills. The results of the quality assessment of the use of the micro-learning approach showed that artificial intelligence technology improved the skills of character movement design in game design and using mixed reality. The quality of the content (mean = 4.85, highest quality) of all subcomponents (source data, theoretical validity, clarity of the media, usefulness of examples and exercises, and up-to-date content) was rated as the "highest quality" for the quality of the learning materials (mean = 4.91, highest quality), as well as for the quality of the content. Skills developed through the use of media also achieved this evaluation (mean = 4.89, highest quality), including motion design, the use of mixed reality technology, creativity, and analytical and problem-solving skills. All subcomponents were at the level of "highest quality" in terms of learner participation (mean = 4.66, the highest quality). The learners were highly involved in the learning process, especially in terms of participating in lessons, the use of technology and digital media, and satisfaction with learning methods and content. Although the subcomponent "Ability to adapt to a variety of learning approaches" was at the level of "high quality," overall, learner engagement was high. Using mixed reality technology stimulates interest and improves collaboration skills (mean = 4.77, highest quality). It encourages creativity and helps learners to apply their knowledge in practice. Although the sub-element

“Application of techniques and strategies in designing the movement of characters in the game” was at the level of “high quality,” the mixed reality contributions were highly evaluated, as shown in Table 7.



Fig. 6. The image shows the use of micro-learning models.



Fig. 7. The image shows two students interacting with a MR environment.

Table 7. The quality assessment of the use of micro-learning approach

Assessment	Mean $\pm$ SD	Quality level
Quality of content		
The data are generated from reliable sources and are validated	4.87 $\pm$ 0.35	The highest quality
The theory and practice presented are precise	4.83 $\pm$ 0.38	The highest quality
The text, image, or audio is presented clearly and easily understood	4.90 $\pm$ 0.31	The highest quality
Relevant examples and exercises help learners understand well	4.80 $\pm$ 0.48	The highest quality
The content used is up to date to reflect new technologies and trends in the game and motion design industry	4.83 $\pm$ 0.38	The highest quality
Total	4.85 $\pm$ 0.03	The highest quality
Quality of learning materials		
The learning materials used are diverse and interesting	4.93 $\pm$ 0.25	The highest quality
Virtual or mixed reality technology is used in learning	5.00 $\pm$ 0.00	The highest quality
Learning materials encourage learner engagement and interaction	4.90 $\pm$ 0.31	The highest quality
The learning materials provide timely suggestions	4.87 $\pm$ 0.35	The highest quality
The learning materials are easily accessible from a variety of devices and platforms	4.83 $\pm$ 0.38	The highest quality
Total	4.91 $\pm$ 0.06	The highest quality

Skills developed through the use of media		
Character movement design skills	4.97 $\pm$ 0.18	The highest quality
Mixed reality technology to enrich the learning experience	4.90 $\pm$ 0.31	The highest quality
Creativity in developing character concepts and designs	4.83 $\pm$ 0.38	The highest quality
Analytical and problem-solving skills	4.87 $\pm$ 0.35	The highest quality
Total	4.89 $\pm$ 0.05	The highest quality
Learner engagement		
Interesting and engaging in the learning process	4.27 $\pm$ 0.45	Very high quality
Participation in lessons	4.90 $\pm$ 0.31	The highest quality
Use of technology and digital media	4.87 $\pm$ 0.35	The highest quality
Learners can adapt to a variety of learning approaches	4.37 $\pm$ 0.49	Very high quality
Learners are satisfied with the learning method and the content they learn	4.73 $\pm$ 0.45	The highest quality
Learners can see the results of participating in learning	4.83 $\pm$ 0.38	The highest quality
Total	4.66 $\pm$ 0.25	The highest quality
Using mixed reality		
It stimulates learners' interest and involvement in designing the movement of the characters in the game	4.93 $\pm$ 0.25	The highest quality
What you learn can be used to design the movement of the characters in the game	4.83 $\pm$ 0.38	The highest quality
Using MR helps learners develop collaboration skills with the development of knowledge and skills in designing the movement of characters in the game	4.87 $\pm$ 0.35	The highest quality
Creativity that can be used to design the movement of the characters in the game	4.83 $\pm$ 0.38	The highest quality
Application of techniques and strategies to design the movement of characters in the game	4.37 $\pm$ 0.49	Very high quality
Total	4.77 $\pm$ 0.23	The highest quality

V. DISCUSSION

According to the results of the study, the process of using micro-learning approach with artificial intelligence technology to improve character movement design skills in game design and using mixed reality consists of four main processes: 1) the data import; 2) the process – the researcher chose to utilize the micro-learning process with artificial intelligence technology; 3) the results – the skills in character movement design in game design and using mixed reality; and 4) the functional response aspect. This research has created a micro-learning approach with artificial intelligence technology to improve the skills in character movement design in game design and using mixed reality.

This paper studies the effectiveness of micro-learning approach using AI and MR to develop the movement design skills of the characters in the game. The results show the high efficiency of the micro-learning approach, with all aspects being evaluated at an excellent level, reflecting the appropriateness of using AI and MR technologies in teaching and learning, that are consistent with the study of Xie [84] found that AI-driven game character generation in the gaming industry and Busetta *et al.* [85] found AI to create realistic character behaviors with techniques such as behavior trees and GOAP (Goal-Oriented Action Planning). ELEVATE enables exercise creators, directors, and development teams to collaborate effectively through a process that emphasizes continuous communication.

Quality of content and learning materials: The evaluation found that both the content and the learning materials were of

the highest quality. These demonstrate the accuracy and up-to-date quality of the data used. This is in line with previous research that states that high-quality learning materials affect learning performance.

Skills developed: The results suggest that learners develop movement design skills, creativity, and effective problem-solving skills. This supports the belief that hands-on learning and continuous feedback can improve skills better than theoretical learning alone.

Participation: Learner engagement is high. This is especially true in the field of participation in lessons.

Use of technology and satisfaction: This demonstrates the appeal and effectiveness of using AI and MR technologies to motivate and engage learners. In terms of MR use, this has been evaluated at a high level. It also confirms the benefits of this technology in creating immersive and engaging learning experiences. However, the evaluation results in the “Application of techniques and strategies in motion design” assessment are moderate, possibly due to the complexity of the learners’ skills or readiness, which is an issue that should be studied further.

This study was limited in terms of a restricted number of participants, which may have affected the general conclusions. Future studies should expand the sample to obtain more reliable results, and studies should be compared with other learning approach to reach complete conclusions.

VI. CONCLUSION

This research has successfully developed a micro-learning approach using AI to improve the skills of designing the movement of in-game characters and using mixed reality. MR aims to improve design skills and empower game designers to create interesting and natural movements for characters. Artificial intelligence technology also facilitates micro-learning by accessing the data and examples needed to design movements. The MR technology helps to develop the movement design skills of the characters in the game. This demonstrates the effectiveness of this micro-learning approach in skill development. This research offers an interesting approach to developing a more engaging study of the movement design of in-game characters. Future research should expand the sample and compare it with other learning models to reach more comprehensive conclusions.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

VP is responsible for research, design and data collection, data improvement, original drafting, and editing; PN provided advice on the design of research instruments; PW provides advice on research methods, ensuring their improvement and equal support for all; all authors had approved the final version.

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