The Game-based Learning (GbL) Platform with Generative AI to Enhance Digital and Technology Literacy Skills

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Abstract

The GbL platform, or game-based learning platform, with generative AI is a research tool initiated from the combination of game-based learning concepts and generative artificial intelligence technology; thereby, this platform is intended to be used as a guideline for the instruction management, in which learners can respond and interact with the real-time activities by means of gamification. The objectives of this research are (1) to study and synthesize the conceptual framework of the GbL platform with generative AI to enhance digital and technology literacy skills, (2) to develop the architecture of the GbL platform with generative AI to enhance digital and technology literacy skills, and (3) to study the results of the development of the GbL platform with generative AI to enhance digital and technology literacy skills. The results of this research show that (1) the overall elements suitability of the architecture of the GbL platform with generative AI is at the highest level (Mean = 4.51, SD = 0.48), and (2) the overall suitability of the architecture of the GbL platform with generative AI is at the highest level (Mean = 4.59, SD = 0.41). Nevertheless, there are still some research gaps in this study; that is, this study was conducted with quite a small sample group and it focuses mainly on the results of evaluation on the architecture of the GbL platform. Therefore, this research is regarded merely as a pilot study designated for feasibility study to further develop the GbL platform that can be put in practical use in the future.

Keywords: GbL platform, game-based learning, generative AI, digital and technology literacy skills

1. Introduction

The National Education Act B.E. 2562 places an emphasis on the instruction management in which all learners must be able to learn and develop themselves, and meanwhile these learners must be given the greatest importance. At the meantime, the education management process must encourage learners to develop their full potential in a natural manner. According to Section 22, learners must be equipped with knowledge and skills about science and technologies while being promoted to learn from the first-hand experiences. In addition, learners must be urged to think and take action in a practical manner with continual curiosity. Also, the instruction management of this kind must enable instructors to organize atmospheres, environments, learning media, and facilities in a way that enables learners to learn continuously no matter where they are (Ministry of Education, 2010).

Game-based learning is a teaching technique that stimulates learners' interest and engagement under a challenging and fun atmosphere, which is believed to lead to learning outcome. Not only that, the game-based learning is said to help learners stay motivated and engaged in learning (Shaffer et al., 2005; Plass, Homer & Kinzer, 2015). Furthermore, it enables them to learn how to manage their emotions and respond to different situations appropriately. Meanwhile, learners are also encouraged to practice many other skills, e.g., analytical thinking, integration, strategic planning for success, communication, collaboration with others, responsibility, and reasonable respect for the rules. At the same time, learners can learn a variety of contents and practice various skills by means of interaction with the games inserted therein, which is regarded as a way to enhance interest and motivation in learning as well (Cheng & Su, 2012).

Generative AI (Gen-AI) is an artificial intelligence processing technology that creates artificial intelligence, equivalent to that of humans, for non-living things. Generative AI has a processing system similar to the human brain that produces results in the form of actions. It usually focuses on the creation of new innovations and new products. For this reason, generative AI is considered a type of artificial intelligence technology that can produce

different types of contents, including texts, images, sound, and synthetic data (TechTarget, 2023).

At present, generative AI has been applied in various fields for convenience and employed as a tool to promote learning in the form of digital humans with an aim to initiate the new forms of interaction. Thanks to a number of software or platforms today, this kind of technology has become more accessible for all types of users. Recently, generative AI has also been compatible with the new user interfaces, which enable it to create high-quality texts, graphics, and video (TechTarget, 2023). For this reason, generative AI has the potential to transform domains and industries that rely on creativity, innovation, and knowledge processing. In particular, it enables new applications that were previously impossible or impractical for automation, such as realistic virtual assistants, personalized education and service, and digital art (Feuerriegel et al., 2023).

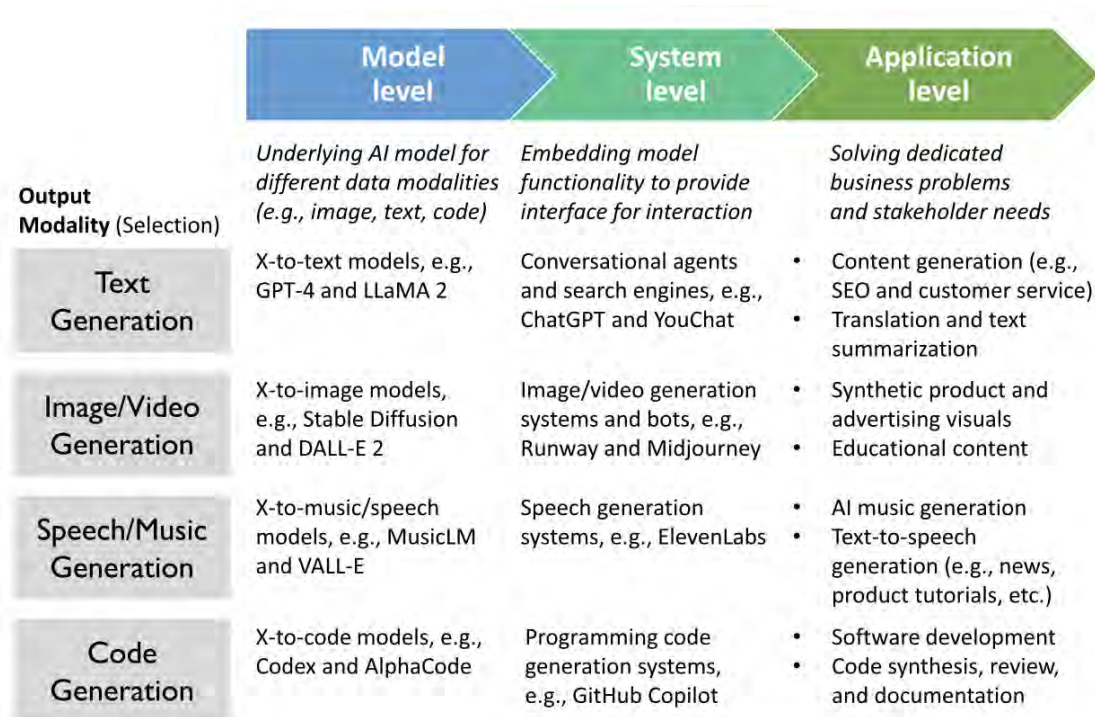| Output Modality (Selection)	Model level — Underlying AI model for different data modalities (e.g., image, text, code)	System level — Embedding model functionality to provide interface for interaction	Application level — Solving dedicated business problems and stakeholder needs
Text Generation	X-to-text models, e.g., GPT-4 and LLaMA 2	Conversational agents and search engines, e.g., ChatGPT and YouChat	• Content generation (e.g., SEO and customer service) • Translation and text summarization
Image/Video Generation	X-to-image models, e.g., Stable Diffusion and DALL-E 2	Image/video generation systems and bots, e.g., Runway and Midjourney	• Synthetic product and advertising visuals • Educational content
Speech/Music Generation	X-to-music/speech models, e.g., MusicLM and VALL-E	Speech generation systems, e.g., ElevenLabs	• AI music generation • Text-to-speech generation (e.g., news, product tutorials, etc.)
Code Generation	X-to-code models, e.g., Codex and AlphaCode	Programming code generation systems, e.g., GitHub Copilot	• Software development • Code synthesis, review, and documentation

Figure 1. A model-, system-, and application-level view on generative AI

(Feuerriegel et al., 2023)

Digital and technology literacy refers to the skills to make the ultimate use of today's digital tools, equipment, and technologies in order to communicate, operate, and collaborate with others. These skills are also used to develop a work process or system in organizations so that it becomes more modernized with more efficiency. As such, digital and technology literacy is seen as the combination of a variety of interrelated skills, which are related to media literacy, technology literacy, information literacy, visual literacy, communication literacy, and social literacy (Chatwattana, 2021; UNESCO, 2018).

As to the aforementioned principles and theories, the researchers have had an idea to develop the GbL platform with generative AI for use as a guideline to enhance digital and technology literacy skills. In this platform, the instruction activities are managed by means of gamification. This is considered a kind of learning management that encourages learners to study and practice by their own; meanwhile, these learners are supervised and facilitated by the instructors in such a manner that their digital and technology literacy skills can be elevated.

This research is related to the design and development of the game-based learning (GbL) platform with generative AI to enhance digital and technology literacy skills, and the research objective and hypothesis are as follows.

- To synthesize the conceptual framework of the GbL platform with generative AI to enhance digital and technology literacy skills,
- To develop the architecture of the GbL platform with generative AI to enhance digital and technology literacy skills,

- To study the results of the development of the GbL platform with generative AI to enhance digital and technology literacy skills.

The results of evaluation on the suitability of the game-based learning (GbL) platform with generative AI to enhance digital and technology literacy skills is at the high level.

2. Research Methodology

This research is related to the design and development of the game-based learning (GbL) platform with generative AI to enhance digital and technology literacy skills, and the research methodology is as follows.

2.1 Participants

The research participants are seven experts from different institutions, all of whom are specialized in design and development of instruction systems.

2.2 Research Instruments

The tools employed in this research consist of (1) the architecture of the GbL platform with generative AI to enhance digital and technology literacy skills, and (2) the evaluation form on the suitability of the architecture of the GbL platform with generative AI to enhance digital and technology literacy skills.

2.3 Research Methodology

The research methodology designated to design and develop this architecture is based on the system approach of Khemmani (2010) & Utranan (1982), which can be divided into three steps as follows;

Step 1 is synthesis of the documents and the researches relevant to the GbL platform with generative AI. In order to establish the conceptual framework of this research, the researchers had studied and analyzed the documents and the researches, which are concerning instruction system, basic education core curriculum, game-based learning, artificial intelligence, generative AI, and digital and technology literacy skills.

Step 2 is development of the architecture of the GbL platform with generative AI. In this stage, the researchers based the design and the development of this architecture on the principles of system approach.

Step 3 is concerning the study of the architecture of the GbL platform with generative AI. The researchers employed the research tools to find out the results after having the participants use the said architecture. There are seven experts in this research who were derived by means of purposive sampling. All of them are the experts from different institutions, who are specialized in design and development of instruction systems.

Figure 2. Research methodology

3. Results

The results of the development of the architecture of the game-based learning (GbL) platform with generative AI to enhance digital and technology literacy skills can be summarized as follows:

3.1 The Conceptual Framework of the Game-based Learning (GbL) Platform with Generative AI

After the study, analysis, and synthesis of the documents and the researches relevant to the GbL platform with Generative AI, especially in terms of instruction system, basic education core curriculum, game-based learning, artificial intelligence, generative AI, and digital and technology literacy skills, the researchers obtained the conceptual framework of this research as shown in Figure 3.
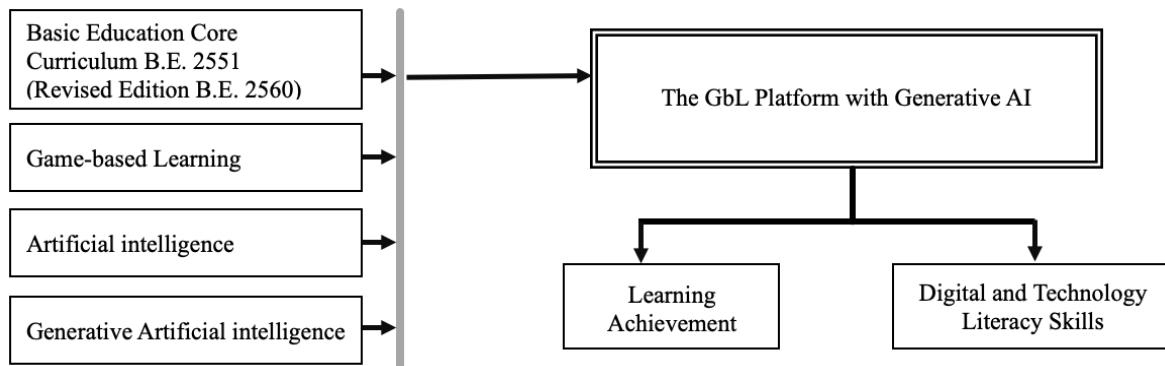
Figure 3. Conceptual framework of the game-based learning (GbL) platform with generative AI

3.2 Results of the Development of the Game-based Learning (GbL) Platform with Generative AI

In the development of the architecture of the GbL platform with generative AI for use as a guideline to further design and develop the GbL platform with generative AI, the game-based learning process integrated with the generative AI technology was applied in the management of instruction activities so that the learners could interact and engage with the said activities in a challenging and fun atmosphere. The GbL platform with generative AI are illustrated in Figure 4.
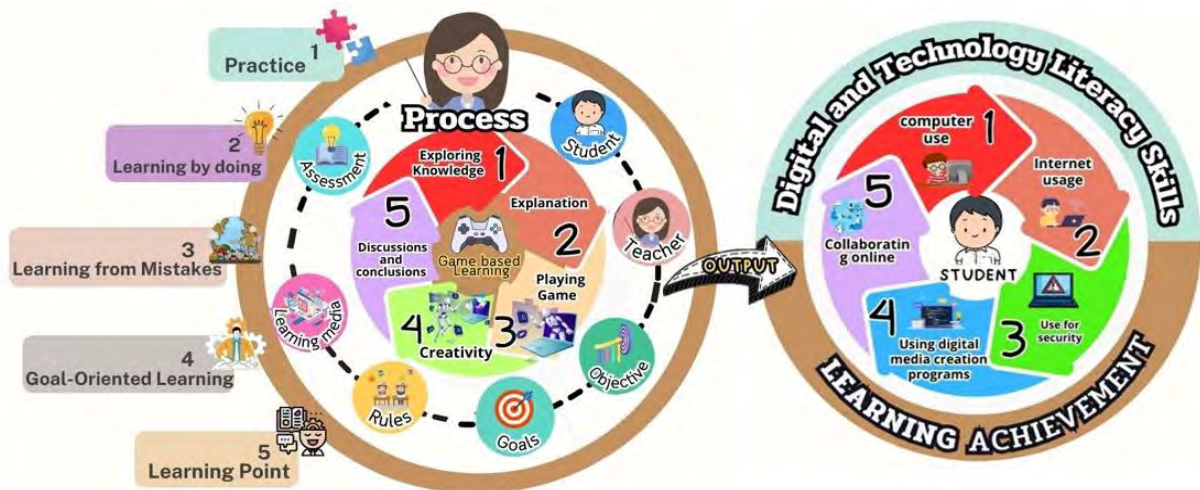

Figure 4. Architecture of the game-based learning (GbL) platform with generative AI

Figure 4 represents the architecture of the GbL platform with generative AI, which includes four main elements as below.

- Input factor: This refers to the elements involved in the development of the GbL platform with generative AI, including 1) student, 2) teacher, 3) objective, 4) goals, 5) rules, 6) learning media, and 7) assessment.

- Game-based learning process with generative AI: In this study, the researchers applied the concepts and technologies related to generative AI in the design of this platform in order that learners could have fun while playing games and, at the same time, they could interact with others as well. The game-based learning process consists of five steps, i.e., exploring knowledge, explanation, playing game, presenting ideas, and discussions and conclusions. Additionally, the researchers applied five principles of game-based learning in this development so as to enhance digital and technology literacy skills among primary school students. Thereby, the said principles consist of (1) practice, (2) learning by doing, (3) learning from mistakes, (4) goal-oriented learning, and (5) learning point.

- Output: This section refers to learning achievement and digital and technology literacy skills. The digital and technology literacy skills herein can be categorized into five aspects, i.e., computer use, internet usage, use for security, using digital media creation programs, and collaborating online.

- Feedback: This element refers to the data derived from output, which will be used to further improve the learning process and the input factor. The feedback includes (1) results of the assessment on learning achievement, and (2) results of the assessment on digital and technology literacy skills.

3.3 The Study Results of the Development of the Game-based Learning (GbL) Platform with Generative AI

The study results of the development of the architecture of the GbL platform with generative AI with seven experts who were derived by means of purposive sampling. The criteria for evaluation and the interpretation of results (Kanasutra, 1995) are shown in Table 1.

Table 1. Mean score range and interpretation of results

Range of average score	Interpretation of suitability
4.50 – 5.00	Highest
3.50 – 4.49	High
2.50 – 3.49	Moderate
1.50 – 2.49	Low
0.00 – 1.49	Lowest

The results of the GbL platform with generative AI are shown in Table 2 and Table 3.

Table 2. Results of the assessment on the development of the architecture of the GbL platform with generative AI (overall elements)

Items for evaluation	Assessment results		Interpretation of results
	Mean	SD	
1. What is the level of suitability of the principles and the concepts used to develop the GbL platform with generative AI?	4.42	0.57	High
2. What is the level of suitability of the elements of the GbL platform with generative AI?			
2.1 Input factor	4.57	0.42	Highest
2.2 Learning process	4.57	0.42	Highest
2.3 Output	4.57	0.42	Highest
2.4 Feedback	4.43	0.57	High
Overall average	4.51	0.48	Highest

Referring to Table 2, it is found that the overall elements suitability of the architecture of the GbL platform with generative AI is at the highest level (Mean = 4.51, SD = 0.48). This can be summarized that the architecture of the GbL platform with generative AI contains such appropriate elements that it can be employed as a guideline to further develop the game-based learning platform with generative AI. It is expected that the learning platform of this kind can enhance learners' digital and technology literacy skills, the necessary characteristics of learners in the digital age.

Table 3. Results of the assessment on the development of the architecture of the GbL platform with generative AI

Items for evaluation	Assessment Results		Interpretation of results
	Mean	SD	
1. Input factor			
1.1 Student	4.71	0.28	Highest
1.2 Teacher	4.71	0.28	Highest
1.3 Objective	4.57	0.42	Highest
1.4 Goals	4.57	0.42	Highest
1.5 Rules	4.57	0.42	Highest
1.6 Learning media	4.29	0.71	High
1.7 Assessment	4.43	0.57	High
2. The learning process using GbL platform with Generative AI			
2.1 Game-based learning steps			
2.1.1 Exploring knowledge step	4.86	0.14	Highest
2.1.2 Explanation step	4.71	0.28	Highest
2.1.3 Playing game step	4.57	0.42	Highest
2.1.4 Presenting ideas step	4.43	0.57	High
2.1.5 Discussions and conclusions step	4.43	0.57	High
2.2 Game-based learning steps			
2.2.1 Practice	4.43	0.57	High
2.2.2 Learning by doing	4.86	0.14	Highest
2.2.3 Learning from mistakes	4.71	0.28	Highest
2.2.4 Define the goal-oriented learning	4.71	0.28	Highest
2.2.5 Define the learning point	4.43	0.57	High
3. Output			
3.1 Learning achievement	4.43	0.57	High
3.2 Digital and technology literacy skills	4.57	0.42	Highest
4. Feedback			
4.1 Results of evaluation on learning achievement	4.57	0.42	Highest
4.2 Results of evaluation on digital and technology literacy skills	4.71	0.28	Highest
Overall	4.59	0.41	Highest

According to Table 3, it is evident that the overall suitability of the architecture of the GbL platform with generative AI is at the highest level (Mean = 4.59, SD = 0.41). Therefore, it can be concluded that the architecture of the GbL platform with generative AI consists of suitable elements and it can be used as a guideline to manage the game-based instruction activities, which are intended to enhance digital and technology literacy skills. With such learning platform and under a challenging and fun atmosphere, learners will be encouraged to think and take action in a practical manner with continual curiosity, which is believed to eventually lead to learning outcome.

4. Discussion

The results of this research show that (1) the overall elements suitability of the architecture of the GbL platform with generative AI is at the highest level, and (2) the overall suitability of the architecture of the GbL platform with generative AI is at the highest level. Once considering these assessment results, it can be clearly seen that the architecture of the game-based learning (GbL) platform with generative AI contains appropriate elements and it can be used as a guideline to further develop other learning platforms with game-based learning process. The game-based learning platform is said to enhance digital and technology literacy skills, which are regarded as significant skills for the 21-st century learners.

The results of this research is corresponding to the research of Kingchang, Chatwattana & Wannapiroon (2023), who said that the application of artificial intelligence technology concepts and digital innovations to create the instruction supporting tools on small mobile devices, which can be accessed anywhere and anytime, can respond to the current education policies that promote lifelong learning and enable learners to seek knowledge by themselves from all forms of learning media. It is also in consistence with the study of Srisawat & Piriyasurawong (2023), who stated that playing games can stimulate learners to learn and motivate them to have

more engagement and enthusiasm by doing activities and interacting with others in a competitive environment, which is thought to bring about fun, challenges, and then continuous learning.

5. Conclusion

The architecture of the game-based learning (GbL) platform with generative AI is composed of four main elements, i.e., 1. input factor, which includes seven sub-elements of (1) student (2) teacher (3) objective (4) goals (5) rules (6) learning media, and (7) assessment; 2. game-based learning process with generative AI, which consists of five steps, i.e., exploring knowledge, explanation, playing game, presenting ideas, and discussions and conclusions, combined with five principles of game-based learning, i.e., (1) practice, (2) learning by doing, (3) learning from mistakes, (4) goal-oriented learning, and (5) learning point; 3. output, which refers to (1) learning achievement, and (2) digital and technology literacy skills; and 4. feedback, which includes (1) results of assessment on learning achievement, and (2) results of assessment on digital and technology literacy skills.

The game-based learning (GbL) platform with generative AI is a kind of learning platform that applies the concepts of game-based learning process in the management of instruction activities. This platform allows learners to participate and practice through the games, encouraging them to learn on their own in a challenging and fun atmosphere. At the same time, learners are also able to respond and interact with others by means of generative AI technologies. Yet, there is still a limitation in this study. The number of participants in this research is very small; consequently, the findings obtained herein are considered only the findings from just a pilot study, which can be employed as guidelines for development in the future. Thus, future studies should be performed with a larger sample group or different research methods.

Authors contributions

Miss. Suthada Muengsan develops the main idea of this research, wrote and compose the manuscript, developing the architecture and studied the results. The research methodology was developed by Dr. Pinanta Chatwattana and review the manuscript. The two authors have approved the final version of this manuscript for publication.

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Obtained.

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No additional data are available.

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