Gamified Flipped Design Innovation Classroom with AI Chatbot to Promote Soft Skills for Student Innovators

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***Abstract*—This study investigates the integration of a gamified flipped design innovation classroom with an Artificial Intelligence (AI) chatbot to promote soft skills for student innovators in high school education. The research aimed to 1) develop the gamified flipped design innovation classroom with AI chatbot model, 2) assess student innovators' soft skills in innovative design projects, and 3) explore the application of gamification and AI chatbots in teaching and learning management. The participants were 130 Grade 11 students from Srinakharinwirot Ongkharak Demonstration School, Nakhon Nayok, Thailand, selected through multi-stage sampling. Findings revealed that the model was rated at the most suitable level (mean = 4.72, *S.D.* = 0.487). Soft skills were assessed using a Likert scale, with a mean score of 4.35 (*S.D.* = 0.54), indicating a good level of development. Pearson correlation analysis revealed strong relationships between soft skills, AI chatbot usage, and gamification levels. Regression analysis showed that AI chatbot usage significantly influenced innovative thinking, networking, communication, and problem-solving mindset, while gamification positively affected leadership and time management. Results indicated that soft skills development was at a good level (mean = 4.35, *S.D.* = 0.54), with AI chatbots positively influencing innovative thinking, networking, communication, and problem-solving skills, while gamification enhanced leadership and time management. Correlation analysis demonstrated strong relationships between soft skills, AI usage, and gamification levels, suggesting that the gamified flipped classroom with an AI chatbot significantly promotes soft skills among student innovators.**

***Keywords*—design innovation, flipped classroom, gamification, Artificial Intelligence (AI) chatbot, soft skills, student innovator, innovative design**

I. Introduction

The current approach of 21st century education not only aims to develop academic achievement, but also focuses on creating desirable characteristics on the part of learners including analytical thinking, creative thinking, social skills, being able to work with others, and being able to communicate effectively [1]. 21st century skills are a collection of abilities and competencies that students need to develop in order to succeed in the work environment and in life generally in the 21st century [2]. These skills encompass a wide area including communication, adaptability, problem-solving, leadership, responsibility, and time management, integrated with the innovative thinking skills [3] that can be achieved by networking among people with diverse backgrounds, experiences, and expertise, promoting the exchange of ideas. This helps find solutions to complex problems, allowing the individual to adapt to new challenges and make progress in various areas, leading to innovative ideas [4].

Innovators are described as individuals who have the ability to develop new concepts or think creatively, and to find new patterns within processes, products or services. Innovators would be able to connect the two sides of the brain in such a way as to develop the necessary skills to create new ideas [5]. Student innovators are students who study how to be innovators, are able to portray new creative concept to others, can initiate experimental ideas and have a positive attitude with regard to innovation. Apart from the ability to foster innovation, the ideal characteristics of a student innovator would be to be able to persuade others and collaborate with them effectively [6].

Innovative design education contributes to promoting students' abilities as innovators, enables educators to rethink traditional teaching methods, integrates technology, encourages interdisciplinary approaches, and includes user-centered design principles to create more meaningful and effective learning experiences through design thinking approaches. Innovative design and 21st century skills are intertwined, with design thinking fostering the skills needed for competitive achievement in society by engaging in innovative design for individuals to develop critical thinking [7], creativity [8], collaboration [9], leadership [10] and adaptability [11].

However, the teaching paradigm in post-covid-19 era has become challenging for educators, especially in terms of innovative design education in that accessing technology and learning resources are crucial. The lack of direct interaction between teachers and students has become one of the greatest challenges brought on by the new normal educational setup [12], and social interactions have not returned to the level young people expect [13]. Learners have faced limitations in terms of accessing physical resources [14] at school. Such challenging situations are consistent with the flipped classroom approach which is a teaching method that is based on the concept of "learn at home, do homework at school" [15]. Moreover, these learning platforms are flexible, creative, critical, interactive, and reflective. They also employ new technologies and methods that can help improve students' motivation, self-regulation, personalization, and continuous learning [16].

Although the flipped classroom is an effective approach, there are still limitations. One of the main concerns for students in flipped classrooms is decreased engagement and motivation [17], both of which are integral parts of the learning process. Motivation is considered the driving force for students when it comes to achieving high-quality performance and results in academic tasks [18]. Due to the lack of classroom interaction during isolation, students' motivation to learn has been affected, resulting in limited idea exchange and creative problem-solving, where collaboration is a key factor in the success of innovation [19]. The lingering effects of the pandemic have

also caused a lack of attentiveness and focus on the part of students due to the shift between remote learning and disrupted traditional routines [20], leading to lower levels of focus and a lack of enthusiasm for physical activity [21]. Therefore, in addition to encouraging learners to stay motivated and engage in learning activities, both of which are consistent with the goal of gamification, given that gamification is the use of game mechanics and game-like experiences designed to connect and motivate people in order to achieve goals [22]. Using gamification in an educational context can enhance the cognitive, emotional and social domains. Key to the process is that learners receive rewards when they pass specific levels and move up to more difficult and complex levels. It is proof of the development of knowledge and emotions when learners receive instructions or activities encouraging them to collaborate with others which, in addition to enhancing social and emotional aspects [23], cause students to be highly motivated and makes their persistence to learn more productive [24].

The integration of a gamified flipped classroom environment seems to be effective approach when it comes to developing the skills and motivations necessary for student innovators. However, in activities where the instructor or facilitator is unavailable, students may encounter difficulties in terms of obtaining advice or the knowledge needed to complete their task. AI chatbot can thus play the role in terms of support by providing information on-demand regardless of geographic location or time constraints. Available 27/7, AI chatbot allows students to seek information at their convenience. This accessibility promotes independent learning and reduces barriers to academic resources [25].

Based on the aforementioned principles, the author has had the idea to develop a gamified flipped classroom integrated with a design thinking approach and AI chatbot technology that aims to enhance the soft skills of student innovators in an innovative design project. The objectives of this research were 1) to develop the gamified flipped design innovation classroom with AI chatbot to promote soft skills for student innovators, 2) to examine the soft skills of student innovators in relation to innovative design projects, and 3) to explore knowledge related to the application of gamification technology integrated with AI chatbots in teaching and learning management.

II. Literature Review

A. Soft Skills for Student Innovator

Student innovators are students who have a unique ability to think outside the box, challenge traditional norms, and develop innovative solutions to problems. Their fresh perspectives and unbridled creativity often lead to new approaches that address complex challenges that can extend beyond the technology domain to other areas [26]. Soft skills for student innovators include creativity and innovative thinking [5, 27–30], problem solving [5, 27–31], communication [5, 32, 33], networking [5, 27, 29, 32, 33], leadership mindset [5, 28–31, 33], and time management [5, 27, 31–34] all of which are skills for student innovators. They are fundamental skills that fuel innovation, the ability to think imaginatively, generate new ideas, and approach challenges from new perspectives [35]. Innovators leverage from their creativity to identify opportunities, imagine new possibilities, develop solutions to complex problems, and use problem-solving skills to analyze problems, involving decomposing them into each component and devising effective strategies [36]. They also have the ability to communicate and collaborate with others. Innovators with good communication skills are able to clearly articulate complex ideas, actively listen to feedback, and facilitate open dialogue [37]. Networking skills enable innovators to leverage diverse perspectives, pool resources, and co-create innovative ideas [38].

In order to achieve such skills, students need a learning approach that encourages them to participate in innovative project activities. However, in some instances these can be time-consuming because students need time to understand problems, design solutions, and complete projects, an approach which is often impossible within regular class hours [39]. Such concerns can be addressed by adopting the flipped classroom model given that studies have provided evidence that it improves problem-solving skills [40], encourages active involvement in discussion and collaboration [41], and streamlines the time needed for learning, making the learning process more efficient [39].

B. Flipped Design Innovation Classroom

Innovative design refers to the creation and application of new and creative solutions to problem solving. It involves using creative thinking and approaches to develop products, services, processes, or systems [42] that are not only visually appealing but also functional in terms of meeting the needs of users. This approach involves interdisciplinary collaboration, integrating knowledge and expertise from fields such as design, engineering, technology, psychology, and business [43]. Innovative design in education focuses on creating learning environments, tools, and methods that foster creativity, critical thinking, and collaboration. The goal is to enhance learning experiences by giving students the opportunity to explore, experiment, and apply knowledge in real-world contexts, enabling educators to rethink traditional teaching methods, integrating technology, interdisciplinary approaches, and human-centered design principles to create more meaningful and effective learning experiences [44].

The flipped classroom concept allows for a dynamic teaching and learning experience between teacher and learner, and enables students to access learning materials at their own pace prior to class. This pre-class session supports personalized learning styles and prepares students for meaningful in-class interactions. Activities such as watching videos, reading texts, or completing online lessons enable students to grasp foundational knowledge and enhance their understanding independently [45]. In-class sessions replace traditional lectures with collaborative activities, discussions, and problem-solving exercises. These activities increase student engagement, encourage critical thinking, and provide students with a deeper understanding of subject matter [46], allowing teachers to support student-centered learning environments that are effective and knowledge-building [47].

The flipped design innovation classroom is an approach that combines the principles of innovative design and flipped classroom models to create a dynamic, student-centered learning environment, focusing on developing creative

solutions and applying interdisciplinary knowledge in real-world contexts, where students access learning materials prior to class to build foundational knowledge at their own pace. During class, they participate in interactive, hands-on activities such as problem-solving and collaborative projects, with teachers acting as facilitators nurturing deeper engagement, personalized learning, and active participation, while integrating technology and interdisciplinary strategies to foster meaningful educational experiences.

Despite the effectiveness of the flipped classroom, there may still be some concerns. Roby [48] addresses the problem of student motivation and engagement, particularly in the context of changes in teaching and learning post-COVID-19, some students having low self-regulation skills and not taking responsibility without appropriate guidance as some of the most important issues encountered in the flipped classroom approach [49]. In a self-learning environment with no teacher around to help, students can be demotivated and discouraged when there is an issue of inability to understand content, causing a motivational decrease over time [50]. These challenges can be overcome through the use of technological applications to enhance student engagement [51] such as gamification that can be used to increase students' engagement levels [52] and AI chatbot to offer personalized and interactive support to learners, providing feedback and guidance [53].

C. Gamified Learning Environment with AI Chatbot

AI chatbot can be defined as a conversational tool that enables users to interact with computers using Natural Language Processing (NLP) that is easily understood by humans. This can involve either service chatbots or social chatbots [54]. AI chatbot provides continuous assistance for students to obtain immediate access to information and support at any time. This availability can meet the diverse needs of modern learners who seek flexible educational resources [55]. The integration of AI chatbots into flipped classrooms addresses several challenges. The traditional one is that of providing personalized learning to meet the individual needs and pace of each student, deliver instant feedback, enable prompt corrections and improvements to the learning process, and offer guidance and assistance during pre-class learning phases to help students effectively prepare for in-class activities [56, 57].

AI chatbot can offer customized and interactive practice sessions, which offer a promising tool when it comes to improving communication and learning outcomes [58]. According to the study on AI chatbot with guidance mechanism in blended learning by Lee *et al*. [58], the authors showed that the Guidance-based ChatGPT-assisted Learning Aid (GCLA) can enhance self-regulated learning, higher-order thinking skills foster cognitive and behavioral engagement, encourage self-efficacy, critical thinking, problem-solving skills, creativity, and knowledge construction [59], and also facilitate critical inquiry and the exploration of problems from various perspectives [60].

The application used in this study was ChatGPT which is accessible via personal computers and mobile devices. This application features advanced natural language processing capabilities and can be integrated with Learning Management Systems (LMS). It provides users with tailored suggestions, supports collaborative learning, and allows for customization to suit specific fields of study. ChatGPT offers comprehensive information and guidance, ensures data security, and is free of charge. Combined with the flipped learning model, it can provide students with an individualized and interactive learning experience [61].

Despite the benefits of AI chatbots, some research points to specific limitations such as potential challenges. These include a lack the ability to handle complex or unstructured users' questions, students' limited technical proficiency and a lack of authentic answer, causing some students to not be motivated to use chatbots consistently throughout a course [62]. The solution to such concerns aligns with the concept of gamification.

Gamification, defined as "the use of game elements in non-game contexts" [63], aims to enhance users' motivation by using game elements such as rewards, achievements, and progress tracking [64]. Gamified learning platforms create an engaging environment that actively encourage students to participate in their studies. Gamified elements such as badges and leaderboards can significantly boost student motivation and promote a sense of competition in students, leading to improved learning outcomes [65]. The benefits of gamification in education include increased participation, improved learning outcomes, and enhanced sustainable education [66]. Gamification is versatile and has been applied across multiple educational domains, including language learning, healthcare, and Science, Technology, Engineering, and Mathematics (STEM) [67].

The integration of gamification into educational settings has gained recognition for its potential to boost student motivation, engagement, interest, and learning outcomes [68] by promoting enjoyment and self-efficacy [69]. The study conducted by Shatila *et al*. [69] showed that well-designed gamification elements significantly increase perceived enjoyment and positively influence academic performance [70]. Combining gamification with approaches such as flipped classrooms allows students to access resources at any time, increasing flexibility and adaptation to individual needs, both key components of self-regulated learning [71].

The gamification platform for this research was selected based on a synthesis of platform features. The selection process considered the gamification elements and functions that support the implementation of flipped classrooms. Specifically, the researcher selected the application classcraft. Classcraft (Figs. 1–3.) provides gamification elements with Role-Playing Game (RPG) characters and rules, including the ability to assign tasks or instructional materials, an online submission system, an assessment system, and features that support collaborative learning activities. It can also be embedded with other outside URL links, making it possible to integrate the platform with AI chatbot technology.

A gamified learning environment with AI chatbot integrates gamification elements such as points, badges, levels, leaderboards, and rewards. These are integrated with AI chatbot technology to enhance the teaching and learning process. Gamification motivates students by fostering engagement, competition, and collaboration through features such as progress tracking and collaborative activities which

improve learning outcomes. At the same time, an AI chatbot powered by NLP provides continuous support by offering instant feedback and personalized learning experiences. Combining gamification and AI chatbots can create an interactive, student-centered learning environment that works in conjunction with a flipped design innovation classroom that aims to foster the soft skills of student innovators engaging in innovative design project-based activities that can promote effective and meaningful learning. This is as shown in the research framework in Fig. 4.

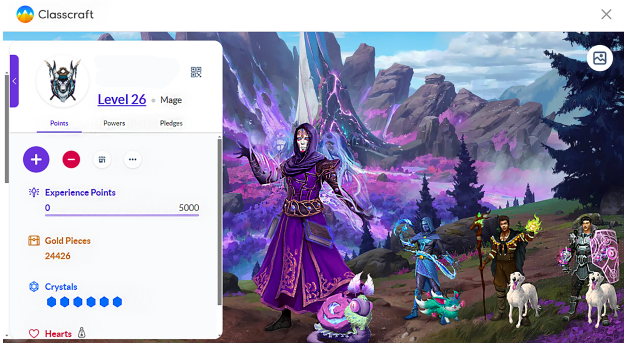

Fig. 1. Classcraft user interface.

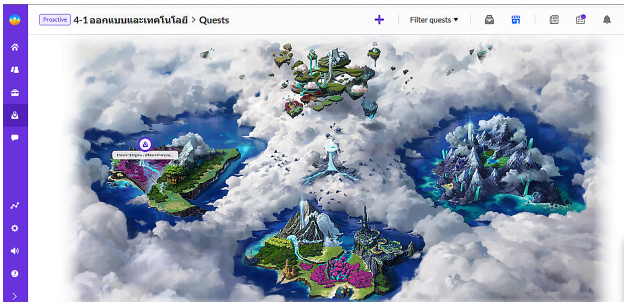

Fig. 2. Classcraft quest map.

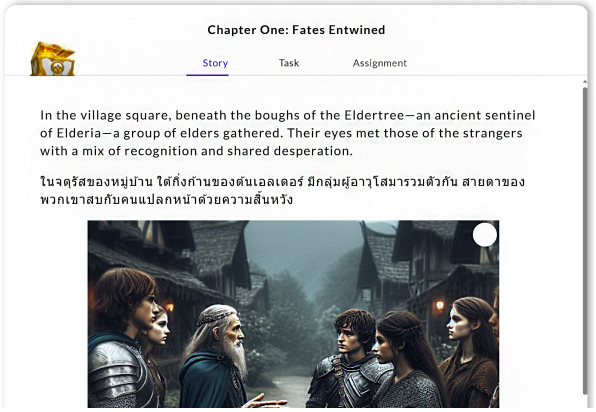

Fig. 3. Classcraft task and assignment interface.

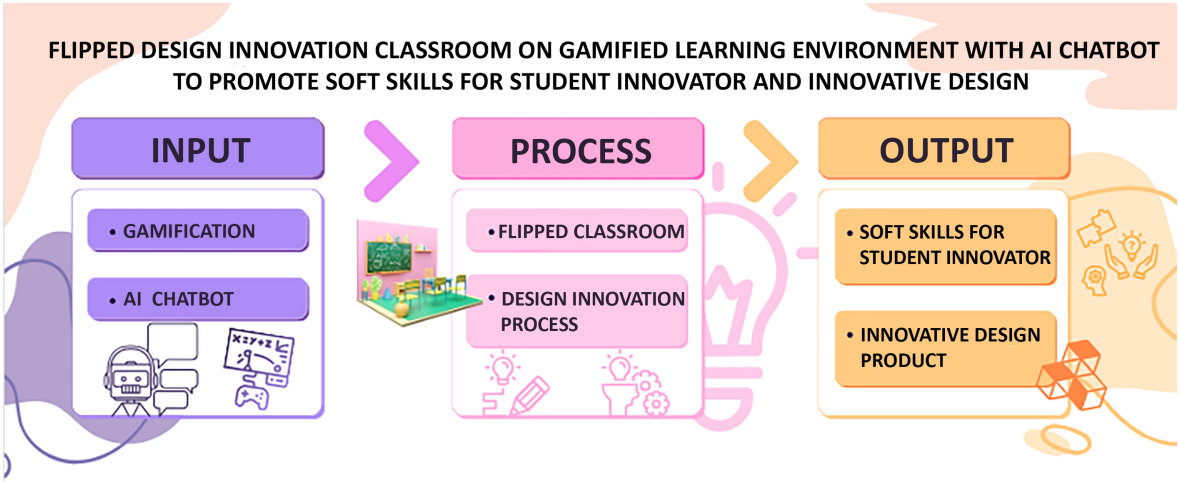

Fig. 4. Research framework.

III. Materials and Methods

A. Participants

The participants comprise 130 Grade 11 students from Srinakharinwirot Ongkharak Demonstration School, Nakhon Nayok, Thailand, identified through multi-stage sampling. Purposive sampling was used to select students who enrolled in the design and technology subject in the academic year 2024. All 130 students were ranked based on their academic performance in the subject. Stratified random sampling was then used to form groups of 4–5 students. Students were categorized as follows: 1–2 students with an average score of 85 or higher, 1–2 students with an average score below 60, and 2–3 students with an average score between 60–84.

B. Hypotheses

1) Students participating in a gamified flipped design innovation classroom with AI chatbot will demonstrate soft skills for student innovators at a level of "good" or higher.
2) Students participating in a gamified flipped design innovation classroom with AI chatbot will have innovative design scores at a level of "good" or higher.
3) The use of AI chatbot and the Gamification Platform influences the soft skills of student innovators.

C. Research Procedure

The research procedure was divided into 2 phases.

Phase 1: Development of a gamified flipped design innovation classroom with AI chatbot. This phase aims to develop a model that fosters soft skills on the part of student innovators and innovative design outcomes. The following steps outline the process: 1) Conduct a needs assessment to explore the use of information technology in teaching and project-based innovation learning among high school teachers in the basic education curriculum. Data will be collected through interviews and questionnaires targeting teachers selected through purposive sampling based on their

expertise in integrating information technology into teaching, with a minimum of three years' experience. Key areas of investigation include the implementation of flipped classroom strategies, gamification in educational contexts, the use of AI chatbots in education, the development of soft skills for student innovators and innovative design outcomes, challenges in teaching, and integrating technology and content suitable for enhancing soft skills and innovative design outcomes. 2) Review and synthesize relevant documents and research to obtain knowledge with regard to developing the classroom model. 3) Identify components that contribute to the development of soft skills on the part of student innovators and innovative design outcomes. 4) Summarize findings from the literature review and research synthesis to inform the development of the gamified flipped design innovation classroom with AI chatbot. 5) Develop evaluation tools to assess students' soft skills and innovative design. 6) Create a 5-level rating scale (Likert scale) for evaluating the appropriateness of the flipped classroom model and its components. 7) Develop a draft of the gamified flipped design innovation classroom with AI chatbot model and the evaluation tools, and submit them to experts for review. Revise and refine the model based on expert feedback. 8) Conduct an experimental evaluation of the appropriateness of the flipped classroom model and assessment tools. The evaluation will involve seven experts with at least five years of experiences in the field of educational technology and innovation education to ensure the model's suitability for fostering soft skills for student innovators and innovative design outcomes.

Phase 2: Examination of the effects of the flipped design innovation classroom model in a gamified learning environment enhanced by AI chatbot technology. This phase focuses on studying the impact of the flipped design innovation classroom model in terms of developing soft skills for student innovators and producing innovative design outcomes among students. The process involves the following steps: 1) Conduct an orientation session for instructors to explain the objectives of the flipped design innovation classroom model, including its gamified learning environment and AI chatbot integration. Prepare instructors to effectively implement the activities. 2) Instructors introduce students to the objectives and activities of the classroom model. This includes guidance on how to engage in learning activities using the flipped classroom approach with gamification and AI chatbot enhancements. 3) Conduct the experiment by having the sample group study computing science and design and technology subjects using the flipped design innovation classroom model. This approach aims to foster soft skills for student innovators and enhance innovative design outcomes. 4) Assess students' levels of soft skills and innovative design outcomes after completing the learning activities using the classroom model. 5) Collect data from the experiment and analyze it to determine the effectiveness of the classroom model in terms of achieving its objectives. 6) Summarize the results of the study, highlighting the impact of the flipped design innovation classroom model in a gamified learning environment enhanced by AI chatbot technology on students' soft skills and innovative design outcomes.

D. Data Analysis

The assessment methods used in the research include: 1) Descriptive statistics to calculate the mean and standard deviation for each criterion, using a Likert scale to determine the evaluation scores. 2) Pearson correlation coefficients to examine the relationship between student gamification levels, AI chatbot usage, and soft skills on the part of student innovators. 3) Regression analysis with Analysis of Variance (ANOVA) to examine the influences of AI chatbot and gamification usage on soft skills for student innovators, using SPSS.

IV. Result

Phase 1: Development of a gamified flipped design innovation classroom with AI chatbot.

A. Result of the Synthesis of the Flipped Classroom Process

The result of the synthesis of the flipped classroom process from related documents are as shown in Table 1.

According to Table 1, the synthesis of the flipped classroom learning process consisted of three distinct phases as follows:

Phase 1: Pre-Class Activities.

This session was used to prepare students for the foundation of knowledge needed before entering class, with students receiving learning material including videos, presentations or learning documents.

Phase 2: In-Class Activities.

During this session, students collaborate in group project-based learning activities, focusing on teamwork. Students have to apply the knowledge they acquired from the pre-class phase to solve problems or complete assignments.

Phase 3: Post-Class Activities.

In the post-class session, students need to review their work and evaluate group performance according to what is based on feedback. Post-class tasks assignments were in the form of follow-up assignments designed to consolidate learning outcomes.

Table 1. Result of the synthesis of the flipped classroom process

Flipped Classroom Process	[72]	[73]	[74]	[75]	[76]	[77]	[78]	[79]	[80]	Synthesis Result
Pre-Class Activities	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Testing / Quiz		✓		✓					✓	
Documents		✓	✓	✓	✓		✓	✓		✓
Multimedia						✓				
Videos	✓	✓		✓	✓	✓	✓	✓		✓
Scenarios						✓				
Questionnaires	✓	✓				✓		✓		
Interactive games						✓				
In-Class Activities	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Laboratory						✓				
Seminar						✓				
Collaboration Learning	✓			✓			✓	✓		✓
Case-Based Learning/ Project-Based Learning	✓	✓	✓		✓				✓	✓
Gamified online Quiz			✓							
Post-Class Activities		✓		✓	✓			✓	✓	✓
Homework/Assignment		✓		✓	✓			✓	✓	✓
Assessment		✓			✓					

B. Results of the Synthesis of the Design Thinking Process for Innovative Design

The result of the synthesis of the design thinking process

for innovative design from related documents are as shown in Table 2.

According to Table 2, the synthesis of the design thinking process for innovative design can be summarized in four key steps as follows:

Step 1. Empathize: Students develop an understanding of the problem or the user's needs by studying and collecting data related to the topic or issue, or gathering data directly from actual users or stakeholders.

Step 2. Define: Students define the problem from the root causes by using the data collected during the empathize phase, and analyze the information to identify the problem and propose solutions. This analysis can be presented in the form of diagrams or maps.

Step 3. Ideate: This step involves students generating diverse and unrestricted ideas and possible solutions to the problem. Activities such as brainstorming or using idea boards are utilized to facilitate innovative thinking and then to evaluate and select the best ideas for solving the problem.

Step 4. Prototype: Students create prototypes from their ideation process. These prototypes can take the form of 3D models or visual representations that effectively demonstrate their concepts and provide clear presentations of their ideas.

Table 2. Results of the synthesis of the design thinking process for innovative design

Design Thinking Process for Innovative Design	[81]	[82]	[83]	[84]	[85]	[86]	[87]	[88]	[89]	Synthesis Result
Inspiration	✓									
Empathize		✓	✓		✓		✓	✓	✓	✓
Define	✓	✓	✓		✓	✓		✓	✓	✓
Synthesis				✓						
Ideate	✓		✓	✓	✓	✓	✓	✓	✓	✓
Prototype			✓	✓	✓	✓	✓	✓	✓	✓
Simulation						✓				
Testing						✓	✓	✓	✓	
Implementation	✓			✓						

C. Results of the Synthesis of Soft Skills for Student Innovators

The results of the synthesis of soft skills for student innovators from related documents are as shown in Table 3.

According to Table 3, the soft skills for student innovators can be summarized as follows.

Table 3. Results of the synthesis of soft skills for student innovators

Soft Skills for Student Innovator	[5]	[27]	[28]	[30]	[31]	[32]	[33]	[34]	[90]	Synthesis Result
Communication Skills		✓		✓	✓	✓	✓	✓		✓
Innovative Thinking	✓	✓	✓	✓	✓	✓			✓	✓
Problem Solving Mindset	✓	✓	✓	✓	✓				✓	✓
Leadership Mindset		✓		✓	✓	✓	✓		✓	✓
Team Synergy		✓			✓	✓				
Networking	✓	✓	✓	✓			✓	✓		✓
Risk-Taking			✓				✓			
Decision-Making									✓	
Time-Managing		✓	✓			✓	✓	✓		✓

Communication skills refer to the ability to convey information clearly and effectively. This includes expressing creative ideas, being able to suggest and provide feedback clearly, understanding others' concerns in order to collaborate effectively and being able to present to various audiences.

Innovative thinking is the ability to generate creative ideas and solutions. It involves developing original and novel concepts that challenge the status quo. Students with innovative thinking are curious, and continuously seek new knowledge and experiences to inspire innovation. They are flexible, open to change, and able to adapt quickly to new information or situations. Additionally, they are willing to take risks and experiment with new ideas.

Problem-solving mindset refers to the attitude of continuously identifying and resolving problems from understanding root causes, and being able to always eagerly search for solutions, have a positive mindset in terms of finding solutions to problems, using available resources effectively to solve problems, having the determination and intention to overcome obstacles, and making informed and timely decisions to move towards solving problems.

Leadership mindset encompasses the ability to inspire and guide others no matter that position they are in the team. This involves having a clear vision for the direction of work and motivating others to work towards a shared goal. It also involves empowering team members to contribute their best work, take responsibility for outcomes, and continuously provide guidance and support to team members throughout the innovation process.

Networking refers to the ability to build and maintain professional relationships. This includes forming connections with colleagues, mentors, experts, and relevant stakeholders. Networking facilitates engaging in discussion and exchanging knowledge with regard to innovative ideas. It also involves requesting and offering assistance, knowledge, or resources within a professional network.

Time management refers to the ability to organize and prioritize tasks efficiently, being able to create plans or schedules and prioritize each task appropriately, including being able to complete tasks on time without decreasing quality and being flexible to adjusting task schedules as needed to meet challenges and seize opportunities for innovation.

D. Results of the Synthesis of Gamified Flipped Design Innovation Classroom with AI Chatbot to Promote Soft Skills for Student Innovator and Innovative Design

The results of the synthesis of gamified flipped design innovation classroom with AI chatbot to promote soft skills for student innovator and innovative design are illustrated in Fig 5.

E. The Evaluation of Gamified Flipped Design Innovation Classroom with AI Chatbot to Promote Soft Skills for Student Innovator and Innovative Design Model

According to Table 4, the evaluation results in terms of the overall appropriateness of the gamified flipped design innovation classroom with AI chatbot to promote soft skills for student innovator and innovative design model are deemed to be most suitable (Mean = 4.72, *S.D.* = 0.487).

F. The Evaluation of Student Innovator Skills Assessment

According to Table 5, the overall appropriateness of the student innovator skills assessment is considered to be most suitable (Mean = 4.69, *S.D.* = 0.47). The highest suitability rating was innovative thinking and problem-solving mindset, with mean scores of 4.86 (*S.D.*= 0.38), reflecting the experts'

opinion that the items effectively captured the concepts. Communication skills and networking were followed, both with mean scores of 4.71 (*S.D.*= 0.49), highlighting their relevance in fostering student innovators. leadership mindset and time management also received high evaluations, with mean scores of 4.57 (*S.D.*= 0.53) and 4.43 (*S.D.* = 0.53), indicating that these items were well-represented in the questionnaire.

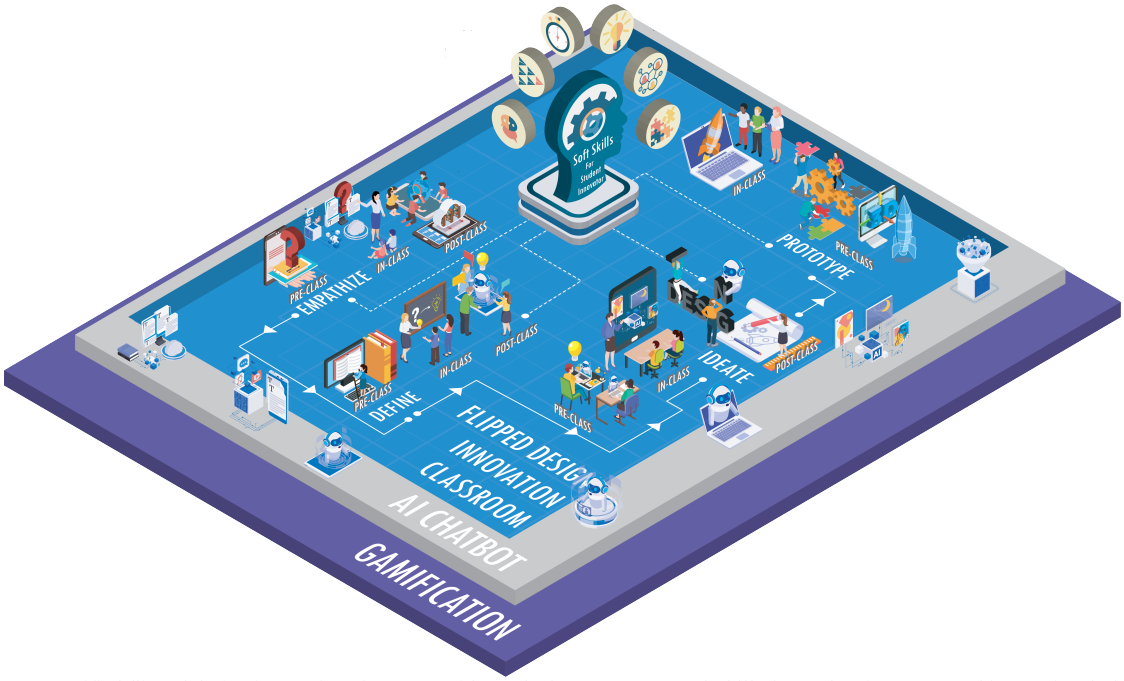

Fig. 5. Gamified flipped design innovation classroom with AI chatbot to promote soft skills for student innovator and innovative design.

Table 4. The appropriateness of the evaluation of gamified flipped design innovation classroom with AI chatbot to promote soft skills for student innovator and innovative design model

Evaluated Item	Level		Suitability Level
	Mean	*S.D.*	
The flipped classroom process can enhance soft skills for student innovators.	4.8	0.447	Most suitable
The design thinking process can enhance soft skills for student innovators.	4.6	0.548	Most suitable
A gamified learning environment enhanced with an AI-powered chatbot can support the flipped classroom in fostering soft skills for student innovators.	4.8	0.447	Most suitable
A learning activity plan using a flipped classroom with a gamified learning environment and AI-powered chatbot can enhance soft skills for student innovators and result in innovative design outcomes.	4.6	0.548	Most suitable
The flipped classroom model in a gamified learning environment, enhanced with an AI-powered chatbot, can enhance soft skills for student innovators and lead to innovative design outcomes.	4.8	0.447	Most suitable
Total	4.72	0.487	Most suitable

Table 5. The appropriateness of the evaluation of student innovator skills assessment

Evaluated Item	Level		Suitability Level
	Mean	*S.D.*	
Communication Skills Clear and coherent communication is established, with continuous engagement and interactive communication with others. The ability to adapt messages or communication methods to suit the audience effectively is demonstrated, along with excellent listening skills, including the ability to pay full attention, retain, and comprehensively understand the information received.	4.71	0.49	Most suitable
Innovative Thinking Consistently generates creative and innovative ideas, while continuously seeking new perspectives, knowledge, or technologies to integrate with the concepts.	4.86	0.38	Most suitable
Problem-Solving Mindset Accurately identifies problems at all times and devises effective, creative solutions. Demonstrates precise analysis in problem-solving and exhibits exceptional adaptability.	4.86	0.38	Most suitable
Leadership Mindset Consistently displays leadership qualities, inspiring and motivating others. Possesses the ability to delegate tasks systematically and appropriately, while serving as a positive role model.	4.57	0.53	Most suitable
Networking Continuously builds interdisciplinary relationships and maintains strong connections with others. Effectively leverages networks to create valuable knowledge and insights.	4.71	0.49	Most suitable
Time Management Demonstrates excellent time management skills, consistently demonstrating punctuality and the ability to prioritize tasks appropriately.	4.43	0.53	Most suitable
Total	4.69	0.47	Most suitable

G. The Results of the Study on Soft Skills Development and Innovative Design Outcomes of Students Learning through a Flipped Design Innovation Classroom in a Gamified Learning Environment with an AI Chatbot

According to Table 6, the results in terms of the data analysis revealed that, overall, the score level of students was at a good level (mean = 4.35, *S.D.* = 0.54). The time management dimension had the highest mean, rated at an excellent level (mean = 4.82, *S.D.* = 0.39), followed by leadership, which was also rated at an excellent level (mean = 4.67, *S.D.* = 0.55). The dimensions rated as good included communication skills (mean = 4.38, *S.D.* = 0.60), networking (mean = 4.21, *S.D.* = 0.61), and innovative thinking and problem-solving mindset (mean = 4.16). The standard deviations for all dimensions ranged from 0.39 to 0.64, indicating a relatively close distribution of the data. These aligns with Hypothesis 1. Innovative design rated as good (mean = 4.09, *S.D.* = 0.45), aligns with Hypothesis 2. An example of the innovative design project prototype is shown in Fig. 6. Students designed the first draft of their prototype, and improved the design with the help of AI chatbot.

Table 6. The results of the study on soft skills development and innovative design outcomes of students learning through a flipped design innovation classroom in a gamified learning environment with an AI chatbot

Evaluated Item	Level		Score Level
	Mean	*S.D.*	
Communication Skills	4.38	0.60	Good
Innovative Thinking	4.16	0.64	Good
Problem-Solving Mindset	4.16	0.51	Good
Leadership Mindset	4.67	0.55	Excellent
Networking	4.21	0.61	Good
Time Management	4.82	0.39	Excellent
Innovative Design	4.09	0.45	Good
Total	4.35	0.54	Good

Fig. 6. The example of innovative design project prototype.

H. The Results of the Study on Gamified Learning Environment with an AI Chatbot on Soft Skills for Student Innovators

Table 7. The results of correlations between student gamification level and AI chatbot usage and soft skills for student innovators

Variables		Soft Skill	Gamification Level	AI Usage Prompt
Soft Skill	Pearson Correlation	1	0.625**	0.688**
	Sig. (2-tailed)	-	0.000	0.000
	N	130	130	130
Gamification Level	Pearson Correlation	0.625**	1	0.581**
	Sig. (2-tailed)	0.000	-	0.000
	N	130	130	130
AI usage Prompt	Pearson Correlation	0.688**	0.581**	1
	Sig. (2-tailed)	0.000	0.000	-
	N	130	130	130

** Correlation is significant at the 0.01 level (2-tailed).

According to Table 7, the analysis revealed significant positive relationships among the three variables: soft skills, gamification usage, and AI usage. Soft skills showed a moderately high positive correlation with gamification usage (r = 0.625) and a strong positive correlation with AI usage (r = 0.688), both statistically significant at the 0.01 level. Gamification usage demonstrated a positive correlation with AI usage (r = 0.581) significant at the 0.01 level. These findings suggest a strong interconnection, particularly between soft skills and AI usage, indicating that the development of soft skills is closely linked to the application of AI technologies and gamification strategies in learning. The results emphasize the importance of these variables in enhancing learning outcomes through innovative and interactive methods.

According to Table 8 and Table 9, we see the results of the ANOVA analysis and coefficients showing the relationship between AI usage and four variables. The ANOVA for communication shows F = 28.075, p = 0.000, indicating statistical significance, with a total sum of squares of 24.312, divided into regression = 4.373 and residual = 19.939. In the case of innovative thinking, F = 83.859, p = 0.000, with a total sum of squares of 32.031, divided into regression = 12.679 and residual = 19.352. With regard to problem solving mindset, F = 41.253, p = 0.000, with a total sum of squares of 18.329, divided into regression = 4.516 and residual = 14.013. For networking, F = 156.019, p = 0.000, with a total sum of squares of 30.502, divided into regression = 16.756 and residual = 13.746. The coefficients show the following beta values: communication: beta = 0.424

(t = 5.299, p = 0.000), innovative thinking: beta = 0.629 (t = 9.157, p = 0.000), problem solving: beta = 0.494 (t = 6.423, p = 0.000), and networking: beta = 0.561 (t = 7.670, p = 0.000). The constants are communication: 3.267, Innovative thinking: 2.542, problem solving: 3.034, and networking: 3.741. In conclusion, the analysis shows that AI usage has a positive impact on all variables, with the greatest effect on innovative thinking (beta = 0.629) and the least effect on communication (beta = 0.424), with all relationships being statistically significant at the 0.000 level. The curve estimation result is shown in Figs. 7–10.

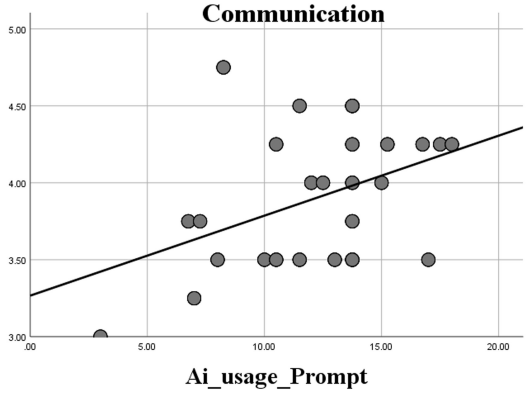

Fig. 7. The results of the analysis of the influence of AI usage on communication.

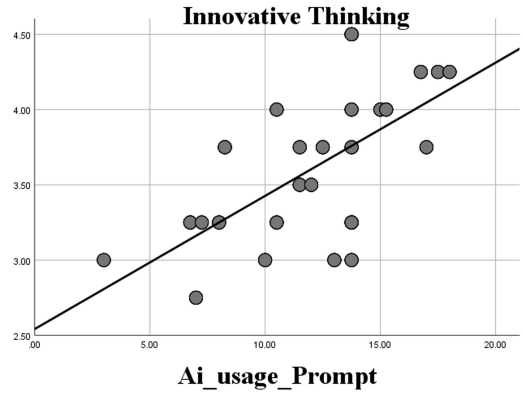

Fig. 8. The results of the analysis of the influence of AI usage on innovative thinking.

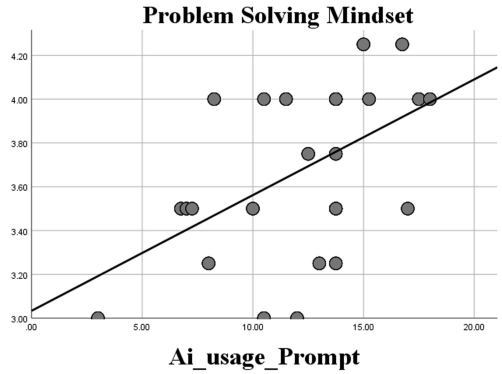

Fig. 9. The results of the analysis of the influence of AI usage on problem solving mindset.

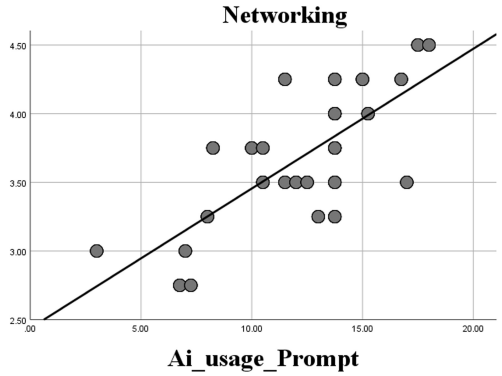

Fig. 10. The results of the analysis of the influence of AI usage on networking.

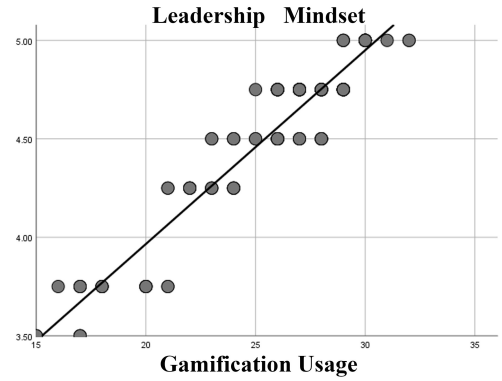

Fig. 11. The results of the analysis of the influence of gamification on leadership mindset.

Table 8. The results of the ANOVA analysis on the influence of AI usage on communication, innovative thinking, problem-solving mindset, and networking skills

		Sum of Squares	df	Mean Square	F	Sig.
Communication	Regression	4.373	1	4.373	28.075	0.000
	Residual	19.939	128	0.156	-	-
	Total	24.312	129	-	-	-
Innovative Thinking	Regression	12.679	1	12.679	83.859	0.000
	Residual	19.352	128	0.151	-	-
	Total	32.031	129	-	-	-
Problem Solving Mindset	Regression	4.516	1	4.516	41.253	0.000
	Residual	14.013	128	0.109	-	-
	Total	18.529	129	-	-	-
Networking	Regression	16.756	1	16.756	156.019	0.000
	Residual	13.746	128	0.107	-	-
	Total	30.502	129	-	-	-

The independent variable is AI_usage.

Table 10 and Table 11 shows the results of the ANOVA analysis and regression coefficients for two dependent variables: leadership mindset and time management. The ANOVA for leadership mindset shows an F-value of 1171.180 and a p-value (Sig.) of 0.000, indicating statistical significance, with the sum of squares for regression at 19.383 and residual at 2.118. The degrees of freedom are 1 for regression and 128 for residual, suggesting one independent variable. For time management, the F-value is 869.007 and the p-value (Sig.) is 0.000, also indicating statistical

significance, with sum of squares for regression at 19.479 and residual at 2.869. The regression coefficients show that for leadership mindset, the gamification level has a coefficient (B) of 0.098 and Beta of 0.9491, with a t-value of 34.223 and a *p*-value of 0.000, indicating a significant effect. The constant is 1.999 with a significance at *p*-value = 0.0001. For time management, the gamification level has a coefficient (B) of 0.099 and beta of 0.9341, with a t-value of 29.479 and a *p*-value of 0.000, indicating a significant effect. The constant is 2.066 with a significance at *p*-value = 0.0001. In conclusion, the analysis shows that gamification level has a significant positive influence on both leadership mindset and time management, with a strong correlation (beta > 0.90) in both cases. The curve estimation result is shown in Figs. 11–12.

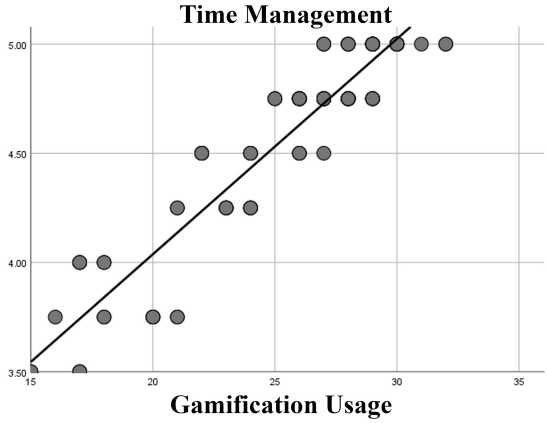

Fig. 12. The results of the analysis of the influence of gamification on time management.

Table 9. The results of the regression coefficients analysis on the influence of AI usage on communication, innovative thinking, problem-solving mindset, and networking skills

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
Communication	AI usage	0.052	0.010	0.424	5.299	0.000
	(Constant)	3.267	0.125	-	26.191	0.000
Innovative Thinking	AI usage	0.088	0.010	0.629	9.157	0.000
	(Constant)	2.542	0.123	-	20.685	0.000
Problem Solving Mindset	AI usage	0.053	0.008	0.494	6.423	0.000
	(Constant)	3.034	0.105	-	29.010	0.000
Networking	AI usage	0.066	0.009	0.561	7.670	0.000
	(Constant)	3.741	0.109	-	34.379	0.000

Table 10. The results of the ANOVA analysis on the influence of gamification usage on leadership mindset and time management

		Sum of Squares	df	Mean Square	F	Sig.
Leadership Mindset	Regression	19.383	1	19.383	1171.180	0.000
	Residual	2.118	128	0.017	-	-
	Total	21.502	129	-	-	-
Time Management	Regression	19.479	1	19.479	869.007	0.000
	Residual	2.869	128	0.022	-	-
	Total	22.348	129	-	-	-

The independent variable is gamification usage.

Table 11. The results of the regression coefficients analysis on the influence of gamification usage on leadership mindset and time management

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
Leadership Mindset	Gamification Usage	0.098	0.003	0.949	34.223	0.000
	(Constant)	1.999	0.075	-	26.709	0.000
Time Management	Gamification Usage	0.099	0.003	0.934	29.479	0.000
	(Constant)	2.066	0.087	-	23.718	0.000

V. Discussion

The results of this study indicate that gamified flipped design innovation classroom with AI chatbot can significantly promote the soft skills of student innovators. The statistical analysis shows that the use of AI chatbot has a positive influence on several skills, particularly with regard to innovative thinking, and also positively affects networking skills, communication, and problem-solving mindset, all of which are essential for student innovators due to their ability to provide personalized learning, real-time feedback, and more interactive and adaptive environments [91]. The results align with those of Ostin [91] that the integration of AI can have a positive impact on fostering soft skills as AI presents the opportunities for enhancing training activities, particularly in the realm of soft skills development [92]. Moreover, AI usage can help students create higher quality work regardless of their design experience [93]. Gamification usage shows a positive impact on leadership mindset and time management, suggesting that the use of game mechanics in learning can develop leadership as it goes beyond entertainment value by increasing engagement, fostering collaboration, encouraging behavioral change, and boosting group productivity [94] in order to achieve group tasks. The same is true with regard to time management skills, while a common approach was that most students worked on the assignment close to the deadline. Gamification, however can create a sense of responsibility when it comes to completing assignments on time, and many students started and finished early. As Malone [94] stated, academic stress is a cause of students' poor time management and that assignments with high engagement or low risk can mitigate stress and thereby improve time management.

All relationships were statistically significant, confirming the reliability of the findings. However, the varying R-squared values across models suggest that other factors may also influence skill development. Future research should explore these additional variables and investigate how cultural, institutional, or individual differences might affect the outcomes. Additionally, longitudinal studies could

provide deeper insights into the long-term impact of these tools on skill development. It is important to acknowledge that this study was conducted in a controlled educational setting focused on the field of design innovation study, which may limit the generalizability of the findings to other learning environments. The reliance on reported data for some measures may introduce response bias, and the relatively short intervention period may not fully capture the long-term effects of the gamified flipped design innovation classroom with AI Chatbot. Further research with diverse educational contexts and more objective skill assessment methods is recommended to validate and extend the findings.

VI. Conclusion

This study presents an innovative teaching approach that integrates flipped design innovation classrooms, gamification, and AI Chatbot to develop soft skills on the part of student innovators, including communication skills, innovative thinking, problem-solving mindset, leadership mindset, networking and time management. The results of the study were well-aligned with the hypotheses: 1) Students innovators participating in a gamified flipped design innovation classroom with AI chatbot will demonstrate soft skills at a level of "good" or higher. 2) Students participating in a gamified flipped design innovation classroom with AI chatbot will have innovative design scores at a level of "good" or higher. 3) The use of AI chatbot and the gamification platform influences soft skills on the part of student innovators. The research findings show a significant improvement in soft skills and innovative design projects which were rated good to excellent, and the statistical analysis showed strong relationships between AI chatbot and the gamified learning environment in terms of influencing the development of soft skills on the part of student innovators.

These findings have important implications for future instructional design, suggesting that the appropriate integration of technology can create a highly effective learning environment, especially in developing the essential skills for 21st-century innovators. Future research should focus on developing AI chatbot algorithms specific to each skill area, designing gamification mechanisms tailored to different learning contexts, studying the long-term effects of these technologies on learner development, analyzing potential confounding factors that may affect learning effectiveness, and exploring the sustainability of skill development outcomes using these methods.

Conflict of Interest

The author declares no conflict of interest.

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