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Development of an e-exhibition in conjunction with a game-based learning communication activity

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ABSTRACT

This study aimed to study and develop of an e-exhibition in conjunction with a game-based learning communication activity in order to raise the perception of green nudges for undergraduate students. The sample group was selected using simple random sampling by drawing 50 students who follow the Energy Environment Safety and Health's Facebook page from the undergraduate students at King Mongkut's University of Technology Thonburi in the 1/2022 academic year. It is found that the needs of the sample groups were at the highest level. The expert evaluation showed that the content quality was at the highest level, as was the quality of the presentation media. The perception of the sample group, after viewing the e-exhibition in conjunction with a game-based learning communication activity, was higher than beforehand, and their satisfaction level was at the highest level.

Keywords: e-exhibition; game-based; green nudges; undergraduate students

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1. INTRODUCTION

At present, there are widespread campaigns aimed at promoting energy and environmental conservation. Moreover, technology is continually advancing and plays a significant role in spreading information and news, resulting in prompt and convenient access to resources. One of the main goals of King Mongkut's University of Technology Thonburi (KMUTT) is to be a sustainable green university with activities and operations within the university, keeping environmental and energy conservation in mind. These activities are integrated into the teaching, learning, and research of every unit in the university, beginning with cultivating awareness and consciousness, extending to initiating activities within the university and the surrounding communities. In 2014, KMUTT initiated a program known as "Green Heart" for students across the university to volunteer to lead and participate in the activities. The program encouraged innovation related to sustainability, aiming to develop a better environment for the university, and to improve understanding of the effects of technology on society, the environment, energy awareness, sustainability, and safety on campus and in nearby communities. Since that time, the university has undertaken many activities to develop Green Heart among students and "Green Learning and Sharing" through learning processes and continuous and systematic involvement according to 2030 SGDs. Moreover, KMUTT has joined the sustainable university network, both at the national and international levels. At the national level, KMUTT is a member of Sustainable University Network of Thailand (SUN Thailand), while, at the international level, the KMUTT is a member of both the Asian Sustainable Campus Network (ASCN) and the International Sustainable Campus Network (ISCN). Also, KMUTT participates as a pilot campus in the Youth

Education and Advocacy Program-United Nations Environment Program (YEA-UNEP), a program that proposes positive changes in behaviors to reduce the university's negative effects on the environment under the concepts detailed in the "Little Book of Green Nudges," which came out on September 1, 2020 (King Mongkut's University of Technology Thonburi, 2020).

The green nudges project aims mainly to enhance the capability of students, personnel, and staff members at the university with respect to behaviors regarding energy and environmental conservation. The goal is to enhance sustainability in terms of the environment of the university in accordance with KMUTT's policies, which call for development of a "green heart" among students, while stimulating changes in the university's environment through implementation of strategies from "nudge theory" that encourage positive incremental behavioral changes. The hope is that these changes will lead to sustainable management of the environment within the university using indirect guidance to create motivation and positively influence decisions. All of this is carried out in a non-confrontational way; the aim is to encourage people to adjust behaviors with consent under the freedom provided by the university to empower everyone in the KMUTT community. Even though the use of the nudge theory in the project was announced in 2021, widespread communication to the community, especially among the undergraduate students, has been hampered due to the COVID-19 situation (United Nations Environment Programme, GRIDArendal and Behavioural Insights Team, 2020). The COVID-19 pandemic led to changes in daily life, including how people work and how they organize activities. Therefore, new technologies, techniques, and tools to facilitate and address humans' needs sprang up, and they play important roles in our daily routines, including the publication of news and information. The use of desktop computers, laptops, tablets, and smartphones with wireless internet connection allow easier and more convenient access to resources and ensure information is up-to-date.

Public relations is a strategic endeavor centered on cultivating a positive and reputable image for an organization or business. Its primary objectives revolve around fostering transparency, instilling trust, and promoting a favorable perception of the entity. Through meticulously planned and executed communication efforts, public relations aims to effectively disseminate organizational news and information while simultaneously establishing a conducive environment for enhancing the organization's overall reputation. Institutions of higher learning have a significant role in public science communication. Universities, as centers of knowledge generation, provide major contributions to both the dissemination of scientific information to society and the general public. Studies now available show that communication and public relations (PR) departments at higher education institutions have become more professionalized in terms of instructions, procedures, and standards. They have also grown greatly in recent decades, as shown by the increase in resources, channels utilized, or stakeholders addressed (Volk et al., 2023). Through the growing significance of websites, blogs, and social media platforms like Facebook, Twitter, YouTube, and Instagram, in many facets of daily life, digitalization has influenced PR for more than two decades. Role perceptions, working methods, and procedures have undergone, and continue to undergo, constant change. Expertise and specialty in the workplace frequently gain importance. For instance, as a result of digitization, new talents are emerging, such as those related to the usage of social media, which also creates a new demand for it (Bernhard and Russmann, 2023). One of the key concerns of humanity around the globe is the environment. Numerous experts contend that the post-Corona age presents nations with a unique chance to implement the concepts of sustainable development and green economic recovery. Through the use of a survey, the main success elements of e-exhibition on the revival of the green economy were investigated. The existence of international collaboration, green culture, and visitor attitude are the most crucial success aspects of an e-exhibition to have green economic recovery. An essential practical strategy is the government's support for e-exhibitions through its environmental organizations (Shang et al., 2023).

E-exhibition is a method of holding an exhibition in which audience members can encounter and participate in the exhibition without being physically present. It provides an effective communication tool that is gaining popularity and playing an increasingly important role in modern society. E-exhibition can be improved and used more frequently and effectively. Metaverse is a three-dimensional virtual platform that enables people living in different worlds to meet, chat, and engage in various activities together through avatars. In the future developments, all interactions will become more lifelike. People will be able to walk up to a coworker's desk in the virtual world, sit down together, and have more natural conversations. Instead of viewing artworks through websites, they can put on 3D glasses and stroll around museums as if they were physically there. With the ability to create various things in the Metaverse so realistically, it is possible to learn through new teaching methods that go beyond merely presenting information visually. This aids learners in gaining a much deeper understanding of different subjects. Additionally, learners can acquire knowledge from anywhere in the world and experience scenarios as if they were real. Spatial is another virtual world that can create spaces for various activities, whether it's hosting online meetings, offering online courses, or holding different exhibitions. It can accommodate up to 50 people per space, and numerous organizations and platforms have already utilized Spatial to organize events within its virtual environment (Srupsrisopa, 2022). With the various advantages of Metaverse, such as providing immersive experiences, unrestricted by time and place, building virtual communities, improving social interactions, elevating online social media, and developing online learning (Sriphaan, 2023), it has become a focal point of public relations efforts aimed at enhancing point of public relations efforts aimed at enhancing awareness and understanding of green nudges.

In contrast to game-based learning, which creates learning activities that are inherently game-like, gamification adds game features or a game framework to already-existing learning activities. Both gamification and game-based learning encourage participation and ongoing enthusiasm for learning. Duolingo, Minecraft, Second Life, Coursera, Brainscape, and Kahoot! are some examples of gamification and game-based learning tools. Kahoot! is a classroom response system that is free to use and does not require student sign-up; they simply create a game of Kahoot!, enter questions, and supply the provided pin to the students. Their classmates will then use their phones or laptops to play the game and answer questions (Moore-Russo et al., 2017). Game-based learning is a method that

helps learners explore various topics in a fun and challenging way, where the learners themselves are the players. This approach provides hands-on experience and encourages active participation in the learning process. It offers an enjoyable and engaging learning experience through play, enabling learners to learn by doing. This method fosters self-directed learning, making the learning process meaningful and sustainable. Moreover, games serve as tools and techniques that allow learners to explore different subjects joyfully, have fun, relax, and reduce stress. With high levels of involvement, learning becomes efficient and effective, yielding positive outcomes (Srinathiyawasin, 2021).

When considering all this background, coupled with the problem of having a limited number of media and activities for public relations that fail to sufficiently captivate students' interest, the researchers, as staff members of the Energy Environment Safety and Health Office, saw the importance of offering a learning experience using e-exhibition in combination with game-based learning communication activities to increase the perception of KMUTT green nudges among undergraduate students at KMUTT. The goal was to raise the perception of practice guidelines based on the idea of green nudges. It was further anticipated that students would also gain knowledge from participating in the learning experience outside the class, allowing them to learn regardless of place and time.

Objectives:

The objectives of this study were 1) to survey the needs of the sample group towards the development of an e-exhibition in conjunction with a game-based learning communication activity in order to raise awareness of the green nudges concept for undergraduate students; 2) to develop and identify the quality of the development of the e-exhibition in conjunction with a game-based learning communication activity; 3) to study and compare the perceptions of the green nudges concept among the sample group before and after visiting the developed e-exhibition in conjunction with a game-based learning communication activity; and 4) to assess the satisfaction level of the sample group towards the e-exhibition in conjunction with the game-based learning communication activity.

2. MATERIALS AND METHODS

2.1 Materials

The researchers designed and developed an e-exhibition to raise the perception of the green nudges concept among undergraduate students. After that, a game-based activity was conducted and evaluated based on the ADDIE model (Nichols Hess, and Greer, 2016), as described in Table 1

2.2 Population

The population of this study comprised 9,700 undergraduate students in the first semester of the 2022 academic year at KMUTT who followed the Energy Environment Safety and Health (EESH) Facebook page.

The sample group of this study were selected using simple random sampling by drawing 50 student names from the population of students who followed the EESH Facebook page.

Table 1. The five steps of ADDIE model used in the study

Phase 1 Analyze	Analyze the data obtained from the needs assessment of the sample group
Phase 2 Design	Study relevant concepts, ideas, and theories to develop a guideline for developing the e-exhibition
Phase 3 Develop	Develop the e-exhibition using three types of presentation media: 1) videos; 2) infographics; and 3) motion graphics with narration. These were publicized on Spatial.io
Phase 4 Implement	Hold a 90-minute e-exhibition in conjunction with a game-based learning communication activity via Zoom
Phase 5 Evaluate	Assess the perception and satisfaction levels of the sample group towards the e-exhibition and game-based learning communication activity

2.3 Research instruments

A needs assessment of the sample group of 50 people with respect to the development of an e-exhibition in conjunction with a game-based learning communication activity was used in order to raise perception of the green nudges concept for undergraduate students. Data collection was conducted in November, 2022 through use of Google Forms.

The e-exhibition was created in conjunction with a game-based learning communication activity to raise undergraduate students' perception of the concept of green nudges.

An evaluation form was used relating to the quality of the content and presentation media of the e-exhibition. This was rated by six experts in the relevant fields. Experts all had Master's degrees and relevant work experience of at least five years. The statistics used in this study included the means and standard deviations. Data collection was conducted in December, 2022 by the researchers.

An evaluation form measured the sample group's perceptions before and after viewing the e-exhibition in conjunction with the game-based learning communication activity. The statistics used in this study included *t*-tests. Data collection was conducted through the use of Google Forms.

An evaluation form measured the satisfaction level of the sample group with the e-exhibition in conjunction with the game-based learning communication activity.

All of these tools were used by three experts. They obtained an item-objective congruence (IOC) score of 0.70–1.00.

2.4 Data analysis

The statistics used in this study included means, standard deviations, and *t*-tests (Srisa-ard, 2002). Interpretation of the mean scores considered the following scale:

4.51–5.00 Excellent / Highest

3.51–4.50	Good / High
2.51–3.50	Fair / Moderate
1.51–2.50	Below Average / Relatively Low
1.00–1.50	Poor / Low

3. RESULTS

3.1 The needs assessment

From the needs assessment in Table 2, the overall mean was 4.67, while the standard deviation was 0.49. Compared to the established criteria, it was found that needs were at the highest level. When considering needs in each aspect, the results show that the most desirable type of media in the e-exhibition was infographic posters ($\overline{x}$ = 4.78, *SD* = 0.42), while the most desirable type of activity was online communication activities on EESH's Facebook page ($\overline{x}$ = 4.80, *SD* = 0.40). The most desirable type of content related to information about the need to adjust food consumption behaviors, to be mindful about energy, and environmental conservation ($\overline{x}$ = 4.68, *SD* = 0.47). As for the visual and graphic aspect, using real images together with graphics in the media was identified as the most desirable ($\overline{x}$ = 4.78, *SD* = 0.42), and, in the audio aspect, using teen narrators' voices was the most desirable ($\overline{x}$ = 4.74, *SD* = 0.44). Following the needs assessment, the researchers designed and developed an e-exhibition to raise awareness of the green nudges concept among the undergraduate students. After that, the researchers conducted a game-based activity and evaluation.

Table 2. Results of the needs assessment of the sample group

Items	Results		
	Mean ($\overline{X}$)	Standard deviation	Level
1.Desirable types of media in the e-exhibition			
1.1 Videos	4.72	0.50	Highest
1.2 Infographic	4.78	0.42	Highest
1.3 Photos	4.68	0.55	Highest
Average score	4.73	0.49	Highest
2. Desirable types of activities			
2.1 Holding e-exhibition on the website Spatial.io	4.68	0.47	Highest
2.2 Offering online communicating activities on EESH's Facebook page	4.80	0.40	Highest
2.3 Holding e-exhibition on the website and concurrently offering online communicating activities on the page	4.68	0.51	Highest
Average score	4.72	0.47	Highest
3. The 4-area contents			
3.1 Knowledge of the need to adjust food consumption behaviors to be mindful about energy and environmental conservation			
-Knowledge of "eat sustainably with zero waste"	4.70	0.46	Highest
-Knowledge of "no using trays and picking the right-size plates"	4.74	0.44	Highest
-Knowledge of using plants as a main ingredient for cooking	4.60	0.49	Highest
Average score	4.68	0.47	Highest
3.2 Knowledge of the need to adjust transportation behaviors to be mindful about energy and environmental conservation			
-Knowledge of sustainable travel	4.56	0.54	Highest
-Knowledge of building love of cycling in the university	4.76	0.43	Highest
-Knowledge of supporting the well-being of communities	4.56	0.50	Highest
Average score	4.63	0.50	Highest
3.3 Knowledge of the need to adjust the use of energy and water to be mindful about energy and environmental conservation			
-Knowledge of using (consumers') personal food containers	4.66	0.48	Highest
-Knowledge of utilizing power-saving mode	4.74	0.44	Highest
-Knowledge of water conservation	4.52	0.54	Highest
Average score	4.64	0.50	Highest
3.4 Knowledge of the need to reduce waste or plastic to be mindful about energy and environmental conservation			
-Knowledge of eating food without wasting anything	4.60	0.49	Highest
-Knowledge of how to properly separate waste	4.64	0.48	Highest
-Knowledge of checking the date of the product before purchasing	4.42	0.54	High
Average score	4.55	0.51	Highest
4. Visual and graphic aspect			
4.1 Using real images together with graphics in the media	4.78	0.42	Highest
4.2 Using green tone graphics	4.70	0.46	Highest
4.3 Using bright designs	4.68	0.47	Highest
Average score	4.72	0.45	Highest

Table 2. (Continued)

Items	Results		
	Mean ($\bar{X}$)	Standard deviation	Level
5. Audio aspect			
5.1 Using teen narrators' voices	4.74	0.44	Highest
5.2 Using lively music	4.58	0.57	Highest
5.3 Using realistic sound effects	4.66	0.52	Highest
Average score	4.66	0.52	Highest
Overall average score	4.67	0.49	Highest

3.2 The development of the e-exhibition in conjunction with the game-based learning communication activity

The researchers developed an e-exhibition to raise awareness of the green nudges concept, which comprised the four aspects of 1) food conservation, 2) transportation conservation, 3) energy and environmental conservation, and 4) reduction. The exhibition was presented in three formats, i.e., 1) videos, 2) infographics, and 3) motion graphics with narration, through Spatial.io, a platform that allowed for the creation of virtual avatars and spaces to organize live events and interact with other people in a metaverse environment, in order to make it more interesting to the target group, as shown in Figure 1. (Kaewsomnues, 2023).

The researchers held the e-exhibition using Kahoot! They participated in a 90-min Zoom meeting with the following process (Table3).

The set goals for the development of the e-exhibition in conjunction with game-based communication activities were based on the ADDIE model (Nichols Hess, and Greer, 2016) using five phases: 1) analyzing the content to be presented in the e-exhibition, phase; 2) designing learning format through the e-exhibition; 3) developing the 28 audiovisual and infographic resources to be used as learning media for the e-exhibition; 4) implementing the e-exhibition's and the learning game's usability and quality; and 5) evaluating the perception and satisfaction levels of the sample group towards the electronic exhibition and game-based learning communication activity, as described in Figure 3.

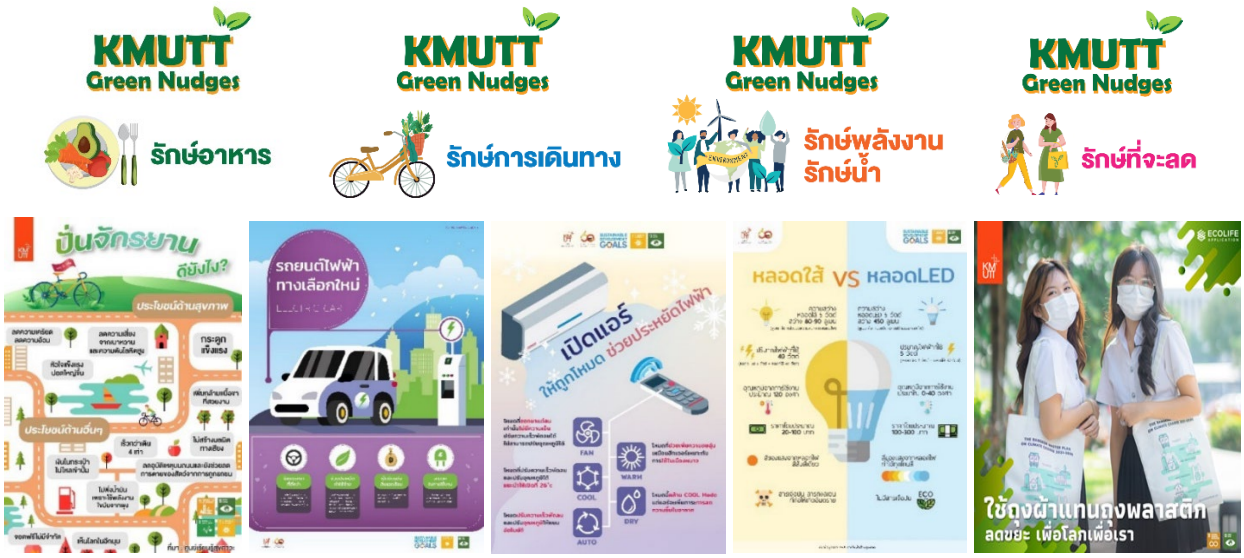

Figure 1. Content of the e-exhibition to raise awareness of the green nudges concept

Table 3. Process of holding game-based communication activities

The process of holding game-based communication activities	Details of the activities
Stage 1: Introduction	1) The students completed an evaluation form of their perceptions before viewing the KMUTT green nudges e-exhibition (10 minutes) as shown in Figure 2. (Kaewsomnues, 2023) 2) The students entered the e-exhibition through Spatial.io to learn about KMUTT green nudges. Content consisted of 1) food conservation, 2) transportation conservation, 3) energy and environmental conservation, and 4) reduction presented by videos, infographics, and motion graphics with narration (30 minutes).

Table 3. (Continued)

The process of holding game-based communication activities	Details of the activities
Stage 2: Teaching	1) An expert talked about KMUTT green nudges (20 minutes) 2) The sample group answered 10 questions presented on the Kahoot! platform to review the information from the presentation (10 minutes)
Stage 3: Conclusion	The speaker and the students discussed and summarized what they had learned about KMUTT green nudges (10 minutes)
Stage 4: Evaluation	1.) The students completed an evaluation form about their perceptions after viewing the KMUTT green nudges e-exhibition (10 minutes) 2.) The students did an evaluation of their satisfaction level with respect to the e-exhibition and game-based learning communication activity (5 minutes)

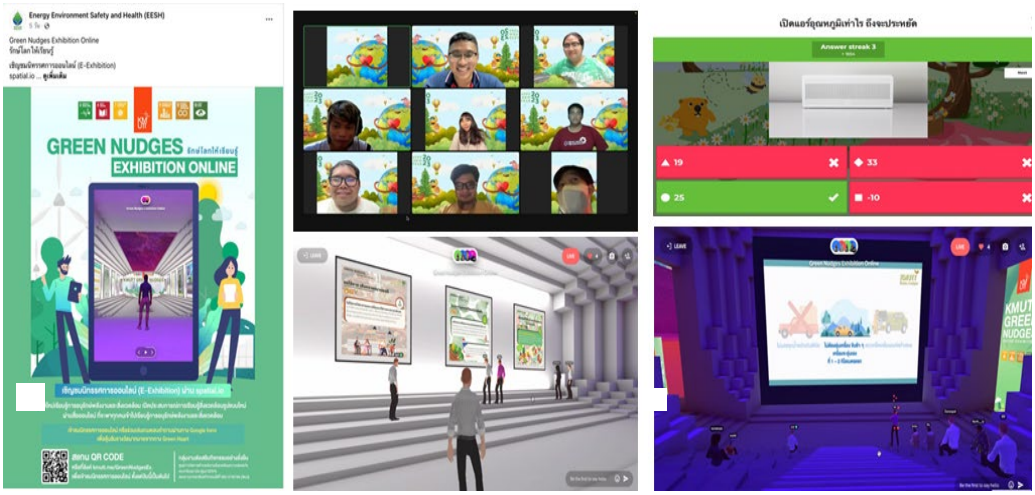

Figure 2. Screen shots of the e-exhibition in conjunction with game-based communication activities

3.3 Expert ratings of content quality

As seen in Table 4, the total mean was 4.78 for the quality of content evaluation given by the three experts in the field towards the e-exhibition in conjunction with game-based learning in order to raise awareness of the green nudges concept. The standard deviation was 0.42. When compared with the established criteria, it was found that the overall quality was at the excellent level.

3.4 Expert evaluation of the presentation media quality

As seen in Table 5, the overall mean of the quality of the presentation media was 4.56, while the standard deviation was 0.50. When compared with the established criteria, it was found that the overall quality was at an excellent level. When looking at each aspect, the item that ranked the highest was the visual and graphic aspect, ($\overline{x}$ = 4.60, *SD* = 0.51), followed by the font and audio aspect ($\overline{x}$ = 4.58, *SD* = 0.51), and the media presentation and activity aspect ($\overline{x}$ = 4.50, *SD* = 0.52).

3.5 Comparison of the perception of the sample group before and after viewing the e-exhibition together with the game-based communication activity

From the comparison in Table 6, it was found that the perception level before viewing the e-exhibition in conjunction with game-based learning communication activities had a mean score of 2.18, with a standard deviation of 0.26 The mean score went up to 4.35 with a standard deviation of 0.35 after viewing the e-exhibition at .05 statistical significance (*t*-test = 32.84). The results of higher than before viewing the media and participating in the activities regarding the four areas of green nudges, statistically significant at the .05 level.

3.6 Satisfaction level assessment of the sample group

From Table 7, the overall satisfaction of the sample group of 50 people with respect to the e-exhibition in conjunction with a game-based communication activity was at the highest level. The overall mean was 4.55, while the standard deviation was 0.57. A closer look at each aspect reveals that satisfaction was basically the same for all three, with the content at $\overline{x}$ = 4.56 and *SD* = 0.54, the visual and audio aspect at $\overline{x}$ = 4.55 and *SD* = 0.57, and the presentation aspect at $\overline{x}$ = 4.55 and *SD* = 0.60. In the content aspect the sample group were satisfied with concise and easy to understand content, and that the received content and information could be applied in practice. In the visual and audio aspect the sample group were satisfied with the clear audio and attractive and eye-catching visuals. In the presentation aspect, the sample group were satisfied that the e-exhibition inspired students to see the importance of energy and environmental conservation; they gained knowledge and understanding

from the e-exhibition on Spatial.io, and had fun doing the game-based activities the *t*-test show that students' post-perception scores were higher than before viewing the media and participating in the activities regarding the four areas of green nudges, statistically significant at the .05 level.

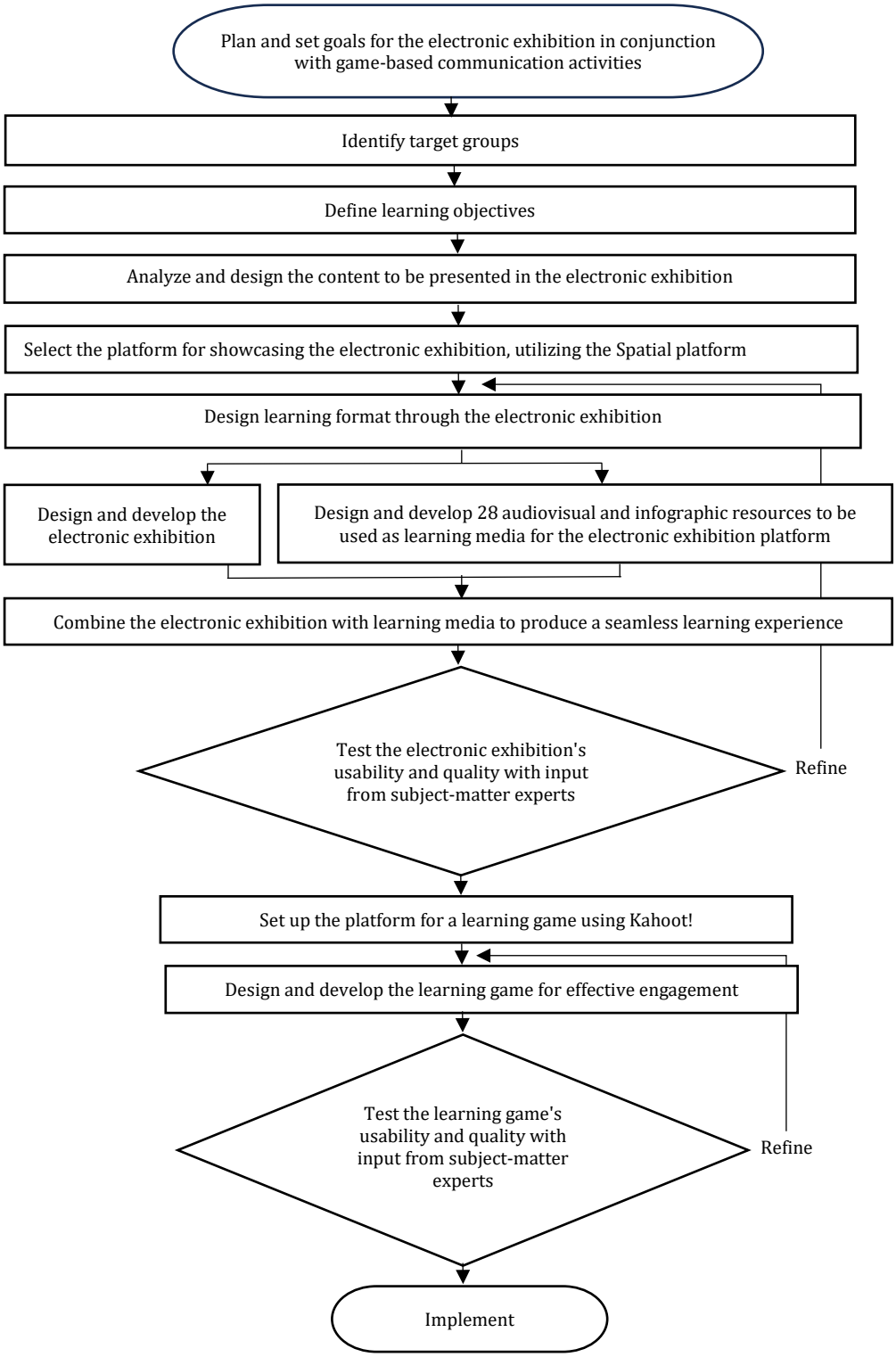

Figure 3. System design of the e-exhibition

Table 4. Results of the content quality assessment

Item	Results		
	$\bar{X}$	*SD*	Level
1. The content was consistent with the objectives	5.00	0	Excellent
2. The content clearly presented the green nudges concept.	5.00	0	Excellent
3. The content inspired ideas about energy and environmental conservation.	4.33	0.58	Good
4. The content was easy to understand.	5.00	0	Excellent
5. The content was accurate and reliable.	5.00	0	Excellent
6. The content was consistent with the visuals.	4.33	0.58	Good
7. The content was consistent with graphics.	5.00	0	Excellent
8. The content was useful and interesting.	5.00	0	Excellent
9. The presented content was concise for the time.	4.33	0.58	Good
Total average score	4.78	0.42	Excellent

Table 5. Results of quality assessment of the presentation media

Item	Results		
	$\bar{X}$	*SD*	Level
1. The visual and graphic aspect			
1.1 Visuals and graphics were clear and interesting.	4.43	0.58	Good
1.2 Visuals and graphics were beautiful.	4.43	0.58	Good
1.3 Visuals and graphics were consistent with the contents.	5.00	0	Excellent
1.4 The implications were easy to understand.	4.33	0.58	Good
1.5 The color tones used were suitable with the Green nudges concept.	5.00	0	Excellent
Average score	4.60	0.51	Excellent
2. The font and audio aspect			
2.1 The size was appropriate to the screen area.	4.33	0.58	Good
2.2 The fonts and the backgrounds were appropriately placed.	4.67	0.58	Excellent
2.3 The audio used to narrate in the media was clear and accurate, and consistent with the content.	5.00	0.00	Excellent
2.4 The accompanying audio helped make the presentation more interesting.	4.33	0.58	Good
Average score	4.58	0.51	Excellent
3. The media presentation and activity aspect			
3.1 The electronic devices were easy to use.	4.33	0.58	Good
3.2 The visibility of the screen was clear and easy to watch.	4.33	0.58	Excellent
3.3 The game-based activities were attractive.	5.00	0	Excellent
Average Score	4.50	0.52	Excellent
Total average score	4.56	0.50	Excellent

Table 6. Comparison of the sample groups perceptions before and after the e-exhibition

Perception assessment results	*n*	$\bar{X}$	*SD*	*t*-test	df	Sig.
Before viewing the e-exhibition	50	2.18	0.26	32.84	49	0.00*
After viewing the e-exhibition	50	4.35	0.35			

Note: * with statistical significance at the .05 level

Table 7. Satisfaction levels of the sample group

Item	Results		
	$\bar{X}$	*SD*	Level
1.Content aspect			
1.1 The content was concise and easy to understand.	4.76	0.48	Highest
1.2 The content organization helped the ease of understanding.	4.48	0.48	High
1.3 The content and information received can be applied in practice.	4.54	0.54	Highest
1.4 The content and information encouraged awareness of energy and environmental conservation based on the concept of green nudges.	4.46	0.54	High
Average score	4.56	0.54	Highest
2. Visual and audio aspect			
2.1 The visuals and the audio were clear.	4.64	0.53	Highest
2.2 Visual compositions were attractive and eye-catching.	4.54	0.58	Highest
2.3 The visuals and the audio descriptions were related.	4.50	0.54	High
2.4 The music and the sound effects helped made the media interesting.	4.50	0.61	High
Average score	4.55	0.57	Highest

Table 7. (Continued)

Item	Results		
	$\bar{X}$	*SD*	Level
3. Presentative aspect			
3.1 It was easy to use the electronic devices.	4.46	0.68	High
3.2 The presentation on Spatial.io was interesting	4.52	0.58	Highest
3.3 Students gained knowledge and understanding from the e-exhibition on Spatial.io	4.58	0.61	Highest
3.4 Students had fun doing the game-based activities	4.58	0.57	Highest
3.5 The e-exhibition inspired students to see the importance of energy and environmental conservation.	4.60	0.57	Highest
Average score	4.55	4.60	Highest
Total average score	4.55	0.57	Highest

4. DISCUSSION

The result of the needs assessment was at the highest level ($\bar{x}$ = 4.67, *SD* = 0.49), indicating that the sample group would like an e-exhibition in conjunction with a game-based communication activity to be developed. The formats, content, and activities that the researcher developed were based on the analysis of the needs of the sample group, whose interest in the concept corresponded to the demand survey of the sampling group of 30 third-year undergraduate students in KMUTT in academic year of 2020 who enrolled in the ETM 314 Professional Experiences in Educational Technology and Mass Communication course. The interactive multimedia and activities for new normal public relations to promote the public image of the Continuing Education Center was at a high level ($\bar{x}$ = 4.40, *SD* = 0.65). Therefore, the researchers developed multimedia and activities for new normal public relations to promote the public image of the Continuing Education Center to the undergraduate students who comprised Generation Z aged individuals (Namaso et al., 2022). Generation Z, or "Gen Z", refers to those born between 1997 and 2012. They are currently between 9 and 24 years old. They will soon become the majority of people in the Asian region. At the moment, the population of Gen Z accounts for 24% of the whole population, and in the future, they will become the main consumer group (Workpoint Today, 2021).

The researchers developed an e-exhibition based on four aspects of the concept. The quality of the content was evaluated at the excellent level ($\bar{x}$ = 4.78, *SD* = 0.42) by the experts, as were the presentation media ($\bar{x}$ = 4.67, *SD* = 0.48). The researchers design was based on the five stages of the ADDIE model (Insa-ard, 2018). It was found that the quality of the content was at the excellent level ($\bar{x}$ = 4.54, *SD* = 0.51), as was the presentation media ($\bar{x}$ = 4.56, *SD* = 0.51). According to research by Tafonao et al., (2020) on learning media and technology, there are a number of ways that technology media might help generation Z and generation Alpha learn. First, pupils' perceptions in the classroom may become uniform due to technology media. Second, technology-based media can promote communication between teachers and students. Third, media technology may effectively and efficiently expedite the teaching and learning process. Fourth, digital media can encourage positive learning attitudes. Fifth, technological media can provide solutions to the problems that the digital world presents. The dynamics of learning in the digital age can be improved by allowing educators to access the demands of generation Z and Alpha students by utilizing technological expertise. As time moves quicker and faster every day. This research project developed videos, infographics, and motion graphics with narration, and has been publicized through Spatial.io in order to address the needs of the targeted generation.

When the sample group's perceptions before and after viewing the e-exhibition in conjunction with a game-based communication activity were compared, it was discovered that the sample group's perceptions after viewing were at a higher level than before, with statistical significance at .05. This was probably because there was a process to promote awareness through the e-exhibition, which comprised videos, infographics, and motion graphics with narration. After the presentation, the speaker and students discussed and concluded the lessons learned about KMUTT green nudges. The students then played a game to encourage awareness and interaction throughout their learning process. As a result, good recognition followed. According to the study of Disara (2019), which found that the learning outcomes of the sample group after viewing a virtual museum on Thungwa Ancient Elephants, Satun province was higher than before viewing. It could be concluded that if people receive information and knowledge through appropriate learning formats with the use of the senses, and combine it with relevant experience and interpretation of the things that they touch, it may result in better perception and reactions. According to Iman et al. (2021)'s study students studying chemistry had a positive opinion of game-based learning platforms as a tool for evaluating their learning. Additionally, students felt that Kahoot! made learning more difficult. Kahoot! is another engaging and entertaining tool for testing kids. Direct feedback from Kahoot! is particularly successful in rectifying errors since students feel that their learning drive has grown in preparation for the test. In this research study, the researchers utilized game-based media and communication activities, particularly employing Kahoot! as a tool to enhance interaction with students. Using questions to review perceptions regarding green nudges through Kahoot!, it was found that students found the activities enjoyable and participated more actively in communication activities. Entertainment value also increased.

The satisfaction level of the sample group towards the development of the e-exhibition and game-based communication activity was at the highest level ($\bar{x}$ = 4.55, *SD* = 0.57). This was because the researchers developed the e-exhibition based on evaluation from experts in the field of content and presentation media, and the results of the assessment of the sample group's needs. According to Srupsrisopa (2022) Spatial.io is a cutting-edge Metaverse platform designed to facilitate diverse activities, such as online meetings, virtual courses, and interactive

exhibitions. Its innovative approach to education transcends traditional verbal communication, fostering a more profound comprehension of various subjects. Furthermore, Spatial.io empowers learners to participate from any location globally, providing an immersive and authentic learning experience. This showed that the e-exhibition and game-based communication activity, which were developed by analyzing the sample group's needs and relying on the experts' evaluations, caused the highest level of satisfaction among the sample group. The trend of educational management and public relations communication in various institutions in Thailand has shown increased interest in utilizing the Metaverse. This involves using the Metaverse as a medium for teaching and learning, as well as for organizational and institutional communication. Additionally, in the year 2022, the Ministry of Education, Science, Research, and Innovation invested jointly with public and private sector organizations. The aim was to revolutionize Thailand's education by establishing the largest Metaverse education community in the country on the Aniverse Metaverse platform. The successful completion of this project would undoubtedly lead to significant transformations within the realm of education in Thailand (Sriphaan, 2023).

The findings show that the development of an e-exhibition in conjunction with a game-based communication activity was able to raise the perceptions of the green nudges concept in all four aspects: 1) food conservation, 2) transportation conservation, 3) energy and environmental conservation, and 4) reduction through presentation in the form of videos, infographics, and motion graphics with narration. The game was used to increase fun among the sample group so that they could learn more effectively. Therefore, an e-exhibition offers a way to hold an exhibition that provides the audience with a virtual experience, making it more interesting, which could result in more viewers. All of this is possible due to fairly recent advances in computing, communication technology, and the capabilities of the internet, all of which were combined to create multimedia designed to encourage and fulfill the learning needs of the audience. It appears as if the information and activities from the e-exhibition can enhance knowledge, it can be applied to real life.

5. CONCLUSION

After surveying the needs, the researchers studied ideas and analyzed data to develop an e-exhibition in conjunction with game-based learning communication activities to raise perception of the green nudges concept for undergraduate students.

The study found that after holding an e-exhibition in conjunction with a game-based learning communication activity to raise perception of the green nudges concept, the perceptions of the students who viewed the e-exhibition and participated in the activity was higher than before.

According to the findings, the satisfaction level of the sample group towards the e-exhibition together with a game-based communication activity was at the highest level, which suggests that e-exhibition together with a game-based communication activity can be used to inspire students to see the importance of energy and environmental conservation, and that the information received can be applied in practical situations.

It is advisable to study the guidelines for organizing activities to promote the green nudges concept to undergraduate students using other interesting means and implementing new technologies such as augmented reality or virtual reality.

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