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PAPER

The Design of a Learning Experience Platform using xAPI with Design Thinking Learning to Promote Innovation

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ABSTRACT

This research focuses on designing a learning experience platform using xAPI and incorporating design thinking principles to foster innovation. The study focused on two main areas: a) analyzing and synthesizing the conceptual framework for a learning experience platform using xAPI with design thinking learning to promote innovation; and b) evaluating the suitability of a learning management model design for the learning experience platform using xAPI with design thinking learning to promote innovation. The evaluation was conducted by nine experts and the model consists of five parts: 1) the student module, 2) the teacher module, 3) the learning module, 4) the analytical module, and 5) the portfolio module. These modules were derived from an assessment of the suitability of the learning style, which indicated the highest level. The result regarding the suitability of the components of the LEP-DT learning model was at the highest level ($\overline{X}$ = 4.79, S.D). The value is 0.39. According to the assessment results, the model can be applied to learning management.

KEYWORDS

experience learning, design thinking, xAPI, innovation

1 INTRODUCTION

Modern learning modalities, both in Thailand and abroad, have incorporated technology and various digital tools into the development of teaching and learning methods, both inside and outside the classroom. This is to always enhance the potential and efficiency of learning in all places and at any age. Such development could, however, also eliminate issues such as the number of learners in the classroom, distance, time, various forms of natural disasters, as well as newly emerging diseases, etc. In this connection, the Royal Thai Government has announced its policy-based visions related to Thailand's economic development, also known as "Thailand 4.0" [1]. This is aimed at promoting technological development, creativity,

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innovation, science, technology, and research and development, which could lead to growth in the targeted technology and industrial sectors. Such development would result in economic, social, political, and governmental growth, as well as advancements in education, including higher education, which would contribute to national development.

Based on the report from the Academic Promotion and Registration Office of Rajamangala University of Technology Rattanakosin Borpitpimuk Chakrawat, covering the years 2020–2022, it was found that the learning and teaching management issues and the students' grades for the Multimedia Technology subject offered by the Business Information Technology Department, which is a subject under the Business Administration Faculty and the Bachelor's degree in Business Administration Program in Business and Technology, were at a moderate level. The students demonstrated their ability to adopt various learning methods, and the teaching process primarily consisted of lectures supplemented by practical work assignments in each classroom. This somehow still lacked support in the management of experiential learning and the design thinking process for learners. Furthermore, learners also lacked opportunities for learning outside of the classroom, both during and after school hours, as well as the opportunity to engage in learning exchanges with their peers and teachers.

This research focuses on the design of a learning experience platform using experience application programming interface (xAPI) and design thinking to promote innovation. The study aims to achieve the following objectives: a) to analyze and synthesize the conceptual framework for the learning experience platform using xAPI and design thinking to promote innovation; and b) to evaluate the suitability of a learning management model design for the learning experience platform using xAPI and design thinking to promote innovation. The researcher focuses on developing a learning experience platform using xAPI and design thinking to promote innovation. The design of this learning platform is an important factor in developing learning efficiency and promoting self-learning attributes, which enable learners to realize their own potential. Learners could also plan their learning, diagnose their learning needs, set their own learning targets, choose their own learning methods, search for learning sources, collect data, and self-evaluate. These activities contribute to the development of learners' potential, leading to their highest achievement based on their individual capabilities.

2 LITERATURE REVIEWS

2.1 Experiential learning

Experiential learning refers to the process of acquiring knowledge, skills, and attitudes by using previous experiences to stimulate reflection and generate new knowledge during the learning period. The process and components of learning from experience, based on the concept of [3], involve the reasoning process and the integration between experience and concept. The process of observing and practicing leads to continuous learning. By actively participating in real-life reflection on experiences and considering different perspective, individuals gain knowledge and are able to apply it effectively. Learning concepts is a fundamental process, but it is crucial for acquiring knowledge. If learners are unable to learn from their experiences, they will not be able to seek knowledge or practice skills and will continue

to make repeated mistakes. Eventually, learners may struggle to adapt to changing situations. Therefore, in all life skills, experiential learning is the most important, as every action is a result of an experience [4]. The idea consists of stages of the process, namely the concrete experience-building stage, the reflective observation stage, the abstract conceptualization stage, and the experimenting stage. The idea of [6] is experiential teaching, which incorporates teacher-directed learning (TDL), peer-directed learning (PDL), and self-directed learning (SDL). The experiential teaching would utilize the experiential learning cycle, which allows the learner to engage, interact, and reflect on their experiences.

From the above-mentioned experiential learning, it is evident that learners engage in a process of critical thinking and action to effect change and generate new knowledge. This process starts with identifying problems, searching for solutions, and then adopting oneself through the learning process to be able to apply acquired knowledge in new situations. This is a compilation of learning experiences based on the given duration of learning.

2.2 xAPI (Experience Application Programming Interface)

Experience application programming interface is a learning standard in which all types of learning experiences are recorded and tracked, both offline and online. It is a part of learning and teaching management that can track learners' actions. xAPI is a component of e-learning that facilitates content learning by providing a system for learners to interact with each other. It is a learning method that records and tracks all types of learning experiences. The learning experiences are recorded in the Learning Record Store (LRS). The LRS could also exist in the former learning management system (LMS) or in self-learning [7].

Experience application programming interface, or Tin Can API, is software with new capabilities that enable the collection of data on various actions or experiences of learners, both online and offline. It separates information on events from LMS, such as interactions with mobile applications or any other information that can be transferred to a cloud system. This allows for the recording of an individual learner's lifelong learning experience. XAPI is used as a part of learning and teaching management, which allows for the monitoring of learners' actions, such as their reading or watching the training videos [8].

2.3 Design thinking

Researchers and educators have defined the design thinking process as a cognitive process that focuses on gaining a comprehensive understanding of issues, with learners at the core. The process would involve incorporating the creativity and perspectives of different learners to generate ideas and solutions. These solutions would then be tested and developed to derive innovative ways that address the needs of users and specific situations. There is also a learning innovation that focuses on the human as the center of design thinking, which has been adopted in higher education. It has several different meanings and related diverse forms and technologies, as follows [9], [10]: 1)The design thinking process at Hasso Plattner Institute of Design at Stanford, also known as Stanford d. School [11], divides the thought process into five stages: emphasize, define, ideate, prototype, and test.

2) The design thinking process of the Design Council CK, a charity for strategic design based on the double diamond design process of the UK Design Council [12], consists of four stages: discover, define, develop, and deliver. 3) The design thinking process of the International Design and Consulting Firm (IDEO) [13] proposes the idea that people can make a difference through a process of changes, challenges in something different, and goals towards a solution and development of new things. This would enable positive work outcomes, resulting in freedom of thinking and creativity. The thought process is divided into five stages, namely discovery, interpretation, ideation, experimentation, and evolution. 4) The Design Thinking Process of Google Design Sprints (I) [14] proposes the idea of selecting the best method for a specific goal and planning by surveying, building, and searching for the most effective solution to a particular problem that can be solved quickly. The thought process is divided into six stages: understand, define, sketch, decide, prototype, and validate. 5) The Design Thinking Process of Google Design Sprint (II) [15] is a decision-making process and a way to test ideas that can help us quickly determine which product is needed by customers, typically within five days. This occurs through the changes of three main factors, namely collaboration, innovation, and acceleration. The thought process is divided into five stages: understand, diverge, decide, prototype, and validate.

From all of the above, these models are used in both the education and business sectors. Although the overall objective and intention are similar, which is to apply them to learning. This could be divided into the following four aspects: 1) understanding target groups effectively; 2) synthesizing information, analyzing problems, and selecting potential solutions; 3) engaging in extensive brainstorming to generate new ideas; and 4) creating models and prototypes for testing and evaluation.

Design Thinking is a thought process that aims to gain a deep understanding of problems by placing humans at the center of problem-solving. This would foster creative thinking in the creation, development, and improvement of a prototype, ultimately leading to systematic innovation. The learning management through the Design Thinking concept would place humans at the center of problem-solving, known as Human-Centered Design. The Stanford d. school method emphasizes gathering thoughts from diverse groups of people, creating quick prototype, and then testing and evaluating them until they best meet the users' satisfaction. It can be observed that learning management through design thinking is a process that emphasizes brainstorming, creating prototypes, and then gathering feedback from the target groups. This is a process of testing ideas and gradually developing them until they become successfully completed works [16].

2.4 Innovation

Innovation creation refers to the process of generating new ideas, methods, knowledge, tools, protocols, and products that did not previously exist or improving and modifying existing items to enhance their quality. Also, it is the addition of worth and value that contributes to social, economic, local community, health, environment, political, technological, and informational aspects, which are all linked to achieving success based on set goals and improving work efficiency and utilization [2], [17], [18], [19]. The innovation-creation process in education consists of the following stages: 1) Planning; 2) Implementation; 3) Verification; and 4) Application in the classroom [17].

2.5 Revolution in e-learning

Recent e-learning technology is developing rapidly. The researcher and academic propose a revolution in e-learning. Dhaiouir [35] proposes a system for tracking the development of learners' learning in a MOOC that assists in the operation of e-learning and allows teachers to easily manage the large number of learners enrolled in a distance learning course. Zheng [36] proposes that educational games can act as a medium for this type of learning and as a tool to support learning. They create real-world scenarios for students to solve problems, enhancing problem-solving skills, critical thinking, and creativity efficiently. Additionally, Waladi [37] proposes a "Machine Learning Approach for an Adaptive E-Learning System Based on Kolb Learning Styles," emphasizing the importance of accurately determining the learner's profile that reflects the necessary properties for optimal learning.

3 RESEARCH DESIGN AND THEORETICAL FRAMEWORK

3.1 Research design

The research design involved the following steps for analyzing and synthesizing the design of a learning experience platform using xAPI and design thinking learning to promote innovation:

- Synthesize documents and conduct a literature review on experiential learning, focusing on the works of Dewey [3], Honey and Mumford [4], Kolb [5], and Chaiyong [20]
- Synthesize documents and conduct a literature review on the Experience API (xAPI), as discussed by Helen [7] and Kanyarat et al. [8]
- Synthesize documents and conduct a literature review on design thinking, including works by Stanford d.School [11], The Toolbox [12], Ideo [13], Google [14], Brown [21], Cox [22], Praima and Chujit [23], Nuchjaree [24], and Narit [25]
- Synthesize documents and conduct a literature review on the promotion of innovation, as discussed by Phusit [17], Hughes [18], Toffler [19], Tisana [27], and Robson [28]
- Design the new learning process entitled "The Learning Experience Platform using xAPI with Design Thinking Learning to Promote Innovation (LEP-DT)."

3.2 The theoretical framework

The design of the learning experience platform, which utilizes xAPI and incorporates design thinking principles, aims to foster innovation. It comprises the following components:

1. **Experiential learning**

   The concept: The researcher conducted a literature survey on the concept of experiential learning in relation to design learning processes. From the analysis and synthesis of the definition of experiential learning, it can be concluded that experiential learning refers to the process of building knowledge, skills, and

attitudes by using previous experiences to stimulate reflections and generate new knowledge during the learning period [29], [30].

The process: The researcher conducted a literature review on learning in order to synthesize and design effective learning processes. This involved studying various methods, concepts, and theories derived from case studies and other relevant research papers on experiential learning.

Table 1. The synthesis of the experiential learning process

The Synthesis of the Experiential Learning Process				Experiential Learning Process
Dewey [3]	Mumford [4]	Kolb [5]	Chaiyong [6]	
1. Impulse	1. Having an experience	1. Concrete experience	1. Assessment before experiencing events	1. Building and gaining of concrete experiences
			2. Orientation of experiences	
			3. Confronting experiences	
			4. Reporting of progress	
2. Observation	2. Reviewing the experience	2. Reflective observation	5. Report of confronted experiences	2. Reviewing the experience
3. Judgment for application	3. Concluding of experiences	3. Abstract conceptualization	6. Conclusion of confronted experiences	3. Concluding of experience
	4. Planning for further stages	4. Active experimentation	7. Testing after confronting experiences	4. Planning for further stages

2. **Experience API (xAPI)**

The concept: The researcher conducted a literature survey on the concept of xAPI in relation to the design of learning processes. From the analysis and synthesis of the functions of the xAPI, it can be concluded that it is a learning tool that records and monitors all types of learners' experiences, both online and offline. It can be used as part of learning and teaching management to monitor learners' actions [7], [8].

3. **Design thinking**

The concept: The researcher conducted a literature survey on the concept of design thinking in relation to design learning processes. From the analysis and synthesis of the definition of design thinking learning, it can be concluded that design thinking learning refers to the thought process of creatively solving problems with humans at the center. This process involves systematically creating a logical mind map with a deep understanding of the problem or goal, defining its meaning, and designing through diverse scientific knowledge. The aim is to go beyond traditional concepts and think outside the box, ultimately leading to the full utilization of innovation [21], [22], [23], [24], [25].

Design thinking process: The researcher conducted a literature review on experiential learning to analyze and develop learning processes. This involved studying methods, concepts, and theories derived from case studies and other relevant research papers on experiential learning.

Table 2. The synthesis of the design thinking process

The Synthesis of the Design Thinking Process					Design Thinking Process
Stanford Process d. school [11]	Double Diamond Design Process of UK Design Council [12]	The Google Design Sprint Process [14]	IBM Design Thinking [15]	IDEO Human-Centered Design Model [13]	
1. Emphasizing deeply the target groups (Emphasize)	**1.** Searching of information (Discover)	**1.** Understand	**1.** Observe	**1.** Inspiration	Understanding the problems of the target group (Emphasize)
2. Defining a framework for the problem (Define)	**2.** Analysis for concluding the problem (Define)	**2.** Define	**2.** Reflect	**2.** Ideation	Defining a framework for the problem (Define)
3. Idea creation (Ideate)	**3.** Development of ideas (Develop)	**3.** Diverge	**3.** Make	**3.** Implementation	Idea compilation (Ideate)
4. Prototype creation (Prototype)	**4.** Development for delivering to users (Deliver)	**4.** Decide **5.** Prototype **6.** Validate			Prototype development (Prototype)
5. Test					Usage testing with the target group (Test)

4. Innovation

The concept: The researcher conducted a literature survey on the concept of xAPI in relation to the design of learning processes. From the analysis and synthesis of the definition of innovation creation, it can be concluded that innovation encompasses the thought process, methodology, knowledge, tools, protocols, body of knowledge, creations, and products that either did not exist before or involve the development or modification of previously existing items to improve them. Also, it is the addition of worth and value that contributes to social, economic, local community, health, environmental, political, technological, and information aspects, which are all linked to achieving success based on set goals and improving work efficiency and utilization [2], [17], [18], [19], [31], [32].

Innovation process: The researcher conducted a literature review on innovation to synthesize and design learning processes. This involved studying methods, concepts, and theories derived from case studies and other research papers through experiential learning.

Table 3. The synthesis of the innovation process

Relevant Theories and Concepts			Summary of the Main Points by the Researcher
Educational Research Division [26]	Tissana Khaemanee [27]	Robson [28]	
1. Construct a conceptual framework on developing learning innovation **2.** Curriculum analysis **3.** Determine the learning objectives **4.** Determine the innovation characteristics **5.** Explore resources on innovation development	**1.** Identifying the problems **2.** Determining the objectives **3.** Studying of constraints	**1.** Observation and perception of problems **2.** Identification of main emphasis of the required innovation **3.** Formulation of concept	**1.** Planning stage
6. Design the learning innovation **7.** Plan and proceed on the development	**4.** Innovation invention	**4.** Innovation prototype creation	**2.** Implementation stage
8. Quality inspection of methods or learning innovation	**5.** Usage experimentation	**5.** Testing of innovation and conclusion	**3.** Verification stage
9. Conclusion and evaluation	**6.** Dissemination		**4.** Classroom application stage

Through the synthesis of online experiential learning using xAPI with the design thinking learning management system to promote innovation, the researcher synthesized the concepts and studied the state of problems, theories, documents, and relevant research. The researcher has defined the basic conceptual framework for the LEP-DT model, as shown in Figure 1.

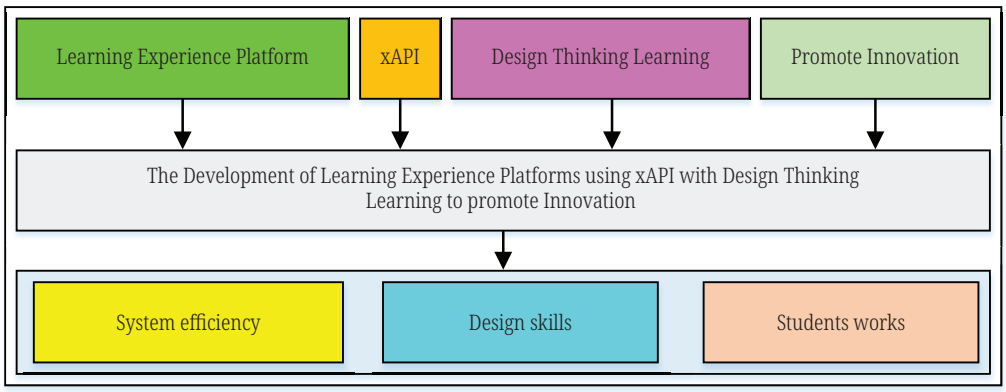

Fig. 1. Conceptual framework for LEP-DT model

3.3 LEP-DT model

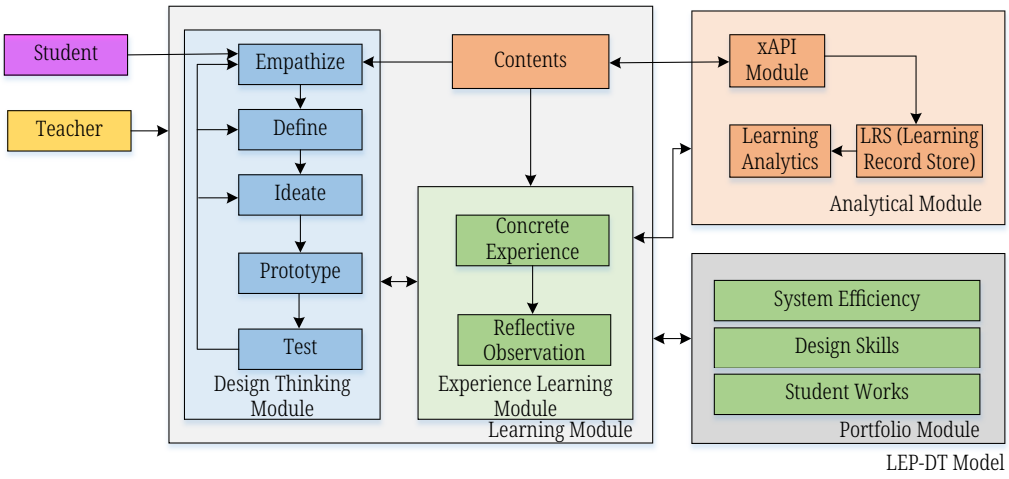

Fig. 2. Model of the LEP-DT

According to Figure 2, the LEP-DT model incorporates five modules as follows:

1. **The student module** functions to collect data from each learner, including basic information and learning and teaching-related information, in order to supplement the design thinking module.
2. **The teacher module** functions to collect basic information about the instructor and also monitors and provides support and advice to the learners. It also functions to determine the teaching patterns or processes based on the teaching content, assignments, and learning activities, as well as provide evaluation that supports the determined activities.

3. **The learning module** is the primary module through which learners engage in activities for online experiential learning. It utilizes xAPI and incorporates design thinking principles. The learning module consists of three sub-modules, which are outlined below.
   a) The design thinking module functions to collect learning activity patterns for creating five stages of learning activities: 1) Emphasize, 2) Define, 3) Ideate, 4) Prototype, and 5) Test.
   b) The experience learning module functions to collect learning information from learners through direct experiential learning activities such as reading books, watching videos, having conversations, and conducting experiments. The module also facilitates the review of experiences, allowing learners to consider and reflect on the knowledge gained.
   c) The contents module is the module that focuses on subjects' content and the assignments given to learners.
4. **The analytical module** functions to collect learners' learning behavioral data and analyze their behaviors, which is divided into three sub-modules.
   i) The xAPI module functions to determine and design learners' experiences. It provides a tool that enables instructors to plan and introduce learners to their learning targets, which are appropriate for their level of competency (discover and consume). Moreover, it would provide an opportunity for learners to interact with each other (connect and collaborate) while also enjoying their learning experience (interactivity and gamification). For instance, learning management systems (LMS), human capital management (HCM), articles, podcasts, the Internet of Things (IoT), videos, e-books, webinars, virtual reality, surveys, quizzes, etc.
   ii) The LRS module is a data collection module known as the learning record store (LRS). It is designed to collect learners' behavioral data, including button-clicking, learning duration, play-stop button usage, and video watching speed to skip lessons.
   iii) The learning analytics module is designed to analyze learners' behaviors by utilizing the data obtained from the LRS and conducting an analysis.
5. **The portfolio module** serves as an outcome of the learning modality, which encompasses three specific outcomes: i) system efficiency, ii) design skills, and iii) student's works.

4 METHODOLOGY

The methodology employed in the experiment involved the following steps to assess the suitability of xAPI with design thinking learning to promote innovation in learning experience platforms:

- Develop a tool to assess the appropriateness of the learning modality.
- The verification of the learning modality was conducted by nine experts who are experienced lecturers with more than five years of teaching experience and hold doctoral degrees. These experts consist of computer studies experts and experts in educational technology and communication.
- Conducted a group conversation with nine experts to assess the suitability of the learning management modality.
- Analysis of the suitability of the learning modality using mean ($\bar{x}$) and standard deviation (SD) measures. A five-point Likert scale was used to assess the appropriateness of the different activities.

5 RESEARCH FINDINGS

This stage involves assessing the suitability of the design learning for students. The stages for this process are as follows: 1) Tool creation for assessing the process, 2) present the process development to the nine doctoral degree experts who are university lecturers, have at least years of relevant experience, and are experts in computer studies, and experts in educational technology and communication. These experts would consider and assess the suitability of the process. Additionally, they would analyze the results. 3) Analysis of the process evaluation using the mean ($\bar{X}$) and S.D. A five-point Likert scale was used to assess the suitability of the process. The suitability of the learning process is certified by nine experts (Table 4).

Table 4. Results of the suitability assessment of the conceptual framework of the LEP-DT model

Evaluated Contents	Evaluation Outcome		Level of Agreement
	($\bar{X}$)	S.D.	
1. Overview of the initial conceptual framework	4.88	0.33	Strongly agree
2. Overview of suitability of LEP-DT model	4.77	0.44	Strongly agree
3. Appropriateness of the practical implementation of the LEP-DT learning model	4.77	0.44	Strongly agree
Overall Result	4.80	0.40	Strongly agree

Table 4 shows that the experts strongly agreed with the overall content to assessing the suitability of the conceptual framework of the LEP-DT model, with a total mean of 4.80. Most of the experts agreed that the overview of the initial conceptual framework ($\bar{X}$ = 4.88) was suitable. The suitability of the LEP-DT model ($\bar{X}$ = 4.77) was appropriate, and the practical implementation of the LEP-DT learning model ($\bar{X}$ = 4.77) was also suitable.

Table 5. Results of the suitability assessment of the components of the LEP-DT learning model

Evaluated Contents	Evaluation Outcome		Level of Agreement
	($\bar{X}$)	S.D.	
1. Student Module	4.88	0.33	Strongly agree
2. Teacher Module	4.88	0.33	Strongly agree
3. Learning Module	4.88	0.33	Strongly agree
4. Analytics Module	4.66	0.50	Strongly agree
5. Portfolio Module	4.66	0.50	Strongly agree
Overall Result	4.79	0.39	Strongly agree

Table 5 shows that the components of the LEP-DT learning model were highly suitable, with an overall mean score of 4.79 and a standard deviation of 0.39 ($\bar{X}$ = 4.79, SD = 0.39). The value is 0.39. When considered separately, it was found that the LEP-DT learning model, as part of the Student Module, Teacher Module, and Learning Module, was rated at the highest level ($\bar{X}$ = 4.88, S.D. The Risk Module had the highest score (0.33), followed by the Analytics Module and the Portfolio Module, respectively.

6 DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

6.1 Discussions

The design of a learning experience platform (LEP) using xAPI, with a focus on design thinking, was developed by incorporating the experiential learning process and the design thinking process. The researcher focused on developing a learning experience platform using xAPI and design thinking to promote innovation. This platform can be applied in subjects where the instructor requires experiential learning process management and design thinking for the learners. This is consistent with the research of Areej Khuder Hassan, who presented a topic in an academic journal entitled "The Effect of a Proposed Strategy According to the Design Thinking Model on Mathematics Achievement and Personal Intelligence among Students of the Sixth Class Scientific" [33]. The research recommends that teachers adopt the design thinking model in education due to its role in developing students' abilities. It also emphasizes the importance of paying attention to students' personal intelligence (both internal and external) and fostering their confidence in themselves and their abilities. It is also aligned with the work of [38] who presented a topic in an academic journal entitled "Concepts of Experiential Learning in Digital Collaboration: New Perspectives for the Higher Education Sector" mentioning collaboration and interaction are crucial factors of experiential learning. In addition, there is research by [34]. They highlighted that changes in students' learning experiences can positively impact their academic performance.

6.2 Conclusion and recommendations

This research aims to analyze and synthesize the conceptual framework of the learning platform and assess the suitability of online experiential learning using xAPI with design thinking learning management to promote innovation creation. From reviewing the relevant documents, articles, and research works, the learning model called LEP-DT was found to be a research outcome. This model comprises five modules: 1) student module, 2) teacher module, 3) learning module, 4) analytical module, and 5) portfolio module. After that, the researcher presented the learning model to nine relevant experts. Their comments consistently established that it is a conceptual framework that could be applied as a prototype to develop the learning and teaching model. Based on the experts' assessment of the learning model, they strongly agreed and suggested that this research is interesting because it can collect learners' learning information from xAPI to analyze their learning experience. They also recommended further investigation into comparing the experiences and learning outcomes in terms of their variation. And for consistency with the researcher's work, setting up learning questions using the same problem would enable a clear decoding of learners' learning experiences. Additionally, the learning outcomes reflected by the learners would allow for a clearer division of academic achievement. As for the platform, e-learning should be utilized as a framework, with Moodle technology being employed as a teaching tool. As for the evaluation, each stage of the design thinking process should be evaluated separately, and the outcome should be presented as the final project.

In the next phase of research, we plan to further develop, implement, and share our findings with teachers in order for students to obtain suitable results and recommendations.

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