

The learning outcomes of total learning experience (TLE) to support digital empathy and literacy skills

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ABSTRACT: The total learning experience (TLE) system is an on-line knowledge management system that can store the diverse bodies of knowledge of the professors in the College of Industrial Technology (CIT) at King Mongkut's University of Technology North Bangkok (KMUTNB), Thailand, in one database with an attempt to enhance the efficiency of knowledge management for the benefit of academics, other staff and students within the Faculty and the University. The current research is related to, and further extends, an earlier article on the TLE model development [1], with the current focus on further development, the perspectives on the development and the post-development learning outcomes. The current TLE system development has been based on the results of the earlier study, so that it would be efficient enough for practical application. The research results are corresponding to the expectation; that is, the TLE system contributes to the development of digital empathy and literacy skills through self-directed learning, and it can promote lifelong learning by making the ultimate use and application of digital innovation and technology in instruction management, research, academic services and in lifelong learning at the higher education level.

Keywords: TLE, total learning experience system, intellectual repository, digital empathy, literacy skills

INTRODUCTION

In the world of the *new normal*, many institutions have applied the existing technologies or platforms in their current learning management. Humanity has been facing many challenges recently, such as wars, natural disasters, epidemics, etc. In 2020, the prevailing on-campus, face-to-face learning mode had to be changed due to the coronavirus pandemic [2]; as a consequence, new paradigms have emerged with the introduction of new technologies that enable more virtual interaction and more access to communication.

The transformation of an institution to be a learning organisation can be achieved by providing its personnel with freedom to learn, create a variety of knowledge, and share their knowledge in order to increase their competency and potential, which is believed to bring progress in business operations while achieving the organisational goals in a continuous manner [3].

The main objective of higher education institutions that have applied the concepts of knowledge management is to become a learning institution with academic excellence. Therefore, the encouragement and provision of opportunities for academics and other staff to demonstrate their potential and competencies through collaboration and knowledge exchange are believed to generate new bodies of knowledge that can be employed to improve organisational efficiency. Thus, it is necessary that administrators of higher education institutions should encourage and support this specific approach to knowledge management.

Marquardt stated that knowledge management consists of the following main components: 1) knowledge acquisition, which is beneficial and effective to the operations both in and out of the organisation; 2) knowledge creation, which can be conducted with creativity, drive, intuition and insight; 3) knowledge storage and retrieval, which refers to the organisation's consideration on what bodies of knowledge are worth preservation, and how to store and retrieve them in an efficient manner; and 4) knowledge transfer and utilisation, which can help enhance the learning within the organisation thanks to the quick and appropriate circulation of knowledge [4].

IMPORTANCE OF AN INTELLECTUAL REPOSITORY IN HIGHER EDUCATION: A CASE STUDY AT THE COLLEGE OF INDUSTRIAL TECHNOLOGY (CIT), THAILAND

The improvement of social service quality, especially in terms of education, exchange of knowledge and interaction through network systems, shall enable the Thai people to have unlimited access to information [5]. The main target of education

development as stated in the National Education Plan B.E. 2560-2574 is to create a quality and efficient education system that can be used as the main mechanism to develop human potential and competencies. Such a system must correspond to education, learning and challenges that are regarded as the world's dynamics [6]. Furthermore, that education system should focus on the pursuit of knowledge, development of skills and positive attitudes towards lifelong learning.

The College of Industrial Technology (CIT) is a faculty of King Mongkut's University of Technology North Bangkok (KMUTNB), Thailand. There are several courses available in this faculty, such as: the Certificate of Vocational Education in Pre-Engineering programme, Bachelor, Master and the doctorate degrees. Not only that, there are many professors who specialise in various fields of study, resulting in numerous bodies of knowledge in the College, which are beneficial for curriculum development, instruction management and research. Nonetheless, at present, the storage of these bodies of knowledge is not effective in terms of data management and retrieval; therefore, it is neither convenient nor effective to search, retrieve and access these data sources.

An intellectual/institutional repository is a digital repository designated to store a large amount of information and provide relevant services with an attempt to disseminate work, bodies of knowledge, and wisdoms generated by academics and other staff. These resources, including academic works in terms of new and applied knowledge, have been collected and stored in a continual manner with an intention to solve any problems and for development at the national scale.

According to the above concepts, the authors of this article have come up with an idea to develop a total learning experience (TLE) system and use it as a tool to store the diverse bodies of knowledge of the professors within the CIT, KMUTNB, Thailand, in one database with an attempt to enhance the efficiency of knowledge management for the benefit of academics, other staff and students within the Faculty and the University. With the ultimate use of different innovations and digital technologies in instruction management and lifelong learning, it is expected that the TLE system can also foster a learning organisation in the future.

THE STUDY AND RESEARCH QUESTIONS

This research is mainly related to the exploration of perspectives towards the development of the TLE system and the learning outcomes derived from the measurement of digital empathy and literacy skills of research participants after the TLE system's implementation. The current study is an extension of an earlier article that focused on the TLE model [1].

All of the participants gave their consent to take part in this research by answering questions on a confidential and anonymous assessment (confidentiality and anonymity). The aim of this research was to test if self-directed learning through the TLE system can support and create a learning organisation by making use of digital technologies in the instruction management and lifelong learning. Therefore, the present research had the following research questions:

RQ1: What is the development methodology of the TLE system, and what instruments are required in this research?

RQ2: What are the main elements and the working process of the TLE system?

RQ3: What are the learning outcomes regarding digital empathy and literacy skills, and what items for evaluation are required in this measurement?

RESEARCH METHODOLOGY

The development of the TLE system presented in this article has been based on the concepts and guidelines obtained from the already-mentioned earlier study [1] in order to acquire a knowledge management system that is efficient enough for practical use. The principles and theories of the TLE system are related to the system approach outlined in other publications [7][8] and the system development life cycle (SDLC) [9]. Also the authors of this article examined the learning outcomes by means of pre-experimental research with one sample group and a one-shot case method.

Participants

The 191 participants were derived by means of cluster sampling, including academics, general staff and students of the CIT, KMUTNB, Thailand. All participants were provided with, and reassured of, confidentiality and anonymity.

The participants were asked to fill out a consent form. Before this stage, the authors had given them the detailed information along with the documents relevant to this study, and then let them decide whether they would join this study or not. Also, the participants were informed that their personal information would be kept confidential with anonymity. In addition, the participants were given the detailed and complete information about this evaluation together with its objectives; and they were allowed to ask any questions until they had eventually got complete understanding.

Research Instruments and Data Collection

The data collection tools for this research were:

1. total learning experience (TLE) system;
2. evaluation form on the quality of the TLE system;

3. measurement form on digital empathy and literacy skills.

The statistics used for data analysis included mean and standard deviation. In regard to data collection, the evaluation and measurement forms used had been reviewed with the index of item-objective congruence (IOC) by experts.

FINDINGS AND DISCUSSION

The essence of this current research involved a detailed explanation about the development methods and the learning outcomes that the authors have acquired after studying the TLE system. This aspect has not yet been covered in the previous research [1].

As mentioned above, the main target of the TLE system's development was to store the diverse bodies of knowledge of the professors within the CIT, KMUTNB, Thailand, in one database with an attempt to enhance the efficiency of knowledge management for the benefit of academics, general staff and students within the Faculty and the University.

In addition, it was expected that the TLE system can also foster a learning organisation in the future in which different innovations and digital technologies can be used to promote instruction management and lifelong learning. Such a learning style is considered a new dimension of learning without borders, leading to new innovations that can promote learning in the world of the *new normal* because it enables learners to have self-learning experiences. In the following section, two of the earlier stated research questions are considered:

RQ1: What is the development methodology of the TLE system, and what instruments are required in this research?

RQ2: What are the main elements and the working process of the TLE system?

Design of the Total Learning Experience System in Higher Education

This stage was related to the design of the structure and elements of the TLE system, so that it could satisfy the demand of the stakeholders. It was also about the study of fundamental demand, which was carried out by examining the problems of knowledge management found within the Faculty and studying the bodies of knowledge provided by the experts, as well as user characteristics. All of that was needed to acquire the guidelines to establish the structure and elements of the TLE system. The research tools used herein were as below:

Use case diagram: the use case diagram of the TLE system was obtained from the analysis and synthesis of users' demand. It shows that there are four groups of stakeholders, i.e. 1) administrator who is responsible for setting user permissions and member management; 2) knowledge developer who is responsible for knowledge management and learning tools; 3) internal user who can manage his/her own data and choose, search, study, access and download any bodies of knowledge; and 4) external user or the person outside the University, who does not sign up to the system, but can still choose, search and study the bodies of knowledge with some limitations (Figure 1).

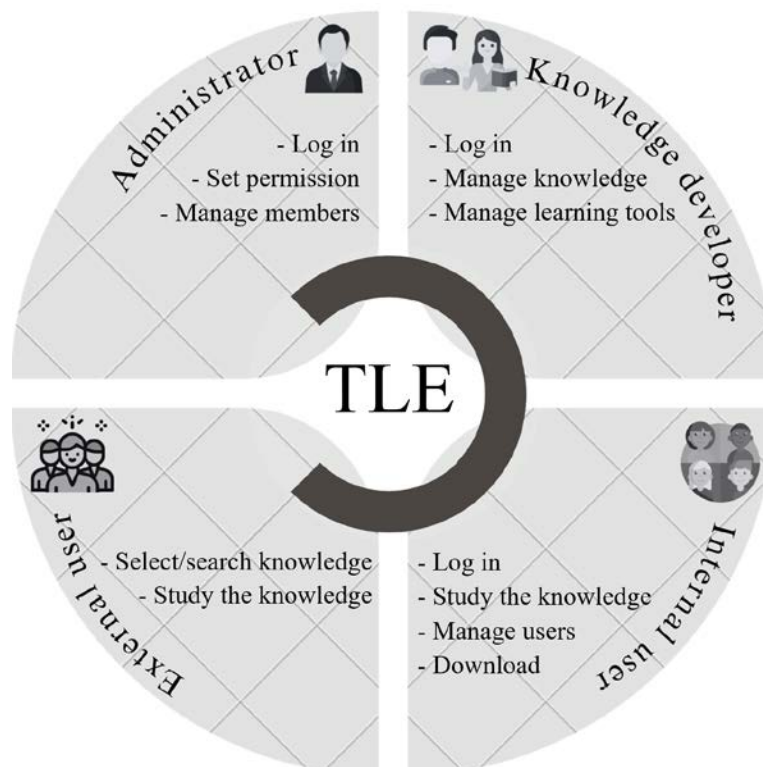


Figure 1: Use case diagram.

In regard to Figure 2, which represents the architecture of the TLE system, there are five main elements, i.e. 1) stakeholder; 2) total learning experience system; 3) expert system; 4) application programming interface (API); and 5) server and database. Each of these elements can be explained as below:

1. Stakeholder refers to those who can use the TLE system, including administrators, knowledge developers, internal and external users. Upon the first access to the system, the first three groups of stakeholders must log in to the system to show their identity and get their specific permissions to access it.
2. TLE system on the cloud using the intellectual repository is designated to manage the diverse bodies of knowledge of the professors within the CIT, e.g. research projects, research/academic findings, books/textbooks, teaching materials, worksheets, exercises, etc. The design of this element was based on the concepts and theories of user experience (UX) and experiential learning, which consist of four steps, i.e. concrete experience, reflective observation, abstract conceptualisation and active experimentation. Also, the concepts of self-directed learning were employed as guidelines for this design and development in order that the system could be used on a variety of devices.
3. Expert system: the key focus of the TLE system is the ability to respond intelligently and interactively to the four groups of stakeholders who have specific different permissions in the system. Furthermore, it must be able to provide multi-user support at the same time, both synchronous and asynchronous.
4. Application programming interface (API) is used to control the interface within the TLE system, the expert system, and the server and database so that these elements can communicate with each other in an efficient manner.
5. Server and the database form an element designated to store the data in the system, such as data of intellectual repository, user profile, user permissions, etc.

The architecture of the TLE presented in Figure 2 refers to the structure and elements within the system, as well as the relationship between the users and the subsystems therein.

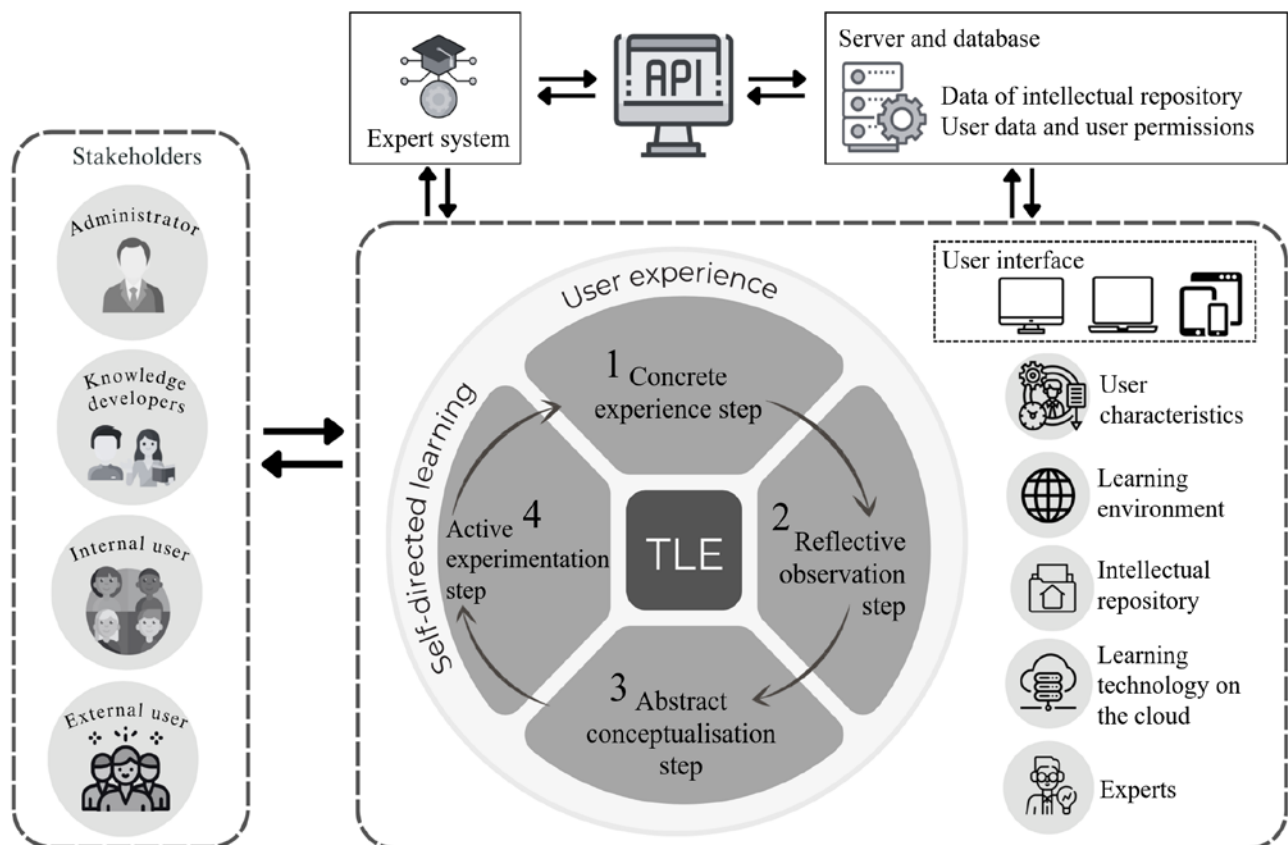


Figure 2: Architecture of the TLE system in higher education.

Development of the Total Learning Experience System in Higher Education

This stage concerned the development of the TLE system, in which the authors of this article employed the theories of user experience design (UXD) [10][11], consisting of five steps, i.e. user research, analysis, design, prototype and user testing. Besides, the theories of system approach were also used to design and develop the instruction system.

The swimlane diagram depicted in Figure 3 illustrates the overall structure of the operation processes of the four groups of stakeholders (administrator, knowledge developer, internal and external users) within the system and the relationship among the subsystems. The authors synthesised this structure based on the theories of total experience and experiential learning, which had been derived from the earlier study [1], with an aim to encourage self-learning while promoting digital empathy and literacy skills.

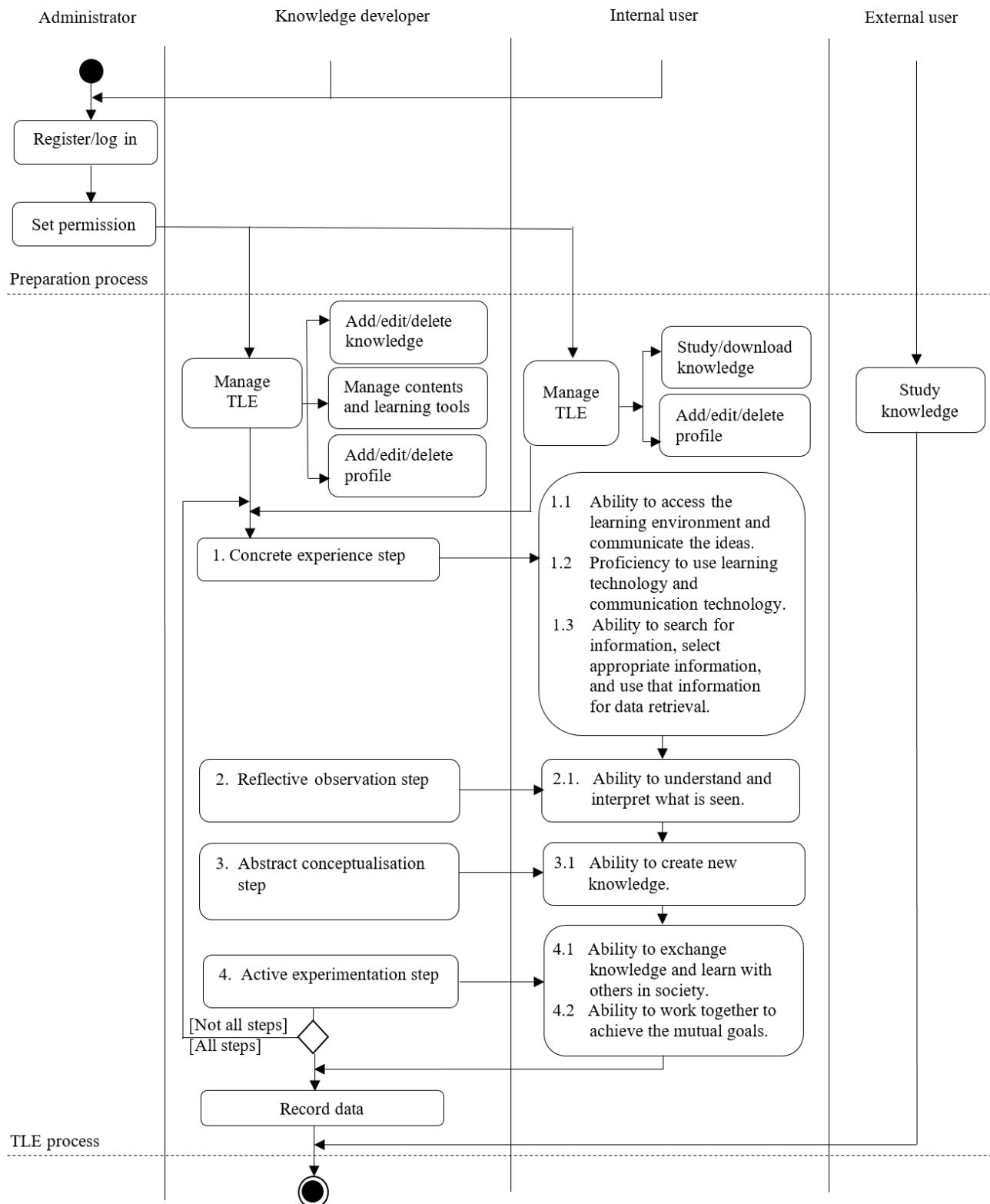
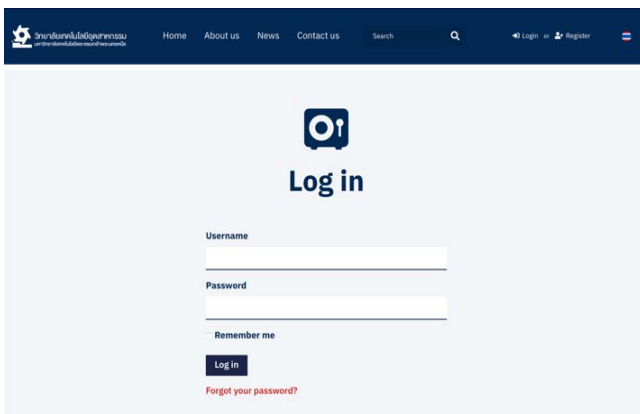


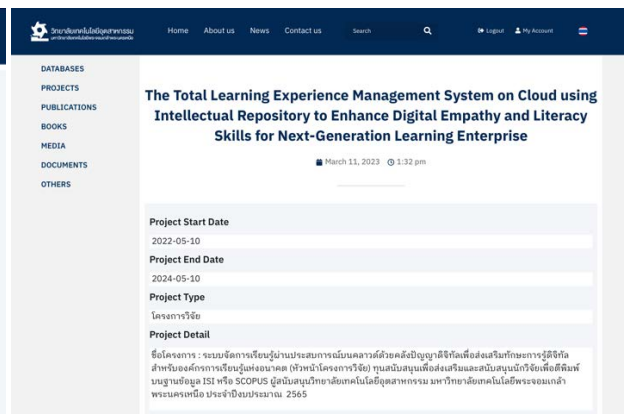
Figure 3: Swimlane diagram of the TLE system in higher education.

The TLE system can support a variety of responsive Web designs capable of displaying text in both Thai and English, while users are able to access the information available in this system anywhere and anytime in an instant manner.

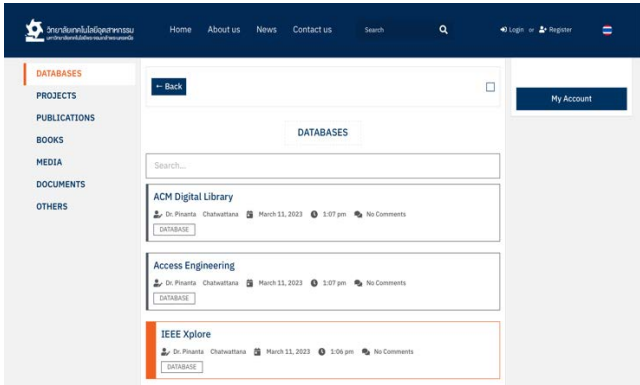
At this stage, the authors employed the Adobe Experience Design (Adobe DX) program to design the user interface that could fulfil the users' needs, along with the structure and elements corresponding to the use case diagram, architecture and the overview structure. The results of the development of the TLE system are shown in Figure 4a to Figure 4f.



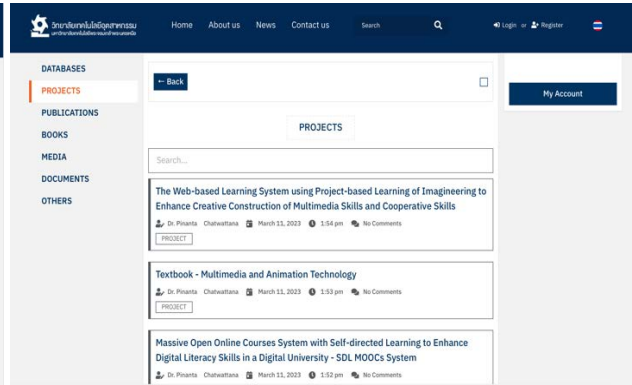
a)



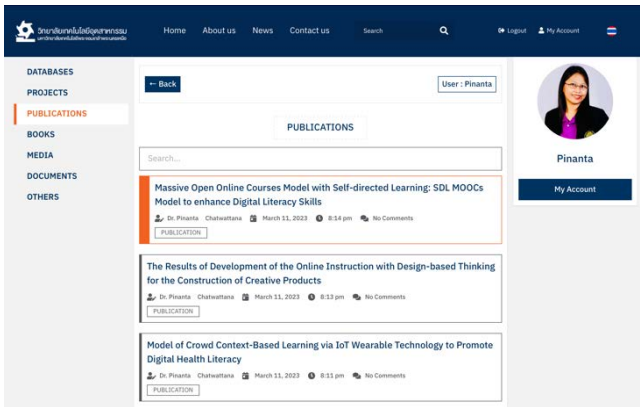
b)



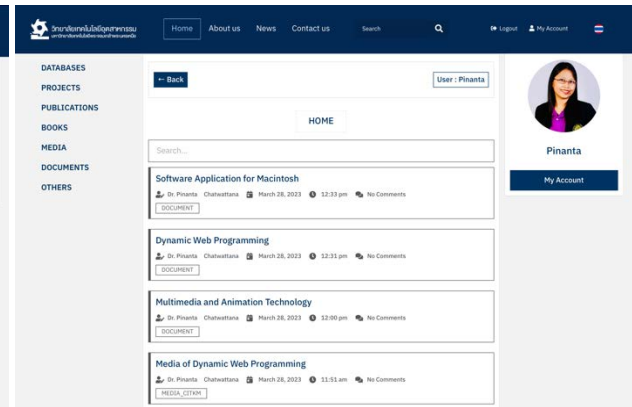
c)



d)



e)



f)

Figure 4: TLE system supporting digital empathy and literacy skills.

Table 1 presents the evaluation results of the quality of the TLE system, which is a continuation and extension from the earlier study [1].

Table 1: Evaluation results of the quality of the TLE system's development in higher education.

	Items for evaluation	Mean	SD
Design	1. Easy to use and understand	4.85	0.37
	2. Images and languages	4.85	0.37
	3. Characters and colours	4.75	0.44
	4. Layout of screen elements	4.70	0.47
	5. User interface	4.65	0.49
	6. Knowledge codification and refinement	4.70	0.47
	7. Learning materials	4.60	0.60
	8. Supporting tools for digital empathy and literacy skills	4.75	0.44
	9. Accessibility to knowledge	4.75	0.44
	10. Continuity of usage	4.60	0.50
	11. Suitability of notifications	4.65	0.49

Efficiency	12. System capabilities	4.85	0.37
	13. Functions	4.80	0.41
	14. Usability	4.70	0.47
	15. Security system	4.60	0.60
	16. Performance	4.70	0.47
Application	17. TLE system can promote digital empathy and literacy skills	4.75	0.44
	18. TLE system can pave ways to a learning organisation in the future	4.70	0.47
	19. TLE system can be used as supplementary to promote informal learning	4.85	0.37
	20. TLE system can promote self-directed learning	4.70	0.47
Overall		4.73	0.46

As can be seen in Table 1, the overall quality of the TLE system is at a very high level (mean = 4.73, SD = 0.46). Thus, it is evident that the TLE development, as well as the study results, in this current research are in compliance with those of the earlier research [1]. Accordingly, the TLE system can be practically applied for self-learning to promote digital empathy and literacy skills.

Learning Outcomes of the TLE to Support Digital Empathy and Literacy Skills

This section is about the measurement results of digital empathy and literacy skills of 191 participants by means of a 25-item questionnaire. All of these participants gave their consent to answer the questionnaire which was synthesised to measure digital empathy and literacy skills [12-14]. The details of the synthesis of digital empathy and literacy skills, including the desired characteristics, have already been stated in the earlier study [1].

The evaluation and measurement forms had been reviewed with the IOC by the experts. Before this stage, the authors had given the potential participants the detailed information and documents relevant to this study, and then let them decide whether they would join this study. Also, the participants were informed that their personal information would be kept confidential with anonymity. In addition, the participants were given the detailed and complete information about this evaluation together with its objectives; and they were allowed to ask any questions until they had eventually got complete understanding. Accordingly, this study was carried out to answer the research question:

RQ3: What are the learning outcomes regarding digital empathy and literacy skills, and what items for evaluation are required in this measurement?

In order to study the measurement results regarding digital literacy (DL) and digital empathy (DE) skills after using the TLE system, the authors divided the measurement into two sections, i.e. 1) digital literacy based on the consideration of four indicators, i.e. information access, use of digital tools, understanding of information and creation/management of information; and 2) digital empathy based on the consideration of two indicators, i.e. communication and collaboration (Table 2).

Table 2: Measurement results regarding DL and DE skills.

Items for evaluation		Mean	SD
Digital literacy			
Access	1. I can access the bodies of knowledge that can promote learning organisations.	4.42	0.54
	2. I can access the learning technologies.	4.31	0.56
	3. I can find the tools and applications to facilitate self-directed learning.	4.21	0.58
	4. I can access the information resources that are appropriate and relevant to my needs.	4.23	0.58
Use	5. I can learn how to use the system by myself.	4.28	0.53
	6. I understand how to use the functions in the system.	4.27	0.55
	7. I can learn how the functions work by myself.	4.32	0.57
	8. I can choose the right information sources to solve the problems.	4.26	0.56
	9. I can select the appropriate information to solve the problems.	4.27	0.56
Understanding	10. I can analyse and use the information to promote learning and communication.	4.24	0.54
	11. I can apply the system technologies and tools by myself.	4.30	0.55
	12. I can use keywords to search and find the desired information.	4.29	0.53
	13. I can integrate my knowledge to build the bodies of knowledge in the system.	4.27	0.54
Creation/management	14. I can create my own knowledge and check its accuracy before using it.	4.23	0.52
	15. I can effectively solve the technical problems arising in the system.	4.19	0.55
	16. I can use the technologies and tools to save knowledge into the system.	4.17	0.54
	17. I screen and select appropriate information and knowledge in order to use them as examples for my study.	4.18	0.49
Digital empathy			
Communication	18. I can share my knowledge with others.	4.27	0.53
	19. I can choose appropriate channels for communication and exchange of knowledge.	4.34	0.53

	20. I can use the available technologies to communicate with others.	4.29	0.52
	21. I am aware of the advantages, disadvantages and effects of using the Internet, and can share that information with others.	4.23	0.48
	22. I am aware of the ethics of using internet and can share them with others.	4.22	0.51
Collaboration	23. I can collaborate with others on a network with no need to meet each other.	4.19	0.49
	24. I can share my knowledge with others through social media or supporting tools used for on-line learning.	4.20	0.50
	25. I respect the privacy of others when using the Internet for communication.	4.08	0.48
Overall DL and DE		4.25	0.53

According to Table 2, it was found that the overall mean of 25 measurement items of digital empathy and literacy skills is at a high level (mean = 4.25, SD = 0.53). Thus, the above findings show that the TLE system can be applied as a tool to store the bodies of knowledge and disseminate them via smartphones to users both in and outside the College. In addition, the system can encourage users to develop digital empathy and literacy skills through self-directed learning, thanks to the use of digital technologies and tools that can satisfy their needs and expectations of learning.

This corresponds to the research of Gómez-Trigueros who stated that the combination of varied methods and technologies can develop the 21st Century skills and foster digital competencies [15]. Moreover, it is in line with the study of Muslimin et al who pointed out that the application of digital technologies in institutions can improve teaching efficiency, facilitate distance learning and promote digital literacy [16]. Therefore, literacy and competency related to digital technology are regarded as positive factors that can be applied in future instruction. The current findings are also consistent with the research of Mailizar et al who mentioned that digital literacy and social presence are considered important external factors [17]. This is because on-line learning facilitates social presence and encourages users to have full engagement in the on-line programmes. Moreover, the current findings are also in compliance with the research of Sapliyan et al who indicated that the application of *new normal* technologies and platforms in education management in Thailand can facilitate the continuous learning anywhere and anytime [18].

CONCLUSIONS

This research is related to an earlier article on the development of the learning experience model and system, and is a continuation and extension of the earlier study [1].

The research results are corresponding to the expectation; that is, the TLE system can be applied as a tool to store bodies of knowledge and disseminate them via smartphones to users both in and outside the College. In addition, the system can encourage users to develop digital empathy and literacy skills through self-directed learning, thanks to the use of digital technologies and tools that can satisfy their needs and expectations of learning.

Moreover, this current research has also been focused on the TLE learning outcomes, which were examined by means of the evaluation form containing 25 items for measurement on digital empathy and digital literacy, along with the consideration of six indicators (information access, use of digital tools, understanding of information, creation/management of information, communication and collaboration). It was found that the overall mean is at a high level, and this means that the TLE system can respond to the users' needs and encourage them to develop digital empathy and literacy skills, which are the abilities to use digital technologies and use ICT tools ethically. It is believed that, with the ultimate use of information technology, digital empathy and literacy skills shall pave ways to the learning and sharing society.

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REFERENCES

1. Chatwattana, P., Piriya-surawong, P., Nilsook, P. and Wannapiroon, P., Total learning experience (TLE) on the cloud with an intellectual repository to enhance digital empathy and literacy skills. *Global J. of Engng Educ.*, 24, 3, 193-201 (2022).
2. Demir, G., Argan, H. and Dinç, H., The age beyond sports: user experience in the world of metaverse. *J. of Metaverse*, 3, 1, 19-27 (2023).
3. Chatwattana, P., Wangsorn, S. and Promchai, P., The mobile application via experiential learning for public relations in Thailand. *Inter. J. of Infor. and Educ. Technol.*, 13, 2, 296-301 (2023).
4. Marquardt, M.J., *Building the Learning Organization: a Systems Approach to Quantum Improvement and Global Success*. New York: McGraw-Hill (1996).
5. Chatwattana, P., A MOOC system with self-directed learning in a digital university. *Global J. of Engng. Educ.*, 23, 2, 134-142 (2021).

6. Office of the Education Council. National Education Plan Framework (B.E. 2560-2574). Bangkok: Office of the Education Council Ministry of Education (2016).
7. Khemmani, T., Science of Teaching: Knowledge of Efficient Learning Process Management. Bangkok: Chulalongkorn University Press (2010).
8. Utranan, S., Systematic Instructional Management. Bangkok: Chulalongkorn University (1982).
9. Dennis, A. Wixom, B.H. and Roth, R.M., *System Analysis and Design* (5th ed). Hoboken: John Wiley & Sons (2013).
10. Tunjaya, P., User experience design of artificial intelligent technology. *J. of Science and Technol.*, 12, 1, 39-46 (2018).
11. Jularlark, S., Chatwattana, P. and Piriyasurawong, P., Information system for public relations via mobile application using in-depth user experience according to education experts. *World J. on Educational Technol.: Current Issues*, 14, 3, 579-591 (2022).
12. UNESCO. A Global Framework of Reference on Digital Literacy Skills for Indicator 4.4.2. UNESCO (2018). 19 February 2023, <http://uis.unesco.org/sites/default/files/documents/ip51-global-framework-reference-digital-literacy-skills-2018-en.pdf>
13. Friesem, Y., Empathy for the digital age: using video production to enhance social, emotional, and cognitive skills. *Emotions, Technol., and Behaviors*, 21-45 (2016).
14. Moto, S., Ratanaolarn, T., Tuntiwongwanich, S. and Pimdee, P., A Thai junior high school students' 21st century information literacy, media literacy, and ICT literacy skills factor analysis. *Inter. J. of Engng. and Technol.*, 13, 9, 87-106, (2018).
15. Gómez-Trigueros, I.M., Digital skills and ethical knowledge of teachers with TPACK in higher education. *Contemporary Educational Technol.*, 15, 2, ep406 (2023).
16. Muslimin, A.I., Mukminatien, N. and Ivone, F.M., TPACK-SAMR digital literacy competence, technostress, and teaching performance: correlational study among EFL lecturers. *Contemporary Educational Technol.*, 15, 2, ep409 (2023).
17. Mailizar, M., Umam, K. and Elisa, E., The impact of digital literacy and social presence on teachers' acceptance of online professional development. *Contemporary Educational Technol.*, 14, 4, ep384 (2022).
18. Sapliyan, S., Chatwattana, P. and Nilsook, P., A constructionist, imagineering learning system with the metaverse: a study of learning outcomes at secondary schools in Thailand. *Global J. of Engng. Educ.*, 25, 2, 90-98 (2023).

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