Model Component Analysis of Online Storytelling Media via Gamification to Enhance the Digital Literacy Skills of Students in Computer Education Thailand

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***Abstract*—At present, digital literacy skills (DLS) are essential for student teachers for developing the ability to use creative IT which is useful for effective work implementation. However, student teachers do not really possess DLS and are unable to apply them to their teaching methods, so the digital storytelling media via gamification to enhance DLS: DSML(Digital story model learning) is needed as an instrument to support them in acquiring digital literacy. The objectives of this research were to analyze the factors of the DSML and to assess the model appropriateness. The study was implemented through 42 papers of relevant articles and research from specific primary and secondary sources. The research instruments included lesson plans, the learning model, assessments of DLS, and assessments of workpieces. The findings of the study show that the factors of model consist of activities through DSML in 2 aspects with 10 factors and 29 variables. The test was validated by experts for the appropriateness of the learning through DSML. Overall, the DSML was found to have the highest appropriateness level (mean = 4.62, S.D. = 0.13) so it can be used in real learning and teaching situations and it is helpful for enhancing students' DLS in the design and development of digital media. Based on the findings, the students could extend their learning scope with DLS in building digital media. These skills are necessary for Thai teachers in the future, and the model can be a prototype for doing classroom-based research or presenting research work at a national level.**

***Index Terms*—Digital storytelling, gamification, digital literacy skills, Thailand**

I. Introduction

The current trend of digital technology leads to lifestyle changes and intelligent competition by using more modern information and knowledge. People who are good at seeking knowledge, adapting tools for seeking knowledge, and have digital technological literacy, are capable in using information technology to creatively seek knowledge with full benefits. Therefore, it is necessary to develop digital literacy skills which are necessary in 21st century education conforming to Thai Education 4.0. However, an enormous quantity of information and knowledge is changing very rapidly at present. Thailand needs to find new strategies for the development of education and the students' useful life skills [1]. In addition, Pansirirot [2] states that learning and teaching in the period of 4.0 must apply knowledge of digital technology from everywhere in the world for creative integration and innovation development in response to social demands. Digital literacy skills are essential in the current world since these skills are useful in developing the country, society, and economy. Readiness in technology comes from progressive changes in education as the basic tools for developing various aspects as well as new knowledge occurring from changes in the digital world [3].

In the past few years, Thailand prepared teachers to be ready for entering the 21st century. The teacher training curriculum has been developed for preparing teachers to be ready for receiving newly developed and changing knowledge. Many important skills need to be developed, and the most important skills which are rarely developed are creative and innovative thinking, and digital technological literacy. Creative and innovative thinking is an important skill for success in the 21st century and is necessary for education and work [4]. Moreover, the Association of College and Research Libraries (ACRL) [5] sets five Information Literacy Competency Standards for Higher Education: 1) determine the extent of information needed; 2) access the needed information effectively and efficiently; 3) evaluate information and its sources critically; 4) use information effectively to accomplish a specific purpose, and 5) use information for understanding the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally. According to the University Library of the University of Illinois [6], digital literacy refers to three competencies: 1) use digital technology as a tool for communication or networks in searching, evaluating, and creating information; 2) understand and use information in different models from various sources through the computer output display, and 3) be able to work effectively in a digital environment. In the USA, Cornell Information Technologies [7] refers to digital literacy in the higher educational perspective as the abilities to search, evaluate, use, share, and create content by using information technology and the internet. It is commonly known that doing activities such as creating multi-media for presentations, posting one's own information, or using online media in daily life needs different levels of digital literacy. Students should learn how to work with digital media.

According to the above studies, in the 21st century, a new generation of teachers with digital literacy skills are needed to use technology for creating outcomes and innovations in teaching and learning for the benefit of education. However, the studies' results show that students do not fully understand how to use technology in terms of digital literacy skills. Insufficient digital literacy leads to low self-control which may lead to distraction in the cyberworlds [8–12]. Therefore, students in teacher education are regarded as important

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human resources to become teachers in the future. These students should develop their skills in every aspect, especially skills in digital literacy, information, media, and technology to be able to manage learning activities with proper information technology together with teaching techniques for the transfer of knowledge to students who will in turn develop to thrive in the next century. The students should be enhanced in terms of self-study and the skills to choose what to accept and what to reject, and to learn about technology at the same time as learning the contents by themselves [13–15]. According to the study on students' digital literacy skills, problems were found from the future teachers in collecting information for the internet and social problems. Not many teachers used the data from comparative comparison to find causes before applying the data in the digital age for developing students to become digital citizens with good knowledge and analytical thinking, advanced technological skills, and self-assistance such as using interactive modules for digital literacy [16, 17].

From the literature review, research into the digital literacy skills of students in teacher education is limited. Therefore, the researcher was interested in investigating the digital literacy skills necessary for students in teacher education. The study results are useful for developing the students' ability to use information technology creatively, and these skills are useful for the teacher students to apply in their study and work effectively.

II. Research Objectives

1) To study and analyze the factors of the learning model with online digital storytelling media via gamification to enhance the digital literacy skills of the students in computer education.
2) To evaluate the appropriateness of the learning model with online digital storytelling media via gamification to enhance the digital literacy skills of the students in computer education.

III. Scope of the Study

A. Data Sources

In the study, there are 30 documents concerning digital literacy skills necessary for the students in teacher education. The data sources are divided into two types as follows.

Primary Sources refers to the sources from which the researcher directly collected the data. These sources were published full research reports, research papers published in Thai and international journals, Ph.D. theses, and research reports of different agencies. The were 15 documents from the primary sources.

Secondary Sources refers to the sources which did not directly include research reports, but they included research findings from academic papers and summary reports in different journals. There were 27 documents from the secondary sources.

B. Population

The population of the study were experts in the learning model with online digital storytelling media via gamification and digital literacy skills.

C. Target Group

The target group of the study were nine experts selected via purposive sampling. They were educators or university lecturers who graduated at the doctoral level or had relevant experience.

D. Variables

The independent variables were the factors of the learning model with online digital storytelling media via gamification to enhance the digital literacy skills of the students in computer education.

IV. Research Methodology

The researcher divided the research procedure into two phases as follows.

Phase 1: Study and factor analysis of the learning model with online digital storytelling media via gamification to enhance the digital literacy skills of the students in computer education.

The steps of the study and factor analysis were as follows.

Study and analyze documents and research relating to online digital storytelling via gamification during 2011–2021 to set the primary research framework on the basis of relating concepts, principles, and themes.

A. The Instruments for Analyzing the Factors of the Learning Model DSML

1) Lesson plans

The lesson plans were created for the learning model with online digital storytelling via gamification to enhance the digital literacy skills for the students in computer education. There were five lesson plans which included teaching steps and learning activities by using the learning model with online digital storytelling media via gamification.

Step 1: The learning process by using online storytelling media was synthesized to obtain the suitable steps for developing the model with the focus on digital literacy skills as shown in Table I.

According to Table I, the synthesized learning model with online storytelling media consists of 7 steps: 1) writing a script, 2) setting a story, 3) meeting to consider and revise the script, 4) sequencing images, 5) adding audio description, 6) adding sound effects and image transition techniques, and 7) adding background music.

Step 2: The learning management with gamification was synthesized into suitable steps for developing the model with the focus on digital literacy skills as shown in Table II.

The learning management with gamification was synthesized into 5 steps: 1) game mechanism, 2) points, 3) levels, 4) rewards, and 5) achievement.

Step 3: The learning management by using digital literacy skills was synthesized into suitable steps for developing the model with the focus on digital literacy skills. The learning management by using digital literacy skills was synthesized into 6 steps: 1) access to information, 2) management, 3)

assessment, 4) summarization, 5) creation, and 6) communication.

TABLE I: THE SYNTHESIZED LEARNING MODEL WITH ONLINE STORYTELLING MEDIA

The learning process by using online storytelling media	1. Write an initial script	2. Plan an accompanying storyboard	3. Discuss and revise the script	4. Sequence the images in the video editor	5. Add the narrative track	6. Add special effects and transitions	7. Add a soundtrack if time permits
[16]	✓	✓	✓	✓	✓	✓	✓
[17]	✓	✓	✓		✓	✓	✓
[18]	✓	✓		✓		✓	
[19]	✓	✓	✓		✓	✓	✓
[20]	✓	✓	✓	✓	✓	✓	✓
[21]	✓	✓	✓	✓	✓	✓	✓
[22]	✓	✓		✓			✓
[23]	✓	✓	✓	✓	✓	✓	✓
[24]	✓	✓	✓			✓	✓
[25]	✓	✓	✓	✓	✓	✓	✓
[26]	✓	✓	✓	✓	✓	✓	✓

TABLE II: THE LEARNING MANAGEMENT WITH GAMIFICATION

The learning management with gamification	1. (Game) Mechanics)	2. (Point)	3. (Level)	4. (Reward)	5. (Achievement)
[27]	✓	✓	✓	✓	✓
[28]	✓	✓	✓	✓	
[29]	✓	✓			✓
[30]	✓		✓	✓	✓
[31]	✓	✓		✓	✓
[32]	✓	✓	✓	✓	✓
[33]	✓		✓	✓	✓
[34]	✓	✓	✓	✓	✓
[35]	✓	✓	✓		✓
[36]	✓	✓	✓	✓	✓
[37]	✓	✓	✓	✓	✓
[38]	✓	✓	✓	✓	✓
[39]	✓	✓	✓	✓	✓
[40]	✓	✓	✓	✓	✓

Step 4: The conclusion and work assessment were performed by requesting the students to present their work and conclude the workpieces. This method was to discover by using the learning process of online digital storytelling via gamification in solving problems for building the workpieces of online digital storytelling.

After that, the lesson plans were examined for accuracy by the lecturer in the research project, and then for appropriateness and useability by the experts.

2) Test of digital literacy skills

The test of digital literacy skills was in a subjective form to test the knowledge of online digital storytelling and gamification from the course of content design and digital media development in 6 aspects that the researcher has used it according to the form that consisted of the research [41] as follows: 1) Access to information refers to the ability to search for information skillfully; 2) Management refers to the ability to analyze and classify information carefully and skillfully; 3) Assessment refers to the ability to assess information by setting criteria for appropriateness; 4) Conclusion refers to the ability to reflect information; 5) Creation refers to the ability to apply information in design and improvement carefully and flexibly; Finally, 6) communication refers to the ability to share information to achieve the goal by selecting the communication method properly.

After that, the test was examined by the research advisor, and then it was revised before being submitted to the experts to consider its congruence.

3) Assessment of workpieces

The workpieces were assessed in four aspects: usefulness of contents for application, planning on implementation, techniques, and presentation and listening to opinions. After that, the assessment form was examined for accuracy by the lecturer in computer education, and then for appropriateness and useability by the experts. Which consists of procedure, instrument and research results were shown in Table III.

Phase 2: Evaluation of the appropriateness of the learning model with online digital storytelling via gamification to enhance the digital literacy skills for the students in computer education.

The steps on evaluating the learning model appropriateness were as follows.

TABLE III: PROCEDURE, INSTRUMENTS, AND RESEARCH RESULTS

Research Steps	Research Procedures	Instruments for Evaluation
Step 1: Analysis	1. Synthesize components of digital literacy skills from the learning model with online storytelling media via gamification in the course of digital media design and development for students in the computer education program. There are four modules: student module, instructor module, contents module, and learning activity module. 2. The learning process with online storytelling media via gamification consists of 5 steps: 1) topic selection, 2) topic analysis, 3) learning management design with online storytelling via gamification, 4) development of learning achievement test, and 5) lesson revision.	Documents, textbooks, and research relevant to learning/teaching problem conditions, guidelines for learning/ teaching in learning achievement development and digital literacy skills, lesson plans, contents evaluation, technical evaluation, and satisfaction evaluation
Step 2: Design and Development	Develop the learning model with online storytelling media via gamification to enhance digital literacy skills in 3 steps. Step 1 is to develop online lessons with online storytelling media via gamification. Step 2 is to improve online lessons with online storytelling media via gamification according to experts' suggestions about techniques before being used with the sample group. And Step 3 is to design online narrative scripts in suitable forms of images, sounds, texts, and presentation styles.	Learning management system with online storytelling media via gamification to enhance digital literacy skills
Step 3: Implementation and Evaluation	Calculate the effectiveness of the developed online storytelling media via gamification to enhance digital literacy skills in 3 steps. 1) Students took the pretest through Google Forms. 2) Students were assigned to do homework from online lessons with online storytelling media via gamification in advance before class in each week. And 3) Students discussed together on what they had learned from the lesson assignments and from doing class activities with worksheets. Then they took the posttest through Google Forms.	Pretest, posttest, and class worksheets
Step 4: Implementation and Evaluation	Compare learning achievement before and after the lessons of the students in computer education who studied with online storytelling media via gamification in 2 steps. 1) Students took the pretest through Google Forms. After the pretest, the teacher reviewed contents of each lesson. And 2) Students took the posttest through Google Forms for evaluating learning achievement.	Pretest and posttest
Step 5: Evaluation	Evaluate satisfaction of the students in computer education on studying with online storytelling via gamification. In this step, the students rated their satisfaction on the learning management model with online storytelling media via gamification.	Satisfaction questionnaire

B. The Learning Model DSML Was Evaluated by Nine Experts Who Were Selected via Purposive Sampling

These experts were educators or university lecturers who graduated at the doctoral level or had experience in evaluating the appropriateness of learning models. The evaluation form used a 5-level rating scale, and the instruments are described below.

1) The learning model with online digital storytelling via gamification to enhance the digital literacy skills for the students in computer education.
2) The evaluation form on the appropriateness of the learning model by using a 5-level rating scale [42].

The criteria for interpreting the learning model appropriateness were as follows.

Mean Levels

4.51–5.00 a very high level of model appropriateness
3.51–4.50 a high level of model appropriateness
2.51– 3.50 a moderate level of model appropriateness
1.51–2.50 a low level of model appropriateness
1.0–1.50 a very low level of model appropriateness

Then the learning model with online digital storytelling via gamification for the students in computer education was revised according to the suggestions of the experts.

V. RESEARCH RESULTS

A. Results of the Study and Factor Analysis

The results of the study and factor analysis of the learning model with online digital storytelling via gamification for the students in computer education were obtained from the synthesis of relevant documents and research. It was found that there were 12 factors relating to the learning model with online digital storytelling via gamification as follows.

The factors of the learning model with online digital storytelling were synthesized into 7 learning steps by using the online digital storytelling: 1) writing a script, 2) setting a story, 3) meeting to consider and revise the script, 4) sequencing images, 5) adding audio description, 6) adding sound effects and image transition techniques, and 7) adding background music.

The factors of the learning model with gamification were synthesized into 5 steps: 1) game mechanism, 2) points, 3) levels, 4) rewards, and 5) achievement [43].

The DSML-Gami Model to enhance digital literacy skills has shown the relation between the components of DSML-Gami format to reinforce digital literacy skills have three parts that cocsists of Part 1: Input Process comprises of curriculum analysis, designation of assignment, evaluation,

users of learning format, Part 2: Input Process consists of the digital storytelling learning process, gamification learning management, learning process of digital literacy skills, Part 3: Output Process comprises evaluation. Such as in Fig. 1.

The description of two aspects with 12 factors is shown in Table IV.

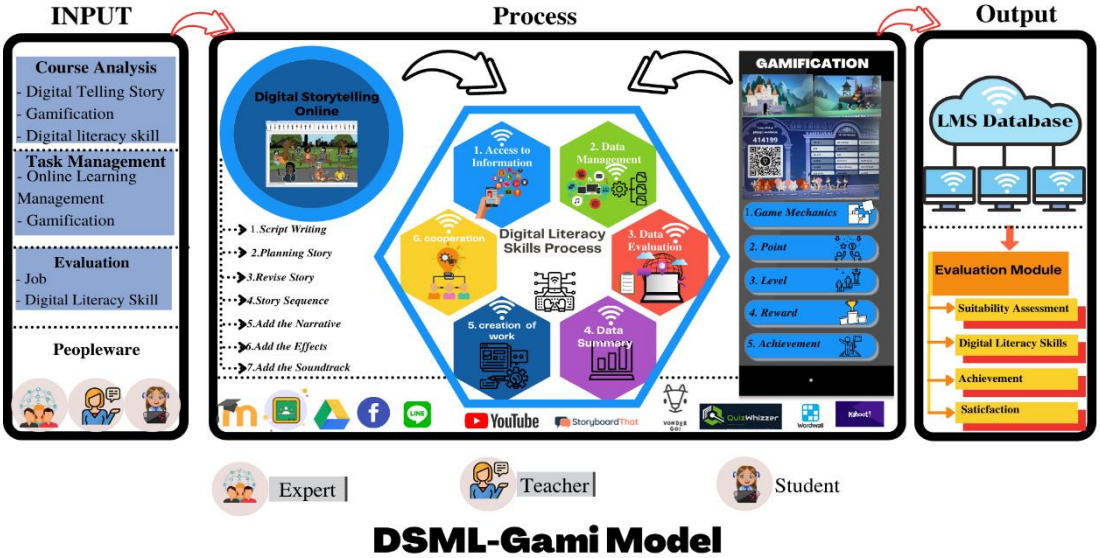

Fig. 1. The DSML-Gami Model to enhance digital literacy skills.

TABLE IV: THE FACTORS RELEVANT TO THE LEARNING MANAGEMENT CONSISTING OF LEARNING STEPS IN ONLINE DIGITAL STORYTELLING VIA GAMIFICATION

Aspects	Factors
1. Digital storytelling	1) writing a script, 2) setting a story, 3) meeting to consider and revise the script, 4) sequencing images, 5) adding audio description, 6) adding sound effects and image transition techniques, and 7) adding background music. The lesson plans were integrated with digital storytelling by allowing the students to use electronic devices to learn through storytelling in the form of short cartoons and the content summary in the job sheets. The digital media and technology presented characters, scenes, and characters' gestures to tell different stories through still images, animation, audio, videos, or game applications on Cloud technology.
2. Gamification	1) game mechanism, 2) points, 3) levels, 4) rewards, and 5) achievement The lesson plans used game mechanisms in learning management consisting of points, levels, rewards, and achievement. The learning activities are a game-like competition to answer questions which were designed to connect and encourage the students to achieve the goal in answering the questions. The points for each question were set as required, so the attack of the competing team could be created, or the competing team may drop a level if giving wrong answers. The game component encouraged more participation in learning as it made the learning activities more interesting, exciting, motivating, and enjoyable according to the game mechanism.

TABLE V: TEST OF DIGITAL LITERACY SKILLS IN A SUBJECTIVE FORM TO TEST THE KNOWLEDGE OF THE STUDENTS IN COMPUTER EDUCATION ABOUT ONLINE DIGITAL STORYTELLING AND GAMIFICATION FROM THE COURSE OF CONTENT DESIGN AND DIGITAL MEDIA DEVELOPMENT

Aspects	Factors	Variables
1. Skills	1. Access to information	1. Ability to search for information skillfully 2. Ability to search for information from search engines by using keywords. 3. Ability to search for information from search engines by using subject directories. 4. Ability to search for information from search engines by using metasearch engines linking to other types of search engines with various information. 5. Ability to identify where to search for the required information.
	2. Management	1. Ability to analyze information accurately. 2. Ability to classify information carefully and skillfully. 3. Ability to record favourite websites with bookmarks for later retrievals without filling in the web locations. 4. Ability to record and store electronic files on the Cloud such as Google Drive, OneDrive, Dropbox, etc. 5. Ability to select electronic file extensions for recording the workpieces.
	3. Assessment	1. Ability to set and create criteria for assessing information carefully, skillfully, and flexibly. 2. Ability to compare the accuracy and reliability of information sources on the websites. 3. Ability to compare updates of web information. 4. Ability to decide to select web information for use.
	4. Conclusion	1. Ability to give reflexive opinions on information. 2. Ability to decide to select web information for use. 3. Ability to select information from various sources. 4. Ability to analyze information by using programs such as Google Forms, spreadsheets, polls, and checklists, etc.

Aspects	Factors	Variables
		5. Ability to conclude which information is to be used for building the workpieces.
	5. Creation	1. Program design of digital storytelling media. 2. Gamification design for learning management with different applications. 3. Development of online digital storytelling media via gamification. 4. Improvement of the development of online digital storytelling media via gamification.
	6) Communication	1. Ability to select communication methods for communicating information accurately, carefully, and properly. 2. Ability to share information to achieve goals by selecting the communication methods properly. 3. Ability to create and communicate information to other people. 4. Ability to understand agreements on disseminating information through websites and social networks. 5. Ability to give opinions on topics of interest through websites, blogs, and social networks. 6. Ability to work and communicate with friends and lecturers through social network channels.
2. Assessment of workpieces	1. Usefulness of contents for application	1. Analysis of concepts from the workpiece contents.
	2. Planning on implementation	1. Analysis of concepts in planning to build workpieces.
	3. Techniques	1. Analysis of concepts in techniques to build workpieces.
	4. Presentation and listening to opinions	1. Analysis of concepts in presentation and listening to opinions on the workpieces.
Total 2 Aspects	10 Factors	29 Variables

B. *Results of Evaluation on the Model Appropriateness*

The results of the evaluation on DSML-model appropriateness. It consists of 10 sides, as shown in the following Table VI.

TABLE VI: EVALUATION OF THE MODEL APPROPRIATENESS

Description	Result $\bar{x}$	S.D.	Rate of appropriateness
1. Method of learning management	4.56	0.53	Very high
2. Contents and additional learning sources	4.44	0.53	High
3. Objectives of the model	4.56	0.53	Very high
4. Learning through online digital storytelling	4.78	0.44	Very high
5. Gamification learning management	4.78	0.44	Very high
6. Problem-solving practice of digital literacy skills	4.56	0.53	Very high
7. Design and application of the developed learning model	4.44	0.53	High
8. Students' uses	4.56	0.53	Very high
9. Workpiece creation and development of digital literacy skills	4.78	0.44	Very high
10. Evaluation	4.78	0.44	Very high
Total	4.62	0.13	Very high

According to Table V, the overall opinion of the experts on the model appropriateness is at the very high level (mean = 4.62, S.D. = 0.13).

VI. DISCUSSION

According to the results of the factor analysis about the learning model of online storytelling via gamification for enhancing the digital literacy skills of the students in computer education, the learning model consists of 12 factors: 1) writing a script; 2) setting a story; 3) meeting to consider and revise the script; 4) sequencing images; 5) adding audio description; 6) adding sound effects and image transition techniques, and 7) adding background music. Moreover, the factors of the learning model were synthesized into 5 steps of gamification learning: 1) game mechanism; 2) points; 3) levels; 4) rewards, and 5) achievement. The researcher systematically analyzed and synthesized the lesson plans of the learning model to achieve high quality and effectiveness. The process of learning management focuses on storytelling in relation to knowledge and real practice via the developed games so the model can enhance the students' digital literacy and interaction with lessons and classmates in groups discussions, leading to positive learning reinforcement. The results are consistent with the study of Dezuanni [44] which trialed the model in real situations with students in Thailand and the Lao People's Democratic Republic, resulting in higher achievement in the experimental group than in the control group. In addition, researches [45–47] state that motivation is related positively and continuously to the users' game playing. These results are also consistent with the study results in Finland which found a positive relationship between game players' experience and emotional responses. Therefore, gamification is an important instrument to reinforce the good learning progress of the game players.

The result of assessing the model appropriateness by nine experts showed a very high level of appropriateness (mean = 4.62, S.D. = 0.13) for the learning model with online storytelling via gamification for the students in computer education. The assessment result at the very high-quality level is consistent with the study of Santosa [48] in a digital learning environment which found that the students gained higher creativity and innovation than students learning with traditional lesson plans at the statistical significance level of 0.01. The researcher studied how to use theories to develop the lesson plans together with the design and development of online media to be more appropriate for managing learning activities [49–52]. Therefore, the quality of the learning model is appropriate for managing learning activities for students in the 21st century.

VII. Conclusion

The model component analysis of online storytelling media via gamification to enhance the digital literacy skills of students in computer education Thailand have two aspects with 12 factors were found. In addition, the test of digital literacy skills in a subjective form to test knowledge about online digital storytelling via gamification from the course of content design and digital media development was assessed. These 2 aspects were found with 10 factors and 29 variables, and they were rated by the experts for the appropriateness of the learning model with online digital storytelling via gamification to enhance digital literacy for the students in computer education. Overall, the model appropriateness was rated at the very high level (mean = 4.62, S.D. = 0.13). Based on the findings, the students could extend their learning scope with digital literacy skills in building digital media. These skills are necessary for Thai teachers in dealing with students in the future, so the model can be a prototype for doing classroom-based research and/or presenting research work at a national level.

VIII. Recommendations

A. Recommendation for Using the Study Results

The results of the study and factor analysis of the model can be used for developing additional learning activities. These results can then be applied leading to the development of quality worker skills and a more sustainable future.

B. Recommendation for Future Research

Future research should consider factors of modern digital literacy skills for students in various disciplines.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Charinthorn Aumgri was conducted the research by defining research frameworks, designing research methodology, analyzing data, modeling, discussing the findings, writing and reviewing the paper and editing the paper, reviewing models and approved the final version..

Kaiyasith Apirating conducted the research by collecting data, analyzing data, modeling and preparing the data for modeling and editing the paper, reviewing models and approved the final version.

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