The Effectiveness of an Online Learning Platform in Collaboration with Virtual Technology using a Digital Ecosystem to Develop Information, Media and Technology Skills of Undergraduate Students

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This research aims to study the results of an online learning platform in collaboration with virtual technology using a digital ecosystem to develop the information, media and technology skills of undergraduate students who learnt with a digital ecosystem. The sample group was 79 undergraduate students who were randomised with a cluster sampling method. The participants were divided into two groups, with 40 students in the experimental group and 39 students in the control group. The research tools used were (1) the teaching plan for online learning platform in collaboration with virtual technology using digital ecosystem, in accordance with the Dick and Carey Model; (2) an academic achievement evaluation form and (3) the student's information skill evaluation form. The data was analysed using mean (X), standard deviation, and Multivariate Analysis of Variance (MANOVA). The research found that, with significance level of 0.5, the academic achievement and information skills of the students who learned using online learning platform in collaboration with virtual technology using a digital ecosystem was higher compared to the students who using the normal learning method.

Key words: Online learning, digital ecosystem, augmented reality, information skills.
Introduction

The Government's “Thailand 4.0 policy” forms an operational plan to develop educational personnel, research, and technology (B.E. 2017-2021). The policy focuses on producing role models, as well as educating science and technology in order to boost learning and teaching achievements. The policy seeks to also develop curriculum to produce manpower which leads the teaching and learning of higher education institute to the goal. Therefore, the qualifications framework for higher education must be set according to Thai Qualifications Framework for Higher Education (TQF) in order to support the graduates so that they can be efficiently proficient in their future careers. Subsequently, the students will be equipped with the essential skills and capabilities for professions, developed through learning with information technology, to support information use and skills in developing innovative media for professions (UNESCO, 2008; Ministry of Education, 2016; Teachers and Basic Education.2010; Personnel Development Ministry of Education. (2016). Ministry of Education. (2017). This corresponds to education management in the 21st century which focuses on life and work skills, learning and innovation skills, and information media and technology skills (Partnership for 21st Century Learning, 2009).

Students' information technology is more important currently and in the future. Yuhyun PC, (2016) mentioned that in the next decade, 90% of the world's population must access to the internet which is used to drive and connect the global society to the world of internet (Internet of Everthing) or (Internet of Things). Therefore, it's presently important to prepare students for this future. This was conformed to PISA THAILAND, (2018) which revealed low assessment results score of Thai students in both math and science and the literacy assessment scores are likely to gradually decline. From the literacy assessment, the students received information from a single and various resources to correspond with the real-life information use of the people in the current world. The Thai education system should therefore encourage the implementation of digital technology in learning to efficiently develop the students' familiarity and boost their proficiency in literacy in the digital world, and ensure that they can keep pace with the global development. The Organization for Economic Cooperation and Development (OECD), (2019) mentioned that information technology can help with good communication and information exchange, and it also creates new opportunities for students to learn outside of school. It allows teachers to manage their teaching and follow the curriculum so that they can change the instruction method and exchange students' learning experiences to enhance their digital learning. Information media and technology competencies and digital literacy are essential skills for students in education in the digital world. The government must urgently ensure that students have proper information skills for this digital century.
However, instruction in Thai higher education institutes continue to face issues from the lack of diverse instruction methods. Practice is less common compared to the lecture, even though practice lessons actually contributes more to the development of future essential skills (Aumgri.C and Petsangsri.S, 2019; Pradubthong, et. al, 2018; Office of the Education Council, 2018) which affects students in the future. Meanwhile, Monchai Tiantong. (2011) stated that online virtual classroom learning can facilitate more effective and widespread learning, corresponding with Keeratikorn (2015) who said that another future essential skill is the virtual collaboration. Therefore, it's necessary to develop the future Thai workforces, and manage instruction and learning of Rajabhat University, which is the government's higher education institute that has been playing an important role in producing teachers for over 90 years and sets the goal in producing computer science teachers. These 41 universities throughout Thailand are under the Office of the Higher Education Commission, Ministry of Education and are able to produce local manpower with mid and high levels of education (Penchan Sangkaew, 2002; Sommai Piathanom, 2008; The History of Rajabhat University, 2019;) by diversely managing the instruction in each subject, depending on the readiness of those universities, and by adjusting the instruction to the local and national contexts. Lara, 2018; Reeve, 2016, from BETT educational technology 2018 also studied the importance of the implemented strategies and technologies which support the education, and found that 82% of the sample group accepted that technology is an important tool which well enhances modern skills.

In reflection of this issue, the researcher decided to develop an online learning platform in collaboration with virtual technology using a digital ecosystem to the develop information media and technology skills of students and improve the academic achievement of undergraduate students, with the intention that this will be implemented as instructional guidelines. Biljana and Dragana, (2017) and Phanich (2012) mentioned that teaching innovations is the important factor which raises the competency and the quality of teaching. It well enhances the 21st century skills, guides the development of instruction, and produces quality graduates who are equally equipped with information skills to live in the future daily digital world.

**Research Objectives**

1. Develop an online learning management plan in collaboration with virtual technology using digital ecosystem to develop the quality of information, media and technology skills.
2. Develop online learning in the collaboration with virtual technology using a digital ecosystem to develop quality and efficient information, media and technology skills.
3. Compare the information, media, and technology against the students' academic performance before and after practicing in the online learning platform in collaboration with virtual technology using a digital ecosystem.

**Research Hypothesis**

It is hypothesised that the students’ information, media, and technology skills as well as their academic achievement of students will improve after participating in the online learning platform.

**Research Methodology**

The populations of this study were 118 undergraduate students from the Faculty of Education, Nakhon Pathom Rajabhat University who were enrolled in the Digital Media Development and Design course in the first semester of the academic year 2019. The research participants were divided into four groups. The populations were randomised by the cluster sampling method. There were 40 people in the experimental group and 39 people in the control group. The sample size was calculated with G*power Version 3.1.7 package software by determining F-test, Manova test (MANOVA: Global effects), and the type of analysis on power of the test. The researcher determined the appropriate sample size before conducting the research (A priori: Compute required sample size – given α, power, and effect size). One - Tailed Test was defined by determining 1) the large effect size according to the criteria of effect size for T-test following Cohen's concept (Cohen, 1977; Nongluck Wiratchai, 2012) which is equal to .80. 2) the probability of type 1 error (α) = 0.05. 3) power of the test (1-β) = 0.80, which was equal to 22 people resulted from the calculation of the sample size. This corresponds to the sample size determination which uses MANOVA when at least 20 people should be determined on each sample group (Hair et al., 2010).

**The Research Tools Used Were Developed by the Researcher and Tested as the Follows;**

**Online Learning Management Plan**

There were 10 steps for the online learning management plan of the collaboration of virtual technology using a digital ecosystem to develop the information media and technology skills, following the steps of the Dick and Carey Model (2005). As shown in table 1, this consisted of the lesson content comprising of educational digital media design, media and instruction plan evaluations by five experts. The quality of the instruction plan was high, with a mean score of 4.68 (SD = 0.34). The evaluation results were divided into five levels: 4.50-5.00 (highest); 3.50-4.49 (high); 2.50-3.49 (average); 1.50-2.49 (low); and 1.00-1.49 (lowest).
**Academic Achievement Assessment Form**

The objective test comprised of 40 items. Index of Item Objective Congruence (IOC) was calculated from the assessment of five experts. The acquired IOC score ranged between 0.60-1.00, the difficulty index was between 0.27-0.63, and discrimination value was between 0.27-0.68, and the test reliability calculated by Cronbach Alpha Coefficient was 0.88.

**Information, Media and Technology Skills**

This tested the students’ information, media, and technology skills and included eight items of the objective test (the weighting of each choice is based on the level of Kohlberg's Moral Development (1976)). The IOC was calculated by five experts with the acquired IOC between 0.60-1.00 and the test reliability calculated by Cronbach Alpha Coefficient was 0.83.

**Data Collection**

1. Give advice on the management of online learning platform of the collaboration of virtual technology using digital ecosystem to improve students’ information, media, and technology skills for teachers and students for their mutual understandings.
2. Students signed an agreement to participate in the online learning platform of the collaboration of virtual technology using digital ecosystem to improve information, media, and technology skills in Digital Media Development and Design course so that the researcher granted their permissions and coordinated in collecting data with the sample group. The students were aged between 22 to 25 years old.
3. Prior to the learning process, the experimental and control sample groups must be tested using an academic achievement assessment form. The test results were used to compare the students' learning background.
4. The online learning platform of the collaboration of virtual technology using digital ecosystem to improve information, media, and technology skills applied ten instructional steps of the Dick and Carey Model (2005) and lasted for a total of ten weeks as shown in Table 1.
Table 1: Shows instructional steps of Dick and Carey Model

<table>
<thead>
<tr>
<th>Steps</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: Assess needs to identify instructional goal(s)</td>
<td>The course's objectives were determined at this stage. The objectives must be correspondingly adjusted to the educational goals. The researcher studied the course, and course description of the Digital Media Development and Design course (course id: 4143606) which is a basic course for undergraduate students on the Computer Education Program at the Faculty of Education, Nakhon Pathom Rajabhat University. The description and content of educational digital media design of the course are presented (Charinthorn Aumgri, 2017).</td>
</tr>
<tr>
<td>Step 2: Conduct instructional analysis</td>
<td>The analysis of instruction is the process when the instructional goals must be pursued for students to achieve in three targeted skills, including academic achievement and information use skills. The designer then analysed the indicators of the designated course so it corresponds with the learning outcome.</td>
</tr>
</tbody>
</table>
| **Learning Outcomes on Academic achievement** | 1. Tell the definition of information system correctly.  
2. Tell the elements of information system's main function process correctly.  
3. Tell characteristics of good information system correctly.  
4. Explain the definitions of information system's characteristics correctly.  
5. Categorise the type of information system correctly  
6. Tell the elements of information system correctly. |
<table>
<thead>
<tr>
<th>Steps</th>
<th>Activities</th>
</tr>
</thead>
</table>
| 7. Tell the definitions of information system's elements correctly.  
8. Tell the functions of the designated devices in information system correctly.  
9. Tell the function of the programs used in information system correctly.  
10. Tell the function of information system's elements correctly,  
11. Tell the operation process of information system correctly.  
12. Explain basic information of Canva program correctly.  
13. Use Canva program correctly.  
14. Create infographic for digital classroom with Canva program.  
15. Explain basic information of Plickers program correctly.  
16. Use Plickers program correctly.  
17. Design digital online classroom with Plickers program correctly.  
18. Explain basic information of Book Creator program correctly.  
19. Use Book Creator program correctly.  
21. Explain basic information of Aurasma is now HP correctly.  
22. Use Aurasma is now HP Reveal correctly.  
23. Create virtual media with Aurasma is now HP. |

**Step 3: Identify entry behaviours, characteristics**
The researcher created an entry behavior assessment form by individually analysing students. This can be classified into two aspects;  
1. Knowledge, competency, and experience  
   (1) Basic knowledge of the course available in that level.  
   (2) Problem-solving abilities  
   (3) Interest and concentration in learning.  
2. Intelligence readiness  
   (1) Creative initiation  
   (2) Rationality  
   (3) Learning competency / thinking prioritisation  

**Step 4: Write performance objectives**
The researcher designed purposive objectives or behavioural objectives which conform to instructional and learning objectives.  

**Step 5: Develop assessment instruments**
The researcher created an assessment tool which explains the relationship between the assessment form, learning objectives, and learning activities. This consisted of information searching skills and a report writing assessment, a data collection assessment, assessment of the group process, experiment operation, knowledge seeking, an assessment of conceptual map management, and knowledge assessment.
| Step 6: Develop instructional strategy | The researcher analysed the mission or instructional steps following Gagne's theory (Gagne. 1985) by applying nine events of the instruction model in designing the computer lesson, and made the lesson become like actual learning which adhered to content presentation principle and interactive learning activities. |
| Step 7: Developing and select instructional materials | The development of instructional media was used when the designer is not an instructor. The team was required to communicate and cooperate to share their skills. With a standard operation process to communicate between the designer and the material developer, the workflow would not be repeated. This would be the combination between the design and skill development by each participant. Hybrid instruction was used, with the instructor was selected and existing materials were adjusted to be appropriate for the instructional strategy. |
| Step 8: Design and conduct formative Evaluation of instruction | The evaluation was conducted during the operation. The learning content was be analysed by experts in contents and multi-media technology. The media was put on trial. One-to-one evaluation: 1. Involvement of students from the target group 2. Involvement of the experts in that learning content 3. The outcomes of the formative evaluation 4. Evaluation of the field trial. Small-group evaluation: 1. The involvement of the students from the target group. Field Trial: 2. Selected appropriate samples to the target group 3. The selected instructional materials 4. Instructor Led Instruction |
| Step 9: Revise instruction | The adjustment process of instructional media according to the recommendations of the five experts in instructional media. |
| Step 10: Design and conduct summative evaluation | Designed and evaluated the conclusions; both content and media production technique, in order to test the efficiency of online lessons in collaboration with the virtual technique using digital ecosystem. The efficiency calculation criteria of Promwong (1978) (E1 / E2) was used. This tool is accepted and widely used in Thailand to evaluate the quality of instruction (Wichian, 2017; Semphuech & Sukkamart , 2019; Komanee, Hoxsuwan, & Phuseeon, 2013; Meksohawannagul & Hiranburana, 2013 & Kannarik, 2014). |

4. After completing the instructional session, the students from the experimental group and the control group were asked to undergo a knowledge assessment, composing of 40 items of a
four-choice objective test. Content validity was checked by five experts. The index of the item and definition of each item was be checked by calculating the IOC (index of item - objective congruence) which was equal to 1.00 for every item. The researcher adjusted the questions according to the experts’ recommendations before testing them with students in Mattayom 4 and 30 research participants who were not in either of the two sample groups. This was undertaken to analyse the difficulty index which was .29-.79 and the discrimination index was .30-.60. The reliability index for the whole test was analysed with the KR-20 formula, with a result of .78. Each 12 items of assessment form the information, media, and technology skills was scored from 0-5 and the IOC was 1.00 in all evaluated items. The IOC was scored by two auditors and calculated with RAI (rater agreement index), which was .92.

5. Data was collected from the academic performance assessment form and the assessment form for information, media, and technology skills. The one-tail test was used to analyse the data.

**Research Results**

The researcher analysed the collected data from the online learning platform in collaboration with virtual technology using a digital ecosystem to develop information, media and technology skills which followed 10 steps of Dick and Carey Model (2005). Pre-test and post-test mean scores for the information, media and technology skills, as well as students' academic performance were compared when students enrolled in Digital Media Development and Design course's online learning platform in collaboration with virtual technology using digital ecosystem. This research then evaluated the hypothesis of MANOVA. The results are detailed in table 2.

**Table 2:** Test results of basic assumption test of MANOVA analysis

<table>
<thead>
<tr>
<th>Statistical Test</th>
<th>Assumption</th>
<th>Data analysis</th>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation of variables by applying Barlett’s Test</td>
<td>Sig &lt; (\alpha)</td>
<td>.00*</td>
<td>The dependent variables did not correlate, which caused multicollinearity</td>
</tr>
<tr>
<td>Variance-covariance matrix by applying Box’s M Test</td>
<td>Sig &gt; (\alpha)</td>
<td>.06</td>
<td>The variance-covariance matrix are equal.</td>
</tr>
<tr>
<td>Data distribution by applying Shapiro-Wilk</td>
<td>Sig &gt; (\alpha)</td>
<td>.05</td>
<td>The data is normally distributed and classified into two groups.</td>
</tr>
</tbody>
</table>

\(*p < .05\)
Table 2 shows that the overall results of every item have complied with the basic assumption of the MANOVA analysis. The test of basic agreement shows the following results. First, by applying Barlett’s Test, it’s found that $\text{Sig} < \alpha$ meaning that the variables did not correlate, thus causing multicollinearity. Second, by applying Box’s M Test, it was found that $\text{Sig} > \alpha$ which can be interpreted that the variance-covariance matrix was equal. Third, by applying Shapiro-Wilk, it was found that $\text{Sig} > \alpha$ which identifies that the data was normally distributed. Therefore, one-way MANOVA was conducted.

Table 3: The results from the analysis of students’ academic achievement and information, media, and technology skills between the experimental group and the control group

<table>
<thead>
<tr>
<th>Group</th>
<th>Achievement score (30 points)</th>
<th>Score of information, media, and technology skills (40 points)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>27.92</td>
<td>1.118</td>
</tr>
<tr>
<td>(n=40)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Group</td>
<td>17.21</td>
<td>2.105</td>
</tr>
<tr>
<td>(n=39)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note, Box’s M =55.404, df = 1090273.816, $p = .00$, Bartlett’s Test: Likelihood = .109, Approx. Chi-Square = 4.265, df = 2, $p = .00$

Table 3 shows that the students’ academic achievement and information, media, and technology skills score is higher after enrolling in online learning platform in collaboration with virtual technology using digital ecosystem. The mean post-test score of students’ problem-solving skill ($\bar{x} = 10.84$, S.D. = 2.11) is higher than the pre-test score ($\bar{x} = 6.00$, S.D. = 2.10). Meanwhile, the post-test score of the students’ academic achievement ($\bar{x} = 12.43$, S.D. = 3.33) is higher than the pre-test score ($\bar{x} = 9.57$, S.D. = 3.28) (Tabachnick and Fidell, 2013).

Table 4: Statistical test in comparison of academic achievement information, media, and technology skills after the learning for the experimental group and the control group

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>Statistical test</th>
<th>Value</th>
<th>F</th>
<th>Hypothesis df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP</td>
<td>Pillai's Trace</td>
<td>.953</td>
<td>549.462</td>
<td>2.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Wilks' Lambda</td>
<td>.065</td>
<td>549.462</td>
<td>2.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Hotelling's Trace</td>
<td>14.460</td>
<td>549.462</td>
<td>2.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Roy's Largest Root</td>
<td>14.460</td>
<td>549.462</td>
<td>2.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

*p<0.05

From table 4, it’s shown that the variance of post-test scores for the academic achievements of the experimental group and the control group are different at significance level of 0.05. This indicates that at least one instructional method affects the difference in at least one
dependent variable of the experimental group and control group. The results from multi-variables test are as follows.

Pillai's trace is used as a test statistic in MANOVA, which has a positive value from 0 to 1. Increasing the statistical value contributes more to the model (Berry, et.al, 2016; Santhuenkeaw.t, 2019). The study results show a value of 0.953

Wilks' Lambda is a positive-valued statistic that ranges from 0 to 1, with decreasing values indicating effects that contribute more to the model (0.65).

Hotelling's trace is the sum of the eigenvalues of the test matrix, which is a positive-valued statistic with increasing values indicating effects that contribute more to the model (14.460). Hotelling's trace is always larger than Pillai's trace.

Roy's largest root is the largest eigenvalue of the test matrix. Thus, it is a positive-valued statistic for which increasing values indicate effects that contribute more to the model. Roy's largest root is always less than or equal to Hotelling's trace. As the study’s two statistics are equal (14.460), the resultant interpretation is that there is a strong correlation between the dependent variables.

Table 5: Tests of between – subjects effects

<table>
<thead>
<tr>
<th>Source</th>
<th>Dependent Variable</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Couple Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>IT Skill</td>
<td>1083.211</td>
<td>1</td>
<td>1083.211</td>
<td>243.499</td>
<td>.00</td>
<td>Experiment &gt; Controls</td>
</tr>
<tr>
<td></td>
<td>Achievement</td>
<td>2269.220</td>
<td>1</td>
<td>2269.220</td>
<td>804.710</td>
<td>.00</td>
<td>Experiment &gt; Controls</td>
</tr>
<tr>
<td>Error</td>
<td>IT Skill</td>
<td>342.536</td>
<td>77</td>
<td>4.449</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Achievement</td>
<td>217.134</td>
<td>77</td>
<td>2.820</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>IT Skill</td>
<td>95421.000</td>
<td>78</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Achievement</td>
<td>42954.000</td>
<td>78</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note, **p < .05

From table 5, it is found that the variance of information, media, and technology skills and the academic achievement of experimental group are higher after the enrolment in the online learning platform at a significance level of 0.5. The analysis of information, media, and technology and academic achievement has already designed pre-test and post-test assessment; therefore, paired sample test was not conducted. The analysis results indicate that the
students’ information, media, and technology skills and academic achievement are higher after enrolling in the online learning platform.

Conclusion

The findings from the online learning platform in collaboration with virtual technology using a digital ecosystem to improve information, media, and technology skills following 10 steps of Dick and Carey Model can be concluded as follows. First, the appropriateness of the plan scored 0.67-1.00 by experts, which comprises the elements of learning management, learning objectives, contents, learning activities, learning media, and assessment and evaluation. Second, the mean scores of information, media, and technology and academic achievement were considered higher than the control group at a significance level of 0.5, both in content and in the media production technique which is categorised in a “very good” level. The efficiency of the online’s process towards the efficiency of outcomes is equal to 81.69/87.28. The students’ information, media, and technology skills and academic achievement is higher after the enrolment in a online learning platform in collaboration with virtual technology using a digital ecosystem to improve information, media, and technology skills at a significant level of 0.5.

Since there are various forms of studies on appropriate thinking skills for the 21st century, it’s necessary to equip students with capabilities, especially their innovation and technology skills, which can be adapted to their daily life. It can also enhance the efficiency of teaching and learning computer (Aumgri.C & Pimdee.P (2018); Radicelli, et. al (2018); Titova, et. al (2018). Online learning is currently a popular instructional strategy which can serve to enhance information, media, and technology skills of students wound the world.
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