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## ***Effectiveness of Blended E-Learning Approach in a Flipped Classroom Environment***

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The Asian Conference on Society, Education & Technology 2016  
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### **Abstract**

Researchers have persuaded educational institutions that there is a new set of vital skills that students are required to have, thus giving rise to a new trend in education called Blended Learning. An example of this is a Flipped classroom where the traditional in-class and out-of-class activities is switched. The purpose of this study is to determine the effectiveness of this type of classroom. The research method used for this paper is quasi-experimental design in which the process consists of three analyses: first is evaluating the effectiveness of flipped classroom; second is comparing the effectiveness of flipped with a traditional classroom; and third, comparing the effectiveness of a flipped classroom to high and moderate to low performing students. Results show that a flipped classroom environment had a large significant effect ( $d = 3.180$ ) in improving the trigonometry performance of the students. Additionally, a flipped classroom environment had a quite larger effect ( $d = 3.619$ ) in improving students' performance compared to traditional classroom environment ( $d = 2.004$ ). However, this difference of effect is considered not to be statistically significant ( $F = 1.837$ ,  $p > 0.05$ ). Furthermore, the effectiveness of a flipped classroom is significantly larger to high performing students compared to moderate to low performing students ( $F = 10.165$ ,  $p < 0.05$ ).

Keywords: Flipped Learning, Blended Learning, 21st Century Skills, e-Learning, Traditional Learning, In-Class Activity, Out-of-Class Activity, Module

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## Introduction

The 21st century offers new opportunities due to the emergence of new ideas and technology. On the other hand, it also offers new challenges. Information where students could attain knowledge is very accessible because of new technology. However, knowledge itself is not enough. Researchers have proposed and subsequently persuaded educational institutions that there is a necessary set of skills that students require to be successful in the 21st century (Schgrader & Lawless, 2011). A student must have the skills on how to use their knowledge. These skills include thinking critically, applying knowledge to new situations, analyzing information, comprehending new ideas, communicating, collaborating, solving problem, making decisions (Partnership for 21st Century Skills, 2011). These skills are further defined into three broad categories: information and communication skills, thinking and problem-solving skills, and interpersonal and self-directional skills. With this development in education, it was imperative to acquire a new approach in methodology, hence blended learning was born.

The term “blended learning” is increasingly being popular in both academic and corporate circles; even so, this term does not give a universal definition that educators could use (Graham, 2004). Definitions were suggested by various authors but still focused on a central idea – combination of approaches, technologies, and methodologies (Sharma, 2010). Three definitions of blended learning are considered relevant: blended learning is the integrated combination of traditional learning with web based on-line approaches; blended learning is the combination of media and tools employed in an e-learning environment; and, blended learning is the combination of a number of pedagogical approaches.

The importance of blended learning came from the fact that traditional and online learning had their limitations. A physical classroom training program limits the access to only those who can participate at a fixed time and location, whereas a virtual classroom event is inclusive of remote audiences (Singh, 2003). However, if teachers rely too much in e-learning and disregard face-to-face instruction, students might not experience the full extent of benefits learning in communities could offer (Hrastinski, 2008). In blended learning, the combination of two approaches could complement the limitations of the other. The value of this approach could be attributed to six benefits it could bring (Osguthorpe & Graham 2003) viz., (1) pedagogical richness, (2) access to knowledge, (3) social interaction, (4) personal agency, (5) cost effectiveness, and (6) ease of revision.

As has been mentioned, blended learning is the combination of learning approaches and one example of which is a flipped classroom. By definition, a flipped classroom is an educational technique that consists of two parts: interactive group learning activities inside the classroom and direct computer-based individual instruction outside the classroom (Bishop & Verleger, 2013). Combining interactive group learning and direct individual instructions such as a flipped classroom is a good example of blended learning. Studies suggest specific advantages of flipping classrooms. To start with, teachers who use flipped classrooms have time to work individually with students (Steed, 2012). Another benefit of flipping classrooms is

that classroom time will be spent working through problems, advance concepts, and engaging in collaborative learning (Tucker, 2012).

Even though blended learning, specifically flipped classroom, is a trend to cater to 21st century needs, there is limited amount of scholarly research on its effectiveness (Bishop & Verleger, 2013). Due to this gap, the researcher wanted to pursue a study to evaluate the efficiency of a blended e-learning approach thru a flipped classroom.

The main problem of the study is to determine the effectiveness of blended e-learning approach in a flipped classroom environment. The study sought to investigate the effectiveness of flipped classroom in improving students' trigonometric achievement, to compare students' performance under flipped classroom and traditional classroom, and to evaluate the extent of effect of flipped classroom to the achievement of high and moderate to low performing students.

### **Conceptual Framework**

The study aims to evaluate the effectiveness of Blended e-learning Approach in a Flipped Classroom Environment. Blended learning suggests a number of definitions that address combination of approaches, technologies, and methodologies of learning (Sharma, 2010). In this study, the considered definition of blended learning is the combination of traditional learning and web based on-line learning (e-learning) approaches (Oliver & Trigwell, 2005). Traditional learning refers to lecture method where students listen to explicit instruction from the teacher. Alternatively, e-learning refers to the intentional use of networked information and communications technology in teaching and learning (Naidu, 2006). Blended learning has a myriad of learning formats: synchronous physical formats, and self-paced asynchronous formats (Singh, 2003). First, synchronous physical formats refer to face-to-face approaches where activities are done in the classroom with teacher supervision. Second, self-paced asynchronous formats refer to on-line methods done outside of the classroom, without live teacher supervision and students dictate their own pace.

Today, a blended learning program may combine one or more of the dimensions, thus the study chose the simplest level – a blended learning experience that combines offline and online forms of learning where the online learning usually means “over the Internet or Intranet” and offline learning happening in a more traditional classroom setting (Singh, 2003). This dimension of blended learning is associated with flipped classrooms. By definition, flipped classroom is an educational technique that consists of two parts: activities inside the classroom, and activities outside the classroom (Bishop & Verleger, 2013). In this study, in-class activities employ group-based interactive learning activities inside the classroom, citing student-centered learning theories thru synchronous physical formats of learning approaches (Bishop & Verleger, 2013). On the other hand, out-of-class activities employ individual on-line learning activities outside the classroom thru synchronous online (live e-learning) and self-paced asynchronous formats of learning approaches (Bishop & Verleger, 2013).

The study evaluated the effectiveness of blended learning approach using a flipped classroom environment. In evaluating, the study considered two procedures: First is comparing the efficiency of a flipped classroom environment with the efficiency of traditional classroom settings. Comparison of the approach being studied to normal setting determines if flipped classroom causes a significant improvement to students'

output. Second is determining the efficiency of a flipped classroom to high performing students and moderately to low performing students. The summary of the framework is reflected on the diagram shown in Figure 1.

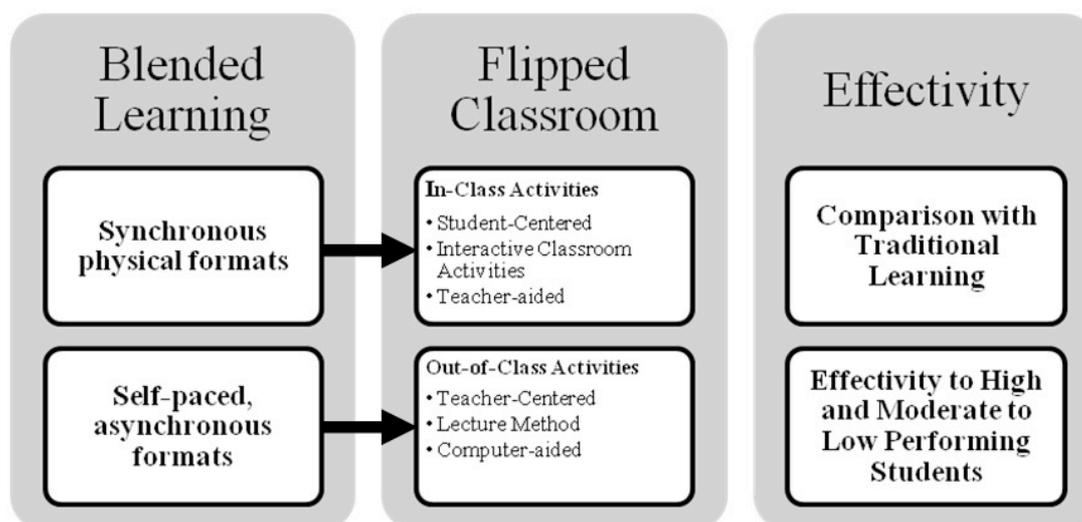


Figure 1: Conceptual Framework

## Review of Related Literature

### *Blended Learning*

Blended learning is an increasingly popular approach in education. However, various authors suggest different definitions of it. Sharma (2010) suggests a set of definition based on its combination of approaches, technologies, and methodologies. Three definitions were provided in his study: blended learning is the integrated combination of traditional learning with web based on-line approaches; blended learning is the combination of media and tools employed in an e-learning environment; and, blended learning is the combination of a number of pedagogic approaches. Graham (2004) also agreed that blended learning has no uniform definition. The study provides also three definitions: combining instructional modalities, combining instructional methods, and combining online and face-to-face instruction. Even though blended learning has a number of definitions, they are mostly just variations of a few common themes.

The original use of the phrase “blended learning” was often associated with simply combining traditional classroom training with e-learning activities. However, the term has evolved to encompass a much richer set of learning strategies or dimensions (Singh, 2004). According to Singh (2004), blended learning is expanded to five dimensions. The first is the simplest level - a blended learning experience that combines offline and online forms of learning where the online learning usually means “over the internet or intranet” and offline learning that happens in a more traditional classroom setting (Singh, 2004). Second is the blending of a self-paced and live, collaborative learning. Self-paced learning implies solitary, on-demand learning at a pace that is managed or controlled by the learner. Collaborative learning, on the other hand, implies a more dynamic communication among many learners that brings about knowledge sharing (Singh, 2004). Third is the combination of structured and unstructured learning. Formal learning program is in organized content with specific sequence like chapters in a textbook. On the other hand, most learning in the

workplace occurs in an unstructured form via meetings, hallway conversations, or e-mail (Singh, 2004). The fourth dimension is blending custom content with off-the-shelf content. Off-the-shelf content is by definition generic—unaware of an organization's unique context and requirements. However, generic self-paced content can be customized today with a blend of live experiences or with content customization (Singh, 2004). Fifth level is blending learning, practice, and performance support. Perhaps the finest form of blended learning is to supplement learning with practice and just-in-time performance support tools that facilitate the appropriate execution of job-tasks (Singh, 2004).

Blended learning does not have a universally accepted categorization. Some studies were done to set up their types of blended learning. A study from Kleber (2015) offers a tangible delineation of blended learning into four models: rotational, flex, a la carte and enriched virtual.

- (1) Rotational model (station, lab, modified flipped, individual): Students move from one activity or location to mix digital teaching tools and mentored application.
- (2) Flex: Credit recovery model where students work independently at an individualized pace with face-to-face support and activities.
- (3) A la Carte: Students take a course entirely online to supplement their regular in class work.
- (4) Enriched virtual: A course or subject in which students have required, face-to-face learning sessions with their teacher of record and then are free to complete their remaining course work remotely.

The sudden increase of blended learning is caused by the benefit it causes in the educational community. A number of studies are dedicated to explore blended learning, specifically its relevance to teacher instruction. According to Zackerman (2012), the more video segments focus on targeted bursts of context, including the 'back story' or 'field truth,' the more learner consumption and appreciation grows, the more delivery of instruction becomes an effective training. Results from Al Musawi (2011) showed that there is a dramatic rise in using blended learning approaches which also made a significant grade improvement for blended learning courses over entire online courses. Osguthorpe & Graham (2003) identified six benefits it could bring: (1) pedagogical richness, (2) access to knowledge, (3) social interaction, (4) personal agency, (5) cost effectiveness, and (6) ease of revision.

### ***Flipped Classroom***

Flipping classroom means that activities that have traditionally taken place inside the classroom now take place outside the classroom and vice versa (Bishop and Verleger, 2013). This model involves the teacher delivering the 'taught' element outside of the classroom. Students complete this element of their learning prior to attending the lesson (Steed, 2012). This implies that the usual lecture methods were done as homework while usual activity assigned sheets were done inside the classroom. However, studies suggest that flipping classroom is more than flipping lectures to assignments. Flipping' a lesson means providing students with a video that explains the concepts, structure and skills, so that when they get to class, after doing a quick re-cap, they can get into a real 'workshop' of learning (Abbey, 2013). Classroom activities must not just be individual seat works, interactive should be group learning activities inside the classroom instead (Bishop and Verleger, 2013).

A flipped classroom is an educational technique that consists of two parts: interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom (Bishop and Verleger, 2013). The combination of these two processes is what makes up the flipped classroom. A graphic representation of this concept is shown in Figure 2.

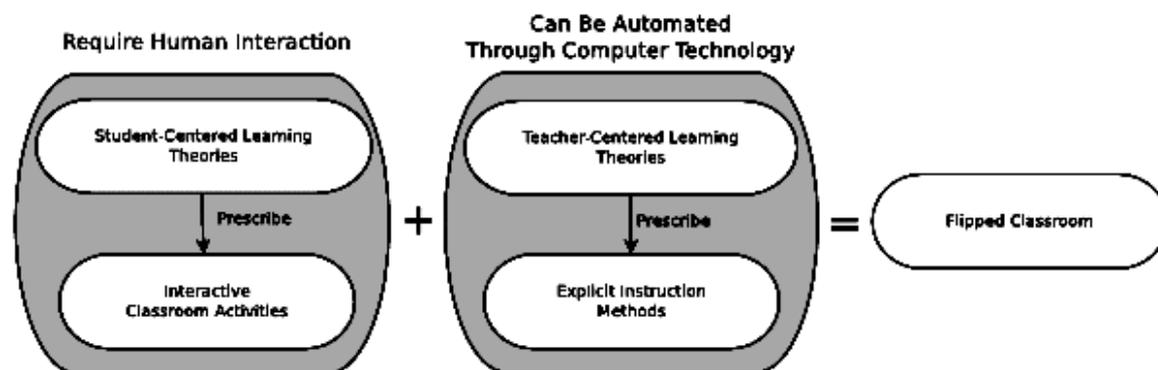


Figure 2: Flipped Classroom

(Adopted from the *Flipped Classroom: A Survey of the Research* by Bishop & Verleger, 2013)

It is to be noted that a flipped classroom is different from flipped learning. It is not necessary that a flipped class could result to a flipped learning (Flipped Learning Network, 2014). Implementers of such method should be aware of the dimensions for an effective flipped classroom, thus the Flipped Learning Network provides the “Four Pillars of F-L-I-P”. These pillars are: Flexible Environment, Learning Culture, Intention Content, and Professional Educator (Hamdan, McKnight, Arfstrom, 2013). Standards on what should be expected in each pillar are included in Table 1.

Table 1: The Four Pillars of F-L-I-P

<b>Flexible Learning</b>	<ul style="list-style-type: none"> <li>✓ I establish spaces and time frames that permit students to interact and reflect on their learning as needed.</li> <li>✓ I continually observe and monitor students to make adjustments as appropriate.</li> <li>✓ I provide students with different ways to learn content and demonstrate mastery.</li> </ul>
<b>Learning Culture</b>	<ul style="list-style-type: none"> <li>✓ I give students opportunities to engage in meaningful activities without the teacher being central.</li> <li>✓ I scaffold these activities and make them accessible to all students through differentiation and feedback.</li> </ul>
<b>Intentional Content</b>	<ul style="list-style-type: none"> <li>✓ I prioritize concepts used in direct instruction for learners to access on their own.</li> <li>✓ I create and/or curate relevant content (typically videos) for my students.</li> <li>✓ I differentiate to make content accessible and relevant to all students.</li> </ul>
<b>Professional Educator</b>	<ul style="list-style-type: none"> <li>✓ I make myself available to all students for individual, small group, and class feedback in real time as needed.</li> <li>✓ I conduct ongoing formative assessments during class time through observation and by recording data to inform</li> </ul>

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future instruction.

- ✓ I collaborate and reflect with other educators and take responsibility for transforming my practice.

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*(Adopted from the Four Pillars of F-L-I-P™ by Flipped Learning Network, 2014)*

Various studies suggest that benefits of flipped classroom, especially in the emergence of outline technology, could make e-learning possible. According to Steed (2012), teachers who use flipped classrooms had time to work individually with students. The approach promotes one-to-one discussions with students in classrooms. Another study suggests classroom time will be spent working through problems, advance concepts, and engage in collaborative learning with flipped classrooms (Bill, 2012). The Flipped Learning Network suggests that in a flipped classroom, the teacher moves lower levels of the taxonomy outside of the class where students work on mastering concepts and can pause, rewind and review the lesson at any time. The teacher and students can focus on upper levels of the taxonomy in class (Hamdan, McKnight, Arfstrom, 2013).

## **Methodology**

### ***Research Design***

The purpose of this study is to evaluate the effectiveness of a blended e-learning approach using a flipped classroom environment. The research method that was selected for this paper is quasi-experimental design for non-equivalent groups. Through quasi-experimental research, performance between group X (group which has undergone traditional learning) and group Y (group which undergo blended e-learning) was compared. Random assignment of participants to conditions or other control was no longer considered. In addition, group Y was further classified into two sub groups: high performing students (Subgroup Y1) and moderate to low performing student (Subgroup Y2). The difference in performance of these two subgroups was analyzed and compared to conclude the effect of flipped approach on different types of students.

### ***Participants***

The study was conducted at a certain Catholic school in Metro Manila. The module for unit 1, Trigonometry, was used for blended learning with a flipped classroom environment. The participants came from three Grade 10 sections, each consisting of an average of 42 students. All of the students in each section of the study belonged to sections named group X and group Y. Group X consisted of one section while group Y consisted of two. Group X underwent traditional method while group Y used the blended learning with flipped classroom environment. In comparing traditional and flipped approach, only one section for both group X and Y was used.

In determining the effect of flipped classroom to high and moderate to low performing students, two sections of Group Y were used. Group Y was divided into two Subgroups: Subgroup Y1 which consisted of high performing students and Subgroup Y2 which consisted of moderate to low performing students. The basis for determining high and moderate to low performing students was based on their National Career Assessment Exam (NCAE) results on Mathematics proficiency for academic year 2014-2015. High Performing students had a score of 90 and above while Moderate to Low performing students had a score of 89 and below.

competencies in the Department of Education K-12 curriculum were used in the tests. Table 2 shows the table of specifications used for the pre and post tests.

### ***Procedure***

To evaluate the efficiency of a blended e-learning approach in a flipped classroom environment, a module was produced by the researcher and was used in class. In preparation of the module, a curriculum map was first created. Topics, standards, and activities that were implemented during the course of the unit were based in the curriculum map. Specifically, the curriculum map is a matrix in which the following are listed: unit topics, content and performance standards, essential questions, enduring understanding, transfer goals, skills, assessments, and strategies.

In preparing the module, the Lasallian Learning Module format was used as a template. The module caters to the “Backward Design” since it starts with determining the desired outcomes which will establish the design of curriculum units, performance assessments, and classroom instruction (Wiggins & McTighe, 2005). Aside from standards and expected outcomes, also included in the module is the lesson flow for the whole unit. Since blended e-learning was the approach used in the module, there is be a portion where blended tools are be listed i.e. face to face and e-learning activities are two dimensions of blended tools.

A pre-test was conducted to students before implementing the revised module. This test determined the prior knowledge of the students. These scores were compared to their post test to see the difference in performance before and after implementing the module. The same pre-test will be given to all students of group X and group Y. The 15-item pre-test was answered for 30 minutes. A brief clarification before the pre-test in which details about the objective, mechanics, time duration, and other instructions in answering the test was given.

The module was implemented after the students took their pre-test. Different modules were given to group X and group Y. Group X, as the controlled group, took the module that uses a traditional approach, while group Y, as the experimental group, took the module that uses blended e-learning approach. The module for group X had the following flow for the lessons: First part includes in-class activities which are teacher-centered and uses lecture method, the second part includes out-of-class activities that consists of student-centered formative assessments. The module of group Y had the following flow for the lesson: First part includes out-of-class teacher-centered activities with online lecture as a method while the second part includes student-centered formative assessment. Figure 2 shows the process of implementation of the module with the pre and post test.

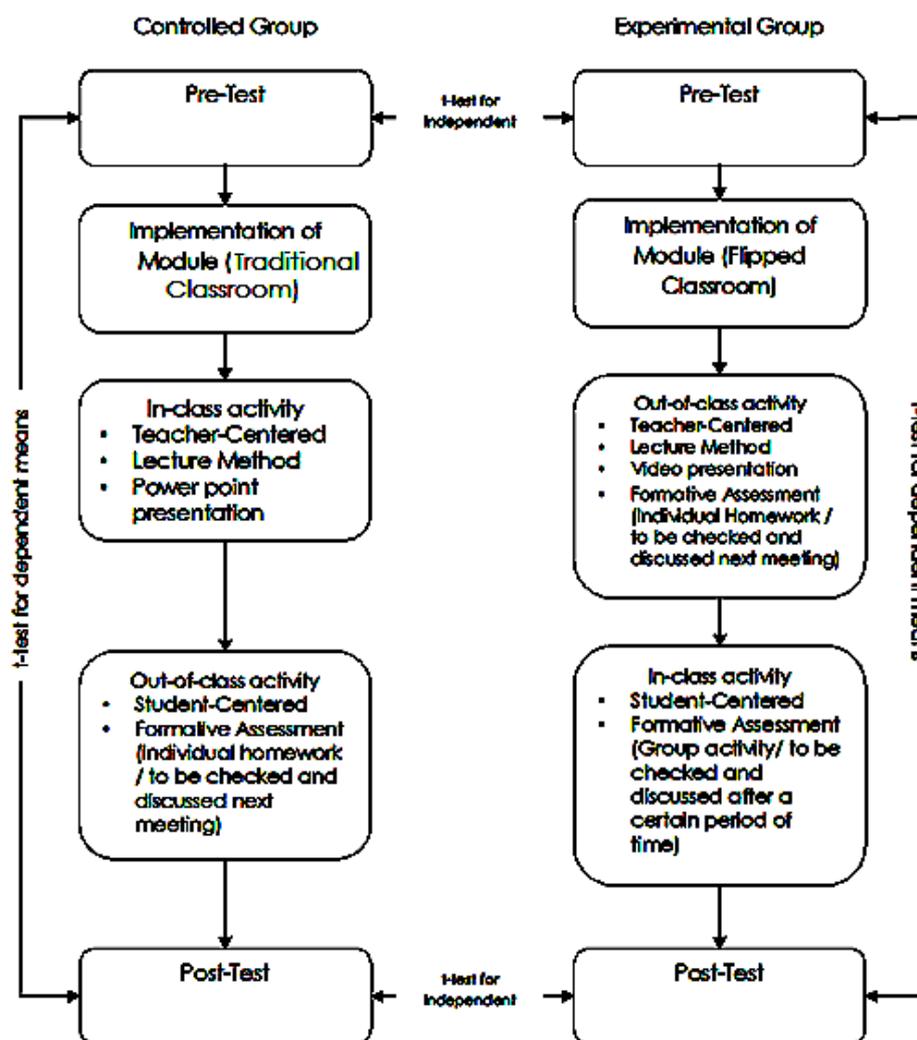


Figure 2: Module Implementation

A post-test was given at the end of the unit. The test, served as their final scores, was compared to their pre-test scores to see the difference in performance before and after implementing the module. The same post-tests were given to all students of groups X and Y. The tests were answered by the students for 30 minutes. A brief clarification was given before the post-tests in which details for the mechanics and time duration were discussed.

Data from the assessments were analyzed to determine the following: the effectiveness of the flipped classroom, the difference of flipped classroom to traditional classroom, and the effect of flipped classroom to high and moderate to low performing students.

### ***Statistical Treatment***

The data were analyzed using two statistical treatments: t-test of dependent means and Analysis of Covariance (ANCOVA). To find out if the flipped classroom has a significant effect on the performance of the students, t-test of dependent means was used to compare the scores on pre and post tests of students. The result determined that the intervention caused significant increase on the performance of the students.

ANCOVA was used to determine if the academic achievement of students who have experienced flipped approach is significantly different to students who have undergone traditional approach. ANCOVA is an analysis procedure for looking at group effects on a continuous outcome when some other continuous explanatory variable also have an effect on the outcome. To determine the difference between the traditional and flipped approach, the post tests of group X and group Y were compared considering the results of the pre-tests of the two groups. The treatment showed the difference of the two approaches (traditional or flipped) affected the post test scores considering the covariate which is the pre test scores.

To find out the effect of a flipped classroom to high and moderate to low performing students, t-test of dependent means and ANCOVA were used. T-test determined the effect size of flipped classroom to the performance of Subgroup Y1 and Y2.

## Results

### *Effectiveness of flipped classroom in improving students' trigonometric achievement*

The first analysis showed the effectiveness of blended e-learning in a flipped classroom environment by inspecting the significance of difference between the pre-test and post-test scores before and after the intervention respectively. To analyze pre-test and post test scores of flipped classroom group (Group Y), t-test of dependent means with 95% confidence is used. Results are shown in Table 2.

Table 2: Comparison of pre and post test results of flipped classroom group

	<i>M</i>	<i>SD</i>	<i>t-value</i>	<i>p</i>	<i>Cohen's d</i>
<i>Post Test</i>	10.348	2.8148	17.333	.000	3.180
<i>Pre Test</i>	3.350	1.3269			

Results show the difference between the post and pre test to be statistically significant where  $t = 17.333$ ,  $p < .05$ ;  $d = 1.56$ . The effect size for this analysis ( $d = 3.180$ ) was found to exceed Cohen's (1988) convention for a large effect ( $d = .80$ ). These results indicate that the post test scores of the students were significantly higher than their pre test results. Consequently, effect size suggests that the intervention of flipping the classroom shows a large effect on the students' trigonometry achievement.

Flipped classroom is expected to cause significant change to students' performance before and after instruction. Nevertheless, results show that flipped classroom is an effective method in delivering instruction to students.

### *Comparison of students' performance under flipped classroom and traditional classroom*

The second analysis examined the effectiveness of flipped classroom environment as compared to a traditional classroom. To compare the two classroom environments, the effect sizes of the traditional classroom group (Group X) and flipped classroom group (Group Y) was determined. Results are shown in Table 3. Additionally, the significance of the difference between the two approaches will be determined by using analysis of covariance with 95% confidence level. Results are summarized in

Table 4.

Table 3: Effect Sizes of Traditional and Flipped Classroom Group

		<i>M</i>	<i>SD</i>	<i>t-value</i>	<i>p</i>	<i>Cohen's d</i>
<b>Traditional (Group X)</b>	<i>Post Test</i>	9.806	3.362	8.706	.000	2.004
	<i>Pre Test</i>	4.417	1.779			
<b>Flipped (Group Y)</b>	<i>Post Test</i>	10.906	2.728	13.831	.000	3.619
	<i>Pre Test</i>	3.281	1.198			

Table 4: Comparison of Traditional and Flipped Classroom Group

	<i>M</i>	<i>SD</i>	<i>F-value</i>	<i>P</i>
<b>Traditional (Group X)</b>	9.81	3.362	1.837	.180
<b>Flipped (Group Y)</b>	10.91	2.728		

It is implied by the results in Table 3 that traditional classroom environment and flipped classroom environment caused significant change on the performance of students (Traditional  $t = 8.706$ ,  $p < .05$ ; Flipped  $t = 13,831$ ,  $p < 0.05$ ). Furthermore, the effect sizes of the two approaches differ in which traditional classroom had Cohen's  $d$  value of 2.004 while flipped classroom had a  $d$  value = 3.619. Even though effect sizes of the two approaches differ, the interpretation remains the same as the values of Cohen's  $d$  exceeds 0.80 interpreted as large effect (Cohen's, 1988). Table 4 summarizes the results of analysis of covariance between post test scores of traditional classroom and flipped classroom groups given pre-test scores as a covariate. Results of ANCOVA ( $F = 1.837$ ,  $p > 0.05$ ) suggest that although the effect sizes of the two approaches differ, the two approaches are still not significantly different with each other. This implies that the change of performance caused by flipped classroom is statistically same as the change caused by the traditional classroom.

From the results, it could be interpreted that the type of classroom approach was not the most influential factor in the performance of the students. The classroom situation had various factors other than the order of in-class and out-of-class activities which is the emphasis of flipped classroom. Factors that could be considered are the following: teacher knowledge, enthusiasm and responsibility for learning; classroom activities that encourage learning; assessment activities that encourage learning through experience; effective feedback that establishes the learning processes in the classroom; and effective interaction between the teacher and the students (Gurney, 2007). The researcher considers the possibility that these other factors which affect students' performance remained the same between traditional and flipped classroom results.

#### ***Effectiveness of flipped classroom environment for High and Moderate to Low performing students***

The third analysis was directed at investigating the effect of flipped classroom environment on two types of students: high and moderate to low performing students. T-test of dependent means is used to see the difference of effect of flipped classroom to the two different types of students; on the other hand, ANCOVA is used to evaluate the significance of this difference. Results are shown in Table 5 and 6.

Table 5: Pre and Post Test Results of High and Moderate to Low Performing Students

		<i>M</i>	<i>SD</i>	<i>t-value</i>	<i>p</i>	<i>Cohen's d</i>
<b>High</b>	<i>Post Test</i>	11.424	2.180	16.876	.000	4.494
	<i>Pre Test</i>	3.333	1.315			
<b>Moderate to Low</b>	<i>Post Test</i>	9.273	2.992	10.167	.000	2.245
	<i>Pre Test</i>	3.727	1.329			

Table 6: Comparison of High and Moderate to Low Performing Students

	<i>M</i>	<i>SD</i>	<i>F-value</i>	<i>P</i>
<b>High</b>	11.424	2.180	10.165	.002
<b>Moderate to Low</b>	9.273	2.992		

Table 5 presents the effect size of flipped classroom environment to high performing students and moderate to low performing students. According to the result, flipping the classroom has both significant effects on both high and moderate to low performing students (High  $t = 16.876$ ,  $p < .05$ ; Moderate to Low  $t = 10.167$ ,  $p < 0.05$ ). In addition, data show that flipped classroom had a different effect size to the two groups. The effect size for high performing students was  $d = 4.494$  while the effect size for moderate to low performing students was  $d = 2.246$ . The two groups may have different value of effect sizes; however, their effect sizes both still exceed Cohen's (1988) convention for a large effect ( $d = .80$ ). This suggested that flipped classroom environment had a strong effect on students' achievement for both high and moderate to low performing groups. Results shown in Table 6 ( $F = 10.165$ ,  $p < 0.05$ ) imply that there is a significant difference between the effect of flipped classroom to high and moderate to low performing students. The result suggests that flipped classroom was significantly more effective to high performing students compared to moderate to low students.

The result for flipped classroom being differently effective to different types of students could be explained by this possible scenario. A flipped classroom environment requires complete compliance to the given out-of-class activities thus, self-study. The ability to self-study is a trait of a high performing student therefore making flipped classroom effective to this type of students compared to moderate to low performing students.

### Summary

By quantitatively analyzing the results of the students' pre-test, post test, and national career achievement examination (NCAE) mathematics proficiency, the researcher come up with the following conclusions:

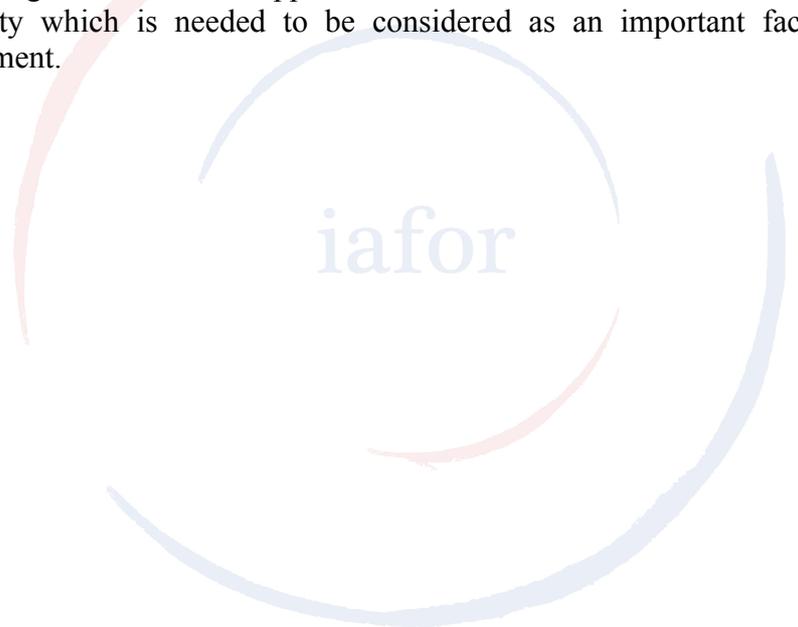
1. Flipped classroom environment had a large significant effect ( $d = 3.180$ ) in improving the trigonometry performance of the students.
2. Flipped classroom environment had a quite larger effect ( $d = 3.619$ ) in improving students' performance compared to traditional classroom environment ( $d = 2.004$ ); however, this difference of effect is considered not statistically significant ( $F = 1.837$ ,  $p > 0.05$ ).

3. While a flipped classroom environment had a large significant effect in trigonometry achievement of both high performing students ( $d = 4.494$ ) and moderate to low performing students ( $d = 2.246$ ), the effectiveness of flipped classroom is significantly larger to high performing students compared to moderate to low performing students ( $F = 10.165, p < 0.05$ ).

### **Recommendations**

In light of the findings of this study, for future researchers who will be interested in further continuing or improving the study, the research offers the following recommendations:

1. Continue to use the advantage of technology in improving the delivery of instruction such as but not limited to using a flipped classroom environment.
2. Consider the order of in-class and out-of-class activities as a factor in improving students' achievement; however, there are other factors needed to be considered other than this order that is possibly a greater factor in improving achievement.
3. Use current data of the class from standardized tests, previous grades, and others in planning the method or approach of instruction. Data from students suggest variability which is needed to be considered as an important factor of their achievement.

The logo for 'iafor' is centered on the page. It consists of the lowercase letters 'iafor' in a light blue, sans-serif font. The text is surrounded by several overlapping, semi-transparent circular arcs in shades of blue and red, creating a dynamic, circular graphic effect.

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## *Preliminary Experiment for Comparing Programming Learning Environments*

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### **Abstract**

Recently, attention to the programming education is growing around the world. The programming education is expected to improve the ability such as creativity, expressiveness, and logically thinking. Learning programming is necessary for people living in the 21st century, and especially, it is good education for children. Currently, there are various environments to learn programming.

In this study, we aimed to clarify the difference of these learning environments. Especially, we compared two representative learning environments. One is “the virtual output environment” in which programming results demonstrated on the display of computer such as Scratch, and another is “the real-world output environment” in which programming results demonstrated in the real-world such as LEGO MINDSTORMS. In this paper, as the start of study, we conducted a simple experiment with “Code.org” as a virtual output environment and “Sphero” as the real-world output environment.

As a result, it was indicated that the real-world output environment gives learners the feelings of “enjoyment” and “accomplishment” as well or better than the virtual-world output environment even though it gives learners the negative feeling of “conflict (such as ‘hard’ or ‘unsolvable’)”. It indicates that if we could identify and address the cause of conflict, the real-world output environment might become a good choice to learn programming.

Keywords: programming education, learning environment, robot programming

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## Introduction

In recent years, programming education is getting a lot more attention. It is not confined to matters of educators. One of the triggers is efforts by “Code.org”. Code.org is non-profitable organization which established in 2013. In February of that year, it uploaded a video titled “What Most School Don’t Teach” to YouTube. In the video, famous entrepreneurs mention the importance of learning to code, and it covered by news media. In the result, it played over 13 million times as of April 2016.

Furthermore, Code.org uploaded a video to YouTube in December 2013’s Computer Science Education Week (CSED). In the video, president Obama asks America to learn computer science, and it also covered by news media.

Under such circumstances, various programming learning environments are appearing. Among them, some of famous are Scratch which was developed by MIT, and MINDSTORMS which was marketed by the LEGO Group. The former, learners write a program on the screen, the result of programming appears on the screen too. The latter, learners write a program on the screen, the result of programming appears as a movement of the concrete object such as a robot. Nowadays, programming environment using physical blocks to code such as OSMO Coding. In this environment, combined and aligned blocks play a role of a source code, and the execution result of the source code appears on the screen when learners scan its by using smartphone camera. Although there is an exception, today, as for programming on the screen, there are two kinds of output ways in programming learning environments. One environment’s output appears on the screen, which we call it the virtual-world output environment. The other output appears in real-world, which we call it the real-world output environment.

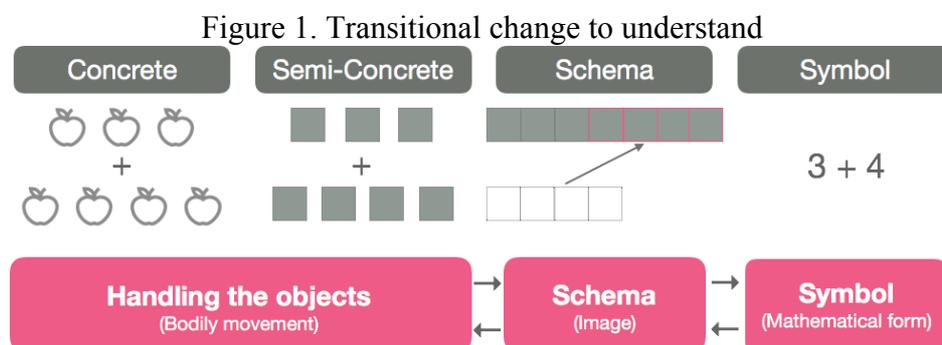
The purpose of this study is to evaluate the influences of the presence of a concrete object to programming learning through comparing the virtual-world output environment to the real-world output environment.

## Relevant Research

Ginbayashi describes about the utility of concrete objects in mathematics. He mentioned that instructional equipment called ‘tile’ work well when teachers teach the concepts of arithmetic operations and numbers to early elementary school years children. It is natural that children can understand only by using concrete objects because their conception is non-fully developed. In addition, he mentioned that even if learners are junior high-school or high-school students, using concrete objects also enhances the fun and easiness to understand.

Furthermore, Ginbayashi describes that what is important to understand mathematics. He classified the calculation into four levels as shown in Figure 1. The first level is to use concrete objects such as apples. The second level is to use semi-concrete objects such as tiles. The third level is to use schema such as tiles of image. The fourth level is to use symbols such as mathematical form. These four are distributed into three phases. The first is the handling objects phase. In this phase, learners move their bodies to solve problems. The second is the schema phase. In this phase, learners build up image to solve problems. The third is the symbol phase. In this phase,

learners describe mathematical form to solve problems. Ginbayashi mentioned, these transitional change is important to understand mathematics. Of course, the above theories are recommended for mathematics. However, we have thought that these are applicable in programming education.



There are a lot of practical research related to programming education. For example, programming education studies dealing with Scratch exist in large numbers (e.g., Malan & Leitner, 2007; Mori & Sugiwarara et al., 2011; Kalelioğlu & Gülbahar, 2014). Also, there are many programming education studies dealing with robot programming (e.g., Lalonde, Bartley & Nourbakhsh, 2006; Odo, Hachiman & Kinjo, 2010).

Kurebayashi and Kanemune compared robot control programming to application programming in junior high school. However, in their study, there was a difference between robot control programming and application programming. Specifically, around that time, robot programming had more restrictions than application programming, but application programming was more freedom and could do a variety of things. In addition, the purpose of their research was that establish a connection with academic results and psychological effects such as feelings and interests. Before now, although there are a lot of practical research related to programming, little study has been done to focus on output ways of programming learning environments.

## Methods

The purpose of this study is to assess the impact to programming learners between the virtual-world output environment and the real-world output environment. In other words, the purpose of this study is to evaluate the influence of the presence of concrete objects in programming education. This section describes the details of this study's methods.

## Overview of the Experiments

This time, we adopted "Sphero" as the real-world output environment, and "Code.org" as the virtual-world output environment. Figure 2 is a sample image of Sphero and Code.org, and Table 1 shows the both feature.

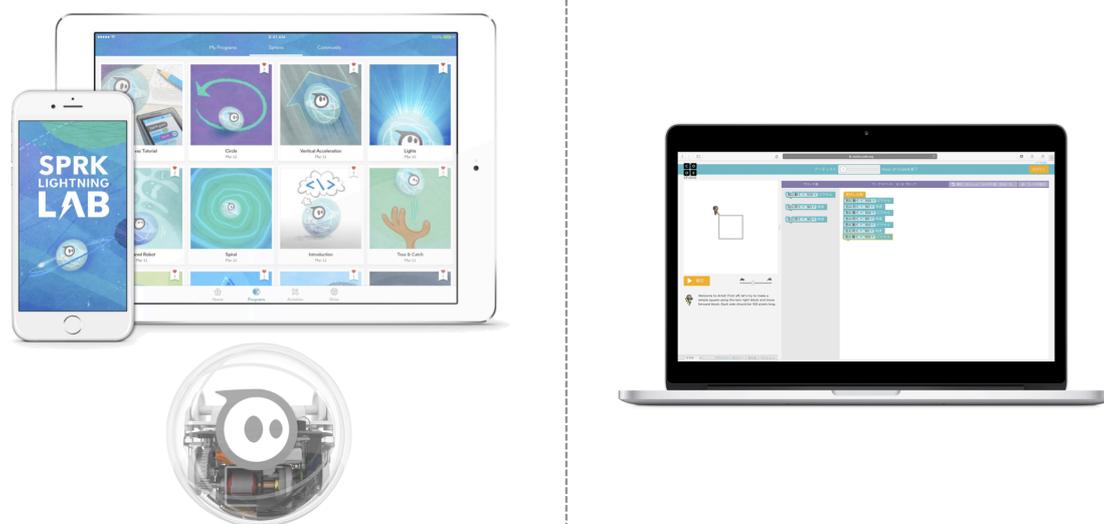


Figure 2. Sample images of Sphero and Code.org

Table 1. Features of Sphero and Code.org

	Sphero	Code.org
Programming Language	Tile-based visual programming language	Tile-based visual programming language
Programming Environment	Smartphone / Tablet	PC
Output	Robotic ball (Real-world)	On the screen (Virtual-world)
Target Age	5 and up	4 and up
Support Japanese	○	○
Handling the object (Bodily movement)	○	×

In the experiment using Sphero, iPad with “Lightning LAB (education oriented Sphero official application)” was used to programming. On the other hand, in the experiment using Code.org, iMac with Safari (macOS default web browser) was used to programming. There are some reasons for adopting Sphero and Code.org. First is the both environments’ programming languages are tile-based visual programming language, and they are intended for programming beginners. Second is the both environments support Japanese. Third is presence or absence of the “handling the object (bodily movement)” element. This means that Sphero allows to think through handling the robotic ball which moves according to the result of programming, and Code.org does not allow it. Because Code.org’s character object which moves according to the result of programming is moved only by programming, learners have to use schema to programming. In this time, because the learners’ experience order (Which learning environments did he or she use first, Sphero or Code.org?) has a potential impact on the results of the experiments, the examinees were divided into 2 groups, one uses Sphero at the beginning, the other uses Code.org at the beginning. Table 2 shows the experimental procedure.

Table 2. Experimental procedure

---

[1] Introduction: Examinees receive an explanation about the experiments. (10 min)
[2 or 4] Sphero Phase: Examinees use Sphero to learn programming. (25 min)
(1) Operating instruction: Examinees receive an explanation about operation of Sphero and Lightning LAB. (5 min)
(2) Pre-experiment: Examinees solve the Sphero phase's practice questions while having dialogues. (5 min)
(3) Experiment: Examinees solve the Sphero phase's questions while having dialogues. (15 min)
[3] Break (10 min)
[2 or 4] Code.org Phase: Examinees use Code.org to learn programming. (25 min)
(1) Operating instruction: Examinees receive an explanation about operation of Code.org. (5 min)
(2) Pre-experiment: Examinees solve the Code.org phase's practice questions while having dialogues. (5 min)
(3) Experiment: Examinees solve the Code.org phase's questions while having dialogues. (15 min)
[5] Reflection: Examinees express their sentiments and answer the questionnaires about experiments. (20 min)

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Meanwhile, experimenters (authors) don't overcommitment during experiments in order to avoid experimenter effects. For example, regarding the introduction, we decided explanation matter up front, so that the explanation does not differ for each group. Basically, experimenters intervened in the experiment only when the unexpected thing was occurring.

### Overview of Examinees

Table 3 shows examinees' properties. Examinees were recruited on the condition that they are paired. They were divided into four groups, and group A and C experience to learn with Code.org first, on the other hand, group B and D experience to learn with Sphero first. They were 20 years old university student, a man and seven women. Their experiences of programming were either "Inexperienced", "Beginner" or "Intermediate". Specifically, "Beginner" means that they have had a chance to learn programming in class, and "Intermediate" means that they understand the concept of constant, variable, and array in computer programming, and sequence, selection, and iteration as known as structured programming. Their majors were either "Administrative Studies (Informatics)", "Administrative Studies (Business)" or "Administrative Studies (Public)".

Table 3. Properties of examinees

Group	Gener	Age	Experience of Programming	Major
A Code.org→Sphero	Female	20	Beginner	Administrative Studies (Informatics)
	Male	20	Inexperienced	Administrative Studies (Business)
B Sphero→Code.org	Female	20	Intermediate	Administrative Studies (Informatics)
	Female	20	Inexperienced	Administrative Studies (Business)
C Code.org→Sphero	Female	20	Intermediate	Administrative Studies (Informatics)
	Female	20	Inexperienced	Administrative Studies (Business)
D Sphero→Code.org	Female	20	Beginner	Administrative Studies (Informatics)
	Female	20	Beginner	Administrative Studies (Public)

### Assessment Methodology

We adopted two assessment methodologies, which were conversation analysis and subjective assessment through questionnaires.

In the conversation analysis, video and audio was recorded by experimenters while examinees were learning programming. In terms of video, the screen showing the programming process, which is same as the screen being looked by examinees, were also recorded. After that, all conversations in the examination were written out on the basis of recorded video and audio. On that basis, transcripts were analyzed by experimenters and they counted “positive utterances (words expressing feeling of pleasure or fun when examinees solve the problems)” and “negative utterances (words expressing feeling of mortification or conflict when examinees can’t solve the problems)”. Finally, the numbers of positive and negative utterances were compared in Sphero phase and Code.org phase.

In subjective assessment through questionnaires, questionnaires were composed of ten questions. Four items were relevant to feelings during experiments, and five items were relevant to a shift in impression of programming before and after of the experiments. Each question was on a scale of one to seven. Last item was free description.

### Results

#### Results of Conversation Analysis

Table 4 shows the results of conversation analysis. Total number of utterances and duration of experiments in each group, these average value, standard deviation, and  $p$ -value which is the result of  $t$ -test are shown in Table 4. In the column of  $p$ -value, the

asterisks \*, \*\* and \*\*\* indicate that the coefficients are statistically different from 0 at the 1 ( $p < 0.01$ ), 5 ( $p < 0.05$ ), and 10 ( $p < 0.1$ ) percent level, respectively. In addition, “n. s.” means that there is no statistically significant difference. Focus on the average value, in Sphero phase, the negative utterance count is larger than the positive utterance count, but it is reversed in Code.org phase. And focus on the  $p$ -value column, there is no statistically significant difference in the number of positive utterance between Sphero phase and Code.org phase. In opposite, there is a statistically significant difference in the number of negative utterance between Sphero phase and Code.org phase ( $p < 0.1$ ).

Table 4. Results of conversation analysis

		A		B		C		D		Average		SD		$p$ -value	
		Posi.	Nega.	Posi.	Nega.	Posi.	Nega.	Posi.	Nega.	Posi.	Nega.	Posi.	Nega.	Posi.	Nega.
Count (Utterances)	Sphero	14	15	12	27	6	11	15	22	11.75	18.75	3.49	6.18	n. s.	***
	Code.org	18	12	5	7	16	11	12	4	12.75	8.50	4.97	3.20		
Duration (Sec)	Sphero	960		1270		1170		1640		1260					
	Code.org	750		840		960		960		877.5					

Posi.: Positive, Nega.: Negative  
\*:  $p < 0.01$ , \*\*:  $p < 0.05$ , \*\*\*:  $p < 0.1$ , n. s.: not significant

## Results of Subjective Assessment through Questionnaires

Table 5 shows the results of subjective assessment through questionnaires. In the questionnaires, eight examinees were asked to evaluate the enjoyment, conflict, accomplishment, and willingness to learn in each phase. Each question was evaluated on a scale of one to seven. Examinee's age, gender, evaluation value for each item, sum of evaluation value, average of evaluation value, standard deviation, and  $p$ -value which is the result of  $t$ -test are shown in Table 5. In the column of  $p$ -value, the asterisks \*, \*\* and \*\*\* indicate that the coefficients are statistically different from 0 at the 1 ( $p < 0.01$ ), 5 ( $p < 0.05$ ), and 10 ( $p < 0.1$ ) percent level, respectively. In addition, “n. s.” means that there is no statistically significant difference. Focus on the  $p$ -value, in the items of enjoyment, accomplishment, and willingness to learn, there is no statistically significant difference between Sphero phase and Code.org phase. In opposite, in the items of conflict, there is a statistically significant difference between Sphero phase and Code.org phase ( $p < 0.01$ ).

Table 5. Results of subjective assessment through questionnaires

		1	2	3	4	5	6	7	8	Sum	Average	SD	$p$ -value
Age		20	20	20	20	20	20	20	20	-	20	-	-
Gender		Female	Male	Female	Female	Female	Female	Female	Female	-	-	-	-
Enjoyment	Sphero	7	7	7	7	7	5	7	6	53	6.63	0.70	n. s.
	Code.org	7	7	5	4	7	6	7	7	50	6.25	1.090	
Conflict	Sphero	6	5	7	7	5	6	6	6	48	6	0.707	*
	Code.org	2	2	2	3	5	4	5	3	26	3.25	1.20	
Accomplishment	Sphero	6	7	6	7	4	5	6	5	46	5.75	0.97	n. s.
	Code.org	4	6	6	2	5	5	5	6	39	4.875	1.27	
Willingness to learn	Sphero	7	7	6	6	5	5	7	5	48	6	0.87	n. s.
	Code.org	7	6	3	3	6	5	6	6	42	5.25	1.39	

\*:  $p < 0.01$ , \*\*:  $p < 0.05$ , \*\*\*:  $p < 0.1$ , n. s.: not significant

According to free description of questionnaires, one examinee said that “When Sphero moved as I intended, I realized that ‘I am controlling it!’ and I felt the fun of programming.” And another examinee said that “Using Sphero brings me a sense of accomplishment, and it is simple to understand.”

## Considerations

According to the results of conversation analysis and questionnaires, we have shown that the real-world output environment (Sphero) gives examinees “conflict” feeling more than the virtual-world output environment (Code.org). We also clarified that they felt positive feelings of “enjoyment” and “accomplishment” in both environments. Some examinees pointed out that “adjustment of direction parameters is somewhat difficult” regarding the real-world output environment (Sphero). From these, even if learning contents are somewhat difficult and give learners “conflict”, it is suggested that the real-world output environment gives feelings of “enjoyment” and “accomplishment” as well or better than that of the virtual-world output environment.

The interesting result has also obtained that the real-world output environment brings “willingness to learn” as well or better than that of the virtual-world output environment. In addition, there were feedbacks from examinees that “knowledge of programming seemed to be useful” and “I felt a sense of accomplishment as much as my conflict was great (in Sphero phase)”. Although there are various motivations for continuing learning, it is presumed that ease of imaging the application destination and enjoyment and accomplishment after the conflict are effectively working.

## Conclusions

We compared two programming learning environments for evaluating the influence of the presence of a concrete object to programming learners. As a result, it was indicated that the real-world output environment gives learners the feelings of “enjoyment” and “accomplishment” as well or better than the virtual-world output environment even though it gives learners the negative feeling of “conflict”. If we could identify and address the cause of conflict, the real-world output environment in which a concrete object uses might become a good choice to learn programming.

However, we analyzed only four groups (eight examinees) in total, and we do not consider examinees’ characteristics such as gender, age, occupation, interests and concerns in programming, proficiency level in programming. In addition, we do not evaluate examinee’s understanding of learning contents. In the future, in order to show the general versatility of the results of this practice, it is necessary to conduct empirical studies considering examinee’s characteristics, understandings of leaning contents, and all that.

## Acknowledgement

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*Investigating The Effective Use of Online Course Tools  
for University Athletes in Japan*

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**Abstract**

University athletes tend to achieve lower academic performance, often due to their extensive commitment to their sport club activity (Cosh & Tully, 2014; Adler & Adler, 1985). The authors of this study believe that online course tools are useful for supporting university athletes academically if both teachers and students use these tools effectively. Thus, in this study, the authors try to encourage university athletes to use one of the online course tools, manaba+R, in their English classes. The aims of this study are 1) to explore to what extent university athletes use manaba+R for their study and their attitude towards using this tool and 2) to discuss how teachers can support university athletes' study with manaba+R. This study mainly used quantitative analysis with some qualitative analysis. As for the quantitative analysis, a questionnaire was used. Then the data were discussed qualitatively. A total of 81 university students (first and second year students) majoring in sports and health science at a private university in Japan participated in this study. The results showed that while the majority of the university athletes had positive attitude towards using manaba+R, they failed to utilize this tool effectively for their study. In particular, the results revealed that they did not effectively use the useful information or material provided on manaba+R for completing their assignments because of their insufficient time for study, lack of time management skills, and low motivation to get higher marks. In light of these findings, practical implications for teachers were discussed.

Keywords: university athletes, online course tools, manaba+R, EFL

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## **Introduction**

The integration of sports and education has remained highly demanding for university athletes, which often results in their lower academic performance and lower motivation to study (Adler & Adler, 1985; Simons, Rheenen, & Covington, 1999; Lucas & Lovaglia, 2002). The authors of this study teach English at a private university in Japan; and many of the university athletes they teach also struggle academically. In order to support these university athletes, the authors of this study believe that online course tools such as Moodle, blackboard or manaba+R can serve as an effective academic support as many past studies have explored the benefits of these tools in education (Hung & Zhang, 2008; Dabbagh & Kitsantas, 2005; Swanson, 2007). Thus, they encourage university athletes to use one of the online course tools, manaba+R, in their English classes. Useful course information, homework and additional material are provided on manaba+R to assist them with their study. However, the authors of this study realize that university athletes do not seem to use manaba+R effectively. Thus, in order to investigate the effective use of this tool for university athletes, this study aims to 1) explore to what extent university athletes use manaba+R for their study and their attitude towards using this tool (compared to university non-athletes) and 2) discuss how teachers can support university athletes' study with manaba+R.

## **Literature Review**

### **Academic performance of university athletes**

University athletes tend to have lower motivation to study and lower academic achievement due to a number of factors. In particular, insufficient time for study has been considered as one of the significant barriers to their academic success (Adler & Adler, 1985; Cosh & Tully, 2014; Simons et al., 1999). Adler and Adler (1985) revealed that a lack of time to study due to athletic participation affected university athletes' motivation to study as most of the university athletes in their study aimed to get only the minimum GPA. Similarly, in Cosh and Tully's (2014) study on Australian student athletes, most athletes felt that they had no control over time to study due to their daily sport commitments, resulting in setting "just doing enough to pass" as their academic goals. Because of the restricted time to study, they regarded academic success as ideal in principle but impossible in practice. In addition, as an athletic participation requires an extensive commitment to physical energy, fatigue has also been considered to have a great influence on their academic achievement (Simons et al., 1999; Yamada, Mizuno, Ebara, & Hirose, 2010; Adler & Adler, 1985). Simons et al. (1999), for example, claimed that fatigue from athletic participation affects university athletes' academic performance as it often interferes with their concentration to study.

University athletes in Japan also experience a similar academic problem. According to the survey conducted by Asahi newspaper and Japanese Association of University Physical Education and Sports (as cited in Kimura, 2015, p. 12), achieving academic success has remained challenging for most university athletes in Japan. The survey results showed that 70.7% of the Japanese universities which participated in the survey felt the need to provide some academic support systems specifically designed

for university athletes. In other words, a number of university athletes in Japan are considered to have difficulty in studying. Yet, nearly 30% of the universities answered that they had not provided any specific support for their university athletes. Nagakura (2016) pointed out that most university athletes in Japan are expected to be responsible for their own academic success even though daily practice and frequent participation in tournaments, training camps or overseas competitions make it extremely difficult for them to have enough time and energy to study. Nagakura (2011, 2016) claimed that it is crucial for universities to provide proper academic support for these university athletes in Japan.

### **Online course tools in education**

Online course tools, often known as Learning Management Systems (LMS), are one of the academic support tools now widely used in tertiary education worldwide. They enable teachers to register students in a certain course, upload course material and assignments, post important information, provide discussion forums, and keep track of students' work online. Some of the online course tools used in Japanese tertiary education are Moodle, blackboard, and manaba+R. Because they can be accessed through any web browser, these online course tools make students' access to learning material possible anytime and anywhere.

According to a number of studies, these online course tools play a significant role in students' learning and their academic success. For example, Hung and Zhang (2008) found that students' active participation in online course tools (e.g. access course material, post messages and/or read messages posted, and attend online discussion) resulted in their high academic performance. In addition, because these tools can be accessed wherever the internet is available, many studies claimed the benefits of online course tools accessibility and portability in facilitating students' learning (Okada, Kainosho, Tamaki, & Ikegashira, 2015; Cavus, 2011). Okada et al. (2015) found that online course tools accessibility and portability enabled students to study through smartphones and to acquire a habit of studying every day. Cavus (2011) also found that most students in her study were motivated to use LMS through mobile phones because of its flexibility of time and place. Furthermore, past studies also reported that online course tools can assist students to engage in self-regulated learning, which refers to the degree to which students actively participate in their own learning process (i.e. set clear goals, plan how to achieve goals, monitor and evaluate their own learning) (Kitsantas, 2013; Dabbagh & Kitsantas, 2005). In Dabbagh and Kitsantas (2005), a variety of LMS tools supported students' self-regulated learning and led to their improved learning. For example, communication-related LMS tools such as discussion forums assisted the students with goal setting while tools related to administration helped them monitor their learning. These studies claim that the proactive use of online course tools clearly contributes to students' learning and their academic success.

However, not every student benefits from these online course tools (Lust, Vandewaetere, Ceulemans, Elen, & Clarebout, 2011; Miyazoe, Anderson, & Sato, 2012; Adzharuddin & Ling, 2013; Swanson, 2007). Lust et al. (2011) found that students' control in using online course tools cannot be taken for granted as most students in their study did not actively use discussion board or practice quizzes provided with their online course tools. Miyazoe et al. (2012) also claimed that in

online discussion forums, low participation is often observed as students tend to not contribute to posting information but only retrieve useful information posted by others for their study. They pointed out that when making a contribution requires much time and effort, but does not guarantee direct rewards, students may become passive participants. Regarding the discussion board in online course tools, even if students are willing to join them, a lack of immediate feedback may discourage them to continue to participate (Adzharuddin & Ling, 2013). Swanson's (2007) study also showed that not every student profits from online course tools as some students in his study did what was necessary and logged out immediately. He claimed that it is necessary for teachers to train students to be a better user of online course tools since the goal of this type of tool is to enhance students' autonomy in learning. Although students' active participation and autonomy are crucial in the learning environment which involves an online learning process, these studies reveal some critical issues as to how students utilize online course tools, which requires teachers to consider the effective use of these tools for students' learning.

### **Research Questions**

In order to investigate how teachers can support university athletes academically with one of the online course tools, manaba+R, this study aims to address the following research questions:

- 1) To what extent do university athletes utilize manaba+R for their study and what are their attitude towards using this tool?
- 2) How can teachers support university athletes' study with manaba+R?

### **Methodology**

#### **Participants**

This study was conducted in the fall semester, 2015. The participants were the first and second year students (51 male and 30 female) majoring in sports and health science at a private university in Japan. They were grouped as university athletes (n=33) and university non-athletes (n=48) for this study. University athletes in this study were considered as participating in the university sports clubs. They accounted for approximately 40% of the participants. University non-athletes, on the other hand, referred to students who did not join university sports clubs (i.e. students who joined cultural organizations, a special athletic trainer program, athletic organizations other than sports clubs, or those who did not join any organization in university). They comprised of nearly 60 % of the participants.

#### **English class**

All participants took two required English classes throughout the semester: skills workshop and project-based English. The data for this study was collected from the project-based English class in which students worked on their own projects in English either individually or in a group. Class participation, weekly homework, presentations, and a final paper were assigned and evaluated for this class. Throughout the semester, weekly homework as well as useful course information and

additional material were provided on manaba+R; and students were encouraged to use this information for completing their presentation and paper assignments.

### Data collection

A questionnaire was used for data collection for this study (See Appendix). It was written in Japanese and consisted of 13 questions on the students' usage of manaba+R in project-based English class and their attitude towards using this tool. The questionnaire was distributed online at the end of the fall semester, 2015. After the data were collected, the questions and all answers were translated into English by the authors of this study.

### Results

Below are the results of the questionnaire regarding the students' usage of manaba+R in project-based English class and their attitude towards using this tool. There are nine figures and one table in total in this section.

Figure 1 shows the students' TOEIC scores. It indicates that the English proficiency levels differed greatly between the two groups. The average TOEIC score of university athletes was 332 while that of university non-athletes was 463.

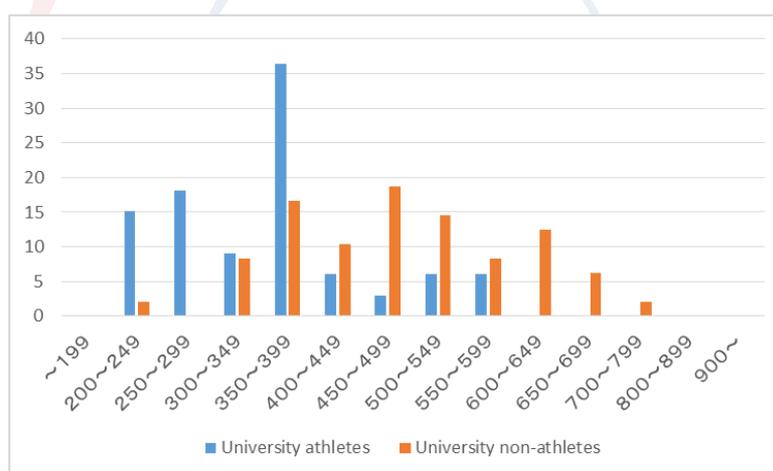


Figure 1: Results of Q4 (What is your TOEIC score?)

Figure 2 shows how frequently students brought their PC into class. Overall, students in both groups frequently brought their own PC to class. Approximately 80 % of both groups answered "every time" and 12 % of them answered "almost every time."

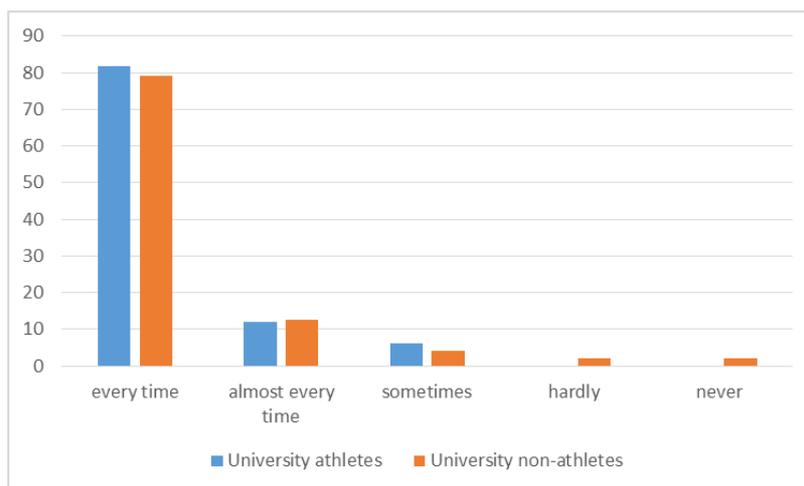


Figure 2: Results of Q5 (How often did you bring your PC into class?)

Figure 3 shows how frequently students used their PC in class. As most students in both groups brought their PC into class (See Figure 2), the high ratio of using a PC in class was seen in both groups as expected. However, university athletes used their PC in class slightly more than university non-athletes as more than 80% of them answered “every time.”

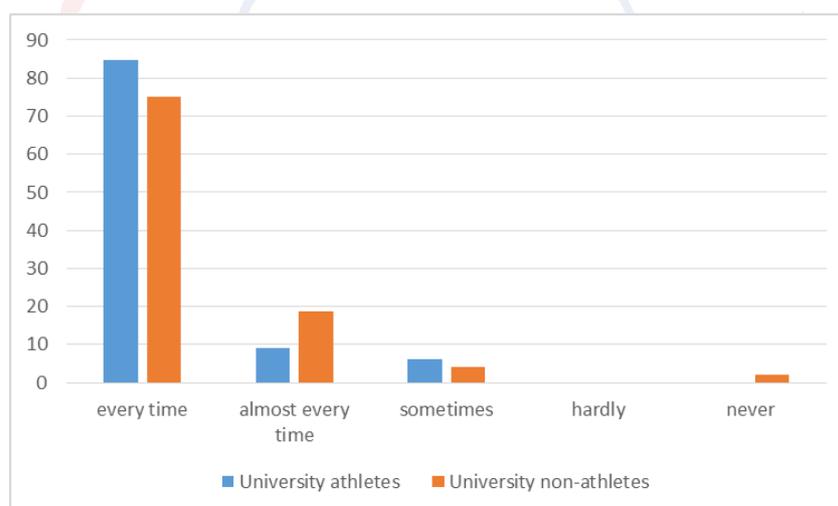


Figure 3: Results of Q6 (How often did you use your PC in class?)

Figure 4 shows the frequency of using manaba+R. Students in both groups used manaba+R frequently as approximately 80% of both groups answered “every week” and 15% of them answered “almost every week.”

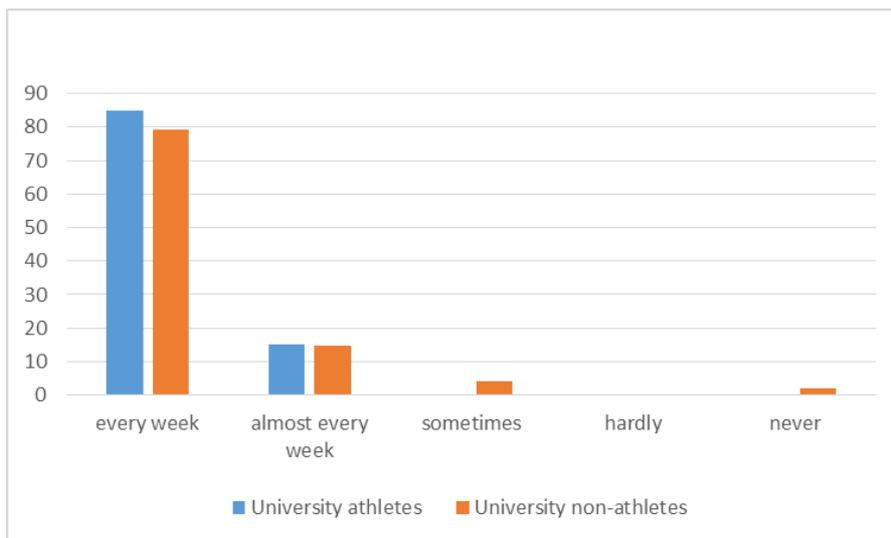


Figure 4: Results of Q7 (How often did you use manaba+R?)

Figure 5 shows whether students think manaba+R is useful for their study. Students in both groups gave positive responses to this question as approximately 95% of them found online course tools useful for their study. 55% of university athletes answered “strongly agree” and 42% of them answered “agree.” Similarly, 52% of university non-athletes answered “strongly agree” and 42% of them answered “agree.”

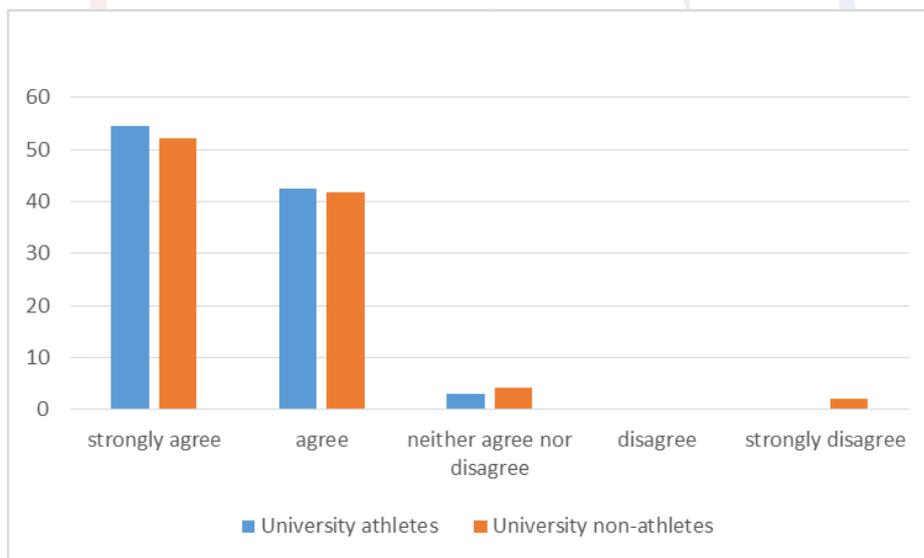


Figure. 5: Results of Q8

(Do you think that online course tools like manaba+R are useful for your study?)

Figure 6 shows which page(s) on manaba+R students often checked. There are mainly three pages on manaba+R where the class information and material were posted for the project-based English class: PROJECT, CONTENT, and BOARD. The authors of this study uploaded weekly homework in PROJECT. In CONTENT, guidelines for assignments (i.e. presentation and paper), useful English expressions and additional material were uploaded. In BOARD, important notices about the class were posted when necessary. Thus, students could choose more than one answer for

this question. The results indicate that students in both groups checked PROJECT quite often as 94% of university athletes and 90% of university non-athletes chose this page. However, the percentage checking CONTENT was low, as less than 50% of both groups checked this page. The percentage checking BOARD was much lower as only 18% of university athletes (n=6) and 35% of university non-athletes (n=17) checked this page frequently.

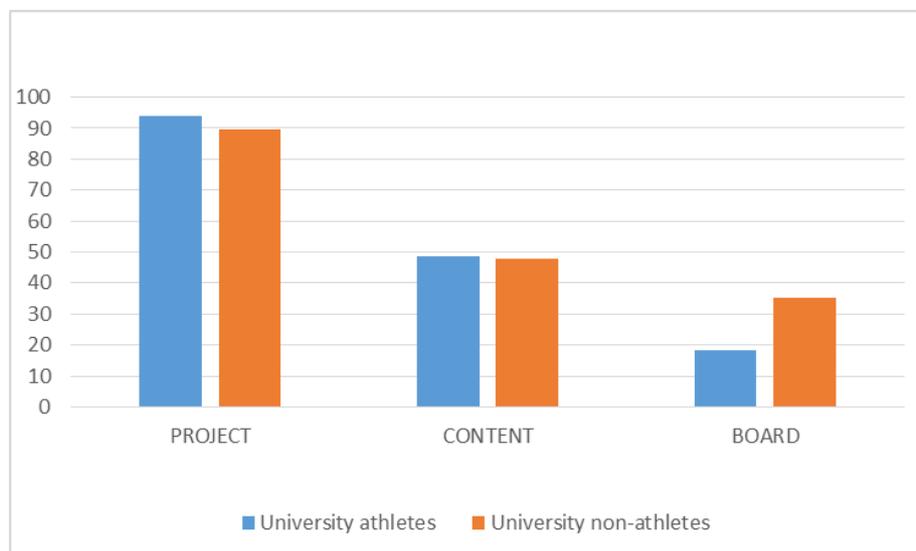


Figure 6: Results of Q9 (Which page(s) on manaba+R do you often check?)

Figure 7 shows what information on manaba+R students found useful for studying. In project-based English class, a variety of information besides homework was often provided on manaba+R. The information here included “guidelines for assignments (i.e. presentation and paper),” “useful English expressions” and “tips for writing a paper.” Thus, students could choose more than one answer for this question. 76% of university athletes thought “guidelines for assignments” and “tips for writing a paper” were useful and 67% of them found “useful English expressions” helpful. As for the university non-athletes group, the popular answers were “guidelines for assignments” and “useful English expressions” as about 80% of them chose these answers while 63% of them found “tips for writing a paper” useful.

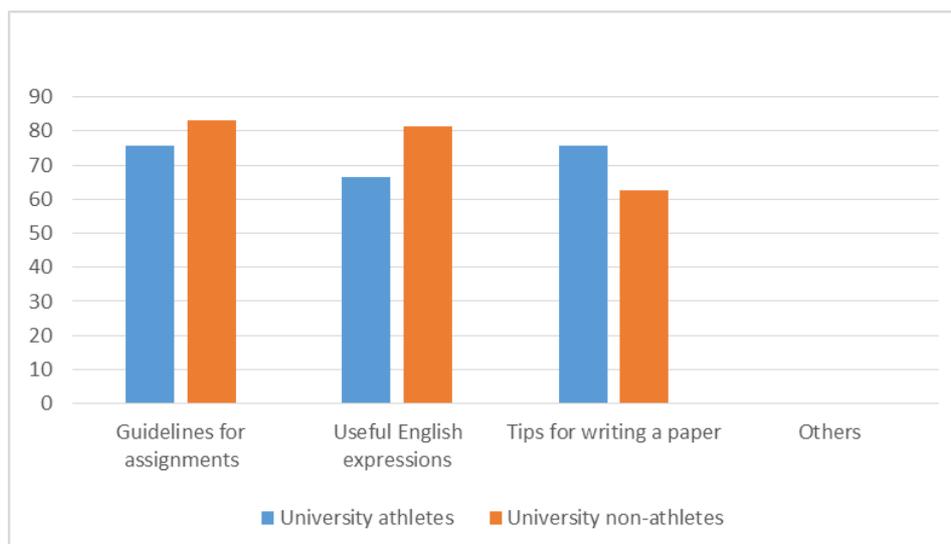


Figure 7: Results of Q10  
(What information on manaba+R did you find useful for your study?)

Table 1 shows the information students want to see on manaba+R for their study. Not all students answered this question, however, different preferences were seen between the two groups from their answers. Most answers from university athletes indicate that they wanted to see information related to assessment, messages about the class, or basic course material. On the other hand, the responses from university non-athletes suggest that they preferred to have tips or advice on making a good presentation or paper.

Table 1: Results of Q11 (Other than the information listed in Q10, What kind of information do you think should be posted on manaba+R for your study?)

	Comments
<b>University athletes</b>	Detailed criteria for assessment
	Assessment of assignments
	Important messages about the course
	Copies of handout
	Examples of English expressions
<b>University non-athletes</b>	Articles or papers recommended by a teacher
	Advice on papers
	Tips for making an effective presentation
	The section where students can ask questions easily

Figure 8 shows where students usually checked manaba+R. Although they often brought their PC into class (See Figure 2), only about 6% of university athletes checked manaba+R in class. Instead, the majority of them (70%) checked manaba+R at home. Interestingly, even though manaba+R could be accessed anywhere as long as the internet is available, only 24% of university athletes checked it outside of class on campus. Moreover, none of them made use of this tool on a bus or a train. The

similar findings were seen for the other group as the majority of university non-athletes (58%) checked manaba+R at home. However, the percentage of those checking manaba+R outside of class on campus (27%) or on a bus or a train (8%) was slightly higher than university athletes.

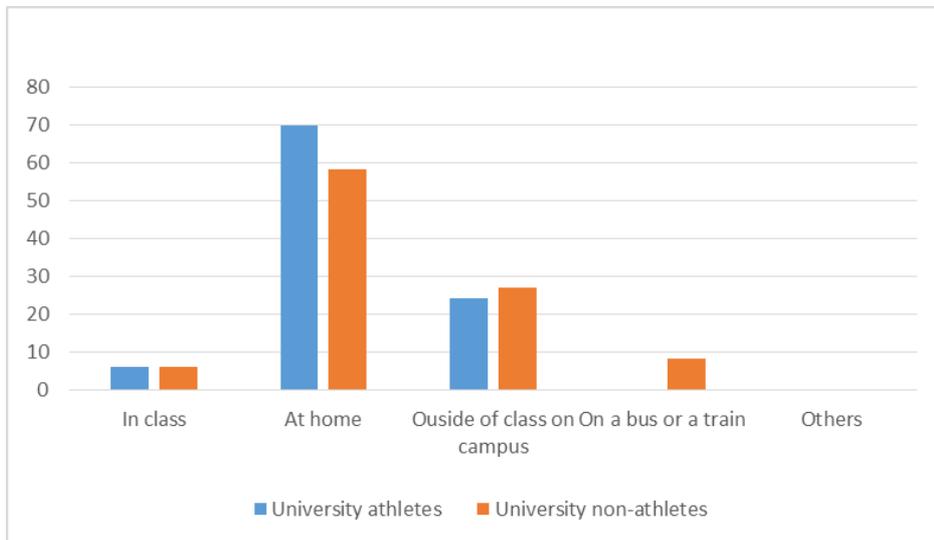


Figure 8: Results of Q12 (Where do you usually check manaba+R?)

Figure 9 shows whether students think manaba+R is useful to communicate with their teacher. Most students in both groups gave positive answers to this question. The total of 78% of university athletes (30% for “strongly agree” and 48% for “agree”) and 73 % of university non-athletes (25% for “strongly agree” and 48% for “agree”) found online course tools useful to communicate with their teacher.

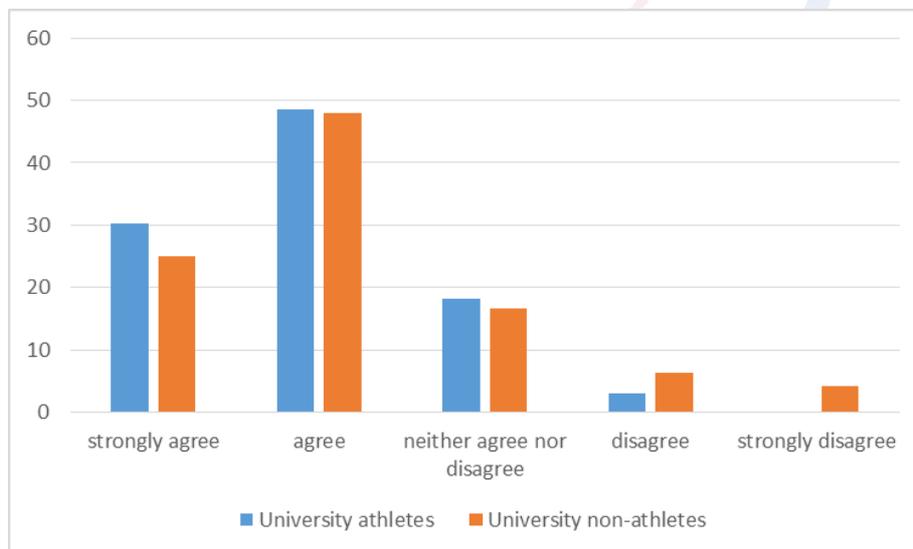


Figure 9: Results of Q13  
(Do you think that online course tools like manaba+R are useful to communicate with your teacher?)

## Discussion

Based on the results of the questionnaire, this study now turns to discuss 1) to what extent university athletes utilize manaba+R and their attitude towards using this tool and 2) how teachers can support university athletes' study with manaba+R. First, two main findings regarding the first question are discussed below. Then, in light of these findings, two implications for teachers are discussed.

### 1) To what extent university athletes utilize manaba+R and their attitude towards using this tool

#### Less hours to study and lack of time management skills

As the results of the questionnaire revealed, university athletes in this study did not tend to utilize manaba+R as much as the authors expected although university athletes showed positive attitude towards using this tool (See Figure 5 and Figure 9). There are two main reasons for it. The first reason is their insufficient time for study and lack of time management skills. As noted earlier, university athletes tend to have less time to study due to their extensive commitment to sports (Cosh & Tully, 2014; Adler & Adler, 1985). In particular, those who have higher achievements in sports tend to be busier as they are expected to participate in a tournament or go on an overseas expedition tour occasionally, and hence are likely to miss classes (Nagakura, 2016). Thus, even if they were motivated to study, it is possible that university athletes in this study were too busy with their sport club activity to make use of manaba+R.

In addition, as the results of Q12 (Where do you usually check manaba+R?) showed, university athletes in this study did not have good time management skills to use manaba+R for their study. In the university where the participants of this study were enrolled, free Wi-Fi is provided so that students can access manaba+R anytime and anywhere on campus. However, only a small number of university athletes made use of class hours to check manaba+R despite the fact that the majority of them brought their PC into class every week (See Figure 2). Even outside of class, most of them failed to make the most of their free time on campus to use manaba+R. In addition, unlike some of university non-athletes, university athletes did not take advantage of their commuting time though manaba+R could be accessed through their mobile phones. Instead of making use of class hours, free time on campus or commuting time, the majority of them used manaba+R at home, presumably after a hard day of class and after-school practice when they were likely to have fatigue. As some past studies showed that fatigue from an athletic participation makes devotion to study very difficult (Yamada et al., 2011; Simons et al., 1999), university athletes in this study clearly did not have good time management skills to use manaba+R for their study, for they mainly used it when they were likely to feel fatigue, instead of effectively using their class hours or free time. Thus, because of their lack of time management skills, most of the university athletes in this study failed to make use of manaba+R effectively.

## **Low motivation to get higher marks**

The second reason is their low motivation to get higher marks. As the results of Q9 (Which page(s) on manaba+R do you often check?) and Q11 (Other than the information listed in Q10, what kind of information do you think should be posted on manaba+R for your study?) suggest, university athletes in this study tended to utilize manaba+R to just satisfy the minimum requirements to pass the course. Though they answered that they used manaba+R frequently (See Figure 4), the results of Q9 revealed that most university athletes only checked PROJECT to see their homework. Only a small number of them frequently checked CONTENT or BOARD where important information to support their study was posted (See Figure 6). For university athletes whose English levels were rather low (See Figure 1), “useful English expressions” uploaded on CONTENT could have been particularly helpful for getting a higher mark on presentation or paper assignments. However, the low percentage of university athletes who answered CONTENT for Q9 clearly indicate that they missed the chance to make use of this information for their study. This finding indicates that they tended to focus on just doing what was necessary to pass and failed to utilize other useful information to perform better in their assignments. The results of Q11 also suggest their concern for passing as the answers from university athletes mainly referred to the information related to assessment and basic course information. On the other hand, the answers from university non-athletes were mainly related to advice on paper or presentation which would be helpful for completing their assignments. Thus, both results of Q9 and Q11 indicate that most university athletes in this study were not motivated to perform better academically to get a higher grade. This finding is in line with the results of past studies (Cosh & Tully, 2014; Adler & Adler, 1985) which showed that university athletes’ primary academic goal tended to be just doing enough to pass due to their substantial commitment to sports. Based on these reasons, university athletes in this study did not tend to make use of manaba+R effectively despite their positive attitude towards using this tool for their study.

## **2) How teachers can support university athletes’ study with manaba+R**

Based on the findings above, there are mainly two implications as to what teachers can do to support university athletes academically with manaba+R. First, teachers can encourage university athletes to make use of the information on manaba+R for their study by grading their active use of this information as part of the course requirements. As the second finding indicated, most university athletes in this study only checked homework on manaba+R and did not utilize other useful information for presentation or paper assignments. However, information such as “useful English expressions” or “tips for writing a paper” would be of great assistance to them in working on these assignments, contributing to their higher academic performance. Thus, to help them achieve academic success, it is important for teachers to raise university athletes’ motivation to study through manaba+R and make sure that they use the information initiatively for their assignments. For this purpose, grading their active use of information on manaba+R should be effective for two reasons. First, as the results of Q9 and Q11 suggested, university athletes in this study were motivated to pass the course as they were trying to satisfy the minimum requirements. In addition, some past studies found that students are likely to utilize online course tools

actively when participation in online activities is graded or important information related to their grades is posted (Rovai, 2003; Yamamoto & Usami, 2015). Therefore, if, for example, using “useful English expressions” or additional material on manaba+R was required to complete their assignments and was evaluated as part of their grade, it is possible that the number of university athletes who become more motivated to make the best use of the information on manaba+R increases. By providing useful information to support their study on manaba+R and evaluating their proactive usage of it, teachers will be able to facilitate their learning more through manaba+R.

Second, teachers can support university athletes’ study by instructing them to have good time management skills. As the first finding showed, university athletes in this study did not tend to effectively use their class hours or free time to study with manaba+R. Past studies also showed that time is often considered as a significant obstacle to academic achievement for university athletes (Cosh & Tully, 2014; Adler & Adler, 1985). However, developing time management skills can be the key to their academic success (Yusof, Chuan, & Shah, 2013; Cosh & Tully, 2014; Miller & Kerr, 2002). Yusof et al. (2013), in their study on Malaysian university athletes, found that having good time management skills was one of the factors that positively influenced university athletes’ academic performance. Cosh and Tully’s (2014) study on Australian student-athletes also showed some cases in which athletes flexibly controlled their time to succeed academically. Similarly, Miller and Kerr (2002) reported that multiple responsibilities as a student and an athlete enabled some university athletes to be good at controlling time and to focus more on studying during their sports seasons.

To help university athletes develop time management skills, manaba+R should be useful because of its accessibility and portability. However, as most university athletes failed to use their time effectively to study through manaba+R, it is important for teachers to instruct them how and when to use this tool properly. For this purpose, teachers can first encourage university athletes to make better use of the class hours. They can upload useful information for each week’s lesson or homework in advance, have students access this information on manaba+R in class as part of a class activity, and evaluate their participation. As Cavus (2011) suggested that the use of online course tools via mobile devices facilitated students’ learning process, teachers should also instruct university athletes to access manaba+R on their mobile phones and strongly encourage them to make use of their free time on campus and commuting time. In addition, it should be effective if teachers upload information or material that can be easily checked and used even on a mobile phone’s small screen. For example, if teachers post a link to a TED Talk presentation or a useful YouTube movie, university athletes can easily watch them on their mobile phones while on a bus or a train. If teachers set up an online discussion page, it would be easy for university athletes to participate in information exchange about their assignments or class discussion at any time. Even when they missed a class, this type of page would enable them to catch up on their work. As Kitsantas (2013) suggested, it should also be useful to upload weekly, monthly, and semester schedules at the beginning of the semester to assist them in making an effective study plan. Encouraging them to check their own portfolio on manaba+R would also be useful for them to understand their study progress. These types of information and instruction will help them pay attention to an overall course schedule and assignment due dates, leading to the

improvement of their time management throughout the semester. If they could develop time management skills, they can make a clear study plan, make use of useful information provided, and manage to perform better in every assignment. Thus, it is important for teachers to carefully consider what and how to offer on manaba+R and strongly encourage university athletes to make use of their time.

## **Conclusion**

This study aimed to investigate the effective use of online course tools for university athletes in Japan. The results of the questionnaire revealed that university athletes had positive attitude towards using manaba+R for their study. However, the results also suggested that because of their insufficient time for study, lack of time management skills, and low motivation to get higher marks, most of the university athletes in this study failed to make use of manaba+R effectively for their study.

In order to support these university athletes academically, this study suggests two implications for teachers. First, this study suggests that in order to encourage university athletes to make use of information on manaba+R, teachers should grade their active use of this information as part of the course requirements. Second, this study strongly encourages teachers to help develop university athletes' time management skills with manaba+R. Because of its accessibility and portability, manaba+R can serve as an effective academic support tool for university athletes who tend to have insufficient time for study. If teachers instruct them to study with manaba+R in class and provide useful information that can be easily checked even through mobile devices, university athletes can be more self-regulated and be better at controlling their time to study even when they are busy with sports.

Although this study shed some light on the effective use of online course tools for university athletes in Japan, several limitations should be noted. First, this study focused only on university athletes with majors in sports and health science, most of whom entered university for the purpose of doing sports and studying about sports. Gathering data from university athletes whose academic majors differ from those in this study should enable us to explore our research questions more in depth. Second, this study used only questionnaire for data collection. In order to further research how university athletes use online course tools, online data on manaba+R such as the number of log-in, message posting, and homework submissions should also be taken into consideration. Last, though the sample size of this study (n=81) was not too small, future research with a larger sample size will give us more insight into the effective use of online course tools for university athletes.

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## Appendix

### Questions on the questionnaire (English translation):

Q1. What is your gender?

Q2. What grade are you in?

Q3. Do you belong to any organization in the university?

Q4. What is your TOEIC score?

Q5. How often did you bring your PC into class?

1 every time, 2 almost every time, 3 sometimes, 4 hardly, 5 never

Q6. How often did you use your PC in class?

1 every time, 2 almost every time, 3 sometimes, 4 hardly, 5 never

Q7. How often did you use manaba+R?

1 every week, 2 almost every week, 3 sometimes, 4 hardly, 5 never

Q8. Do you think that online course tools like manaba+R are useful for your study?

1 strongly agree, 2 agree, 3 neither agree nor disagree, 4 disagree, 5 strongly disagree

Q9. Which page(s) on manaba+R do you often check?

1 PROJECT, 2 CONTENT, 3 BOARD

Q10. What information on manaba+R did you find useful for your study?

1 guidelines for assignments, 2 useful English expressions, 3 tips for writing a paper, 4 others

Q11. Other than the information listed in Q10, what kind of information do you think should be posted on manaba+R for your study?

Q12. Where do you usually check manaba+R?

1 in class, 2 at home, 3 outside of class on campus, 4 on a bus or a train, 5 others

Q13. Do you think that online course tools like manaba+R are useful to communicate with your teacher?

1 strongly agree, 2 agree, 3 neither agree nor disagree, 4 disagree, 5 strongly disagree



***“I’m a Different Person Now”: Online Learning as a De-Facto Higher Education  
Equity Pathway to Transforming Lives***

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The Asian Conference on Society, Education & Technology 2016  
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**Abstract**

In line with global trends in higher education, many Australian universities are energetically embracing the concept of flexible online learning, which has significantly increased the number of students studying university courses through online and/or open-access delivery. This mode is highly utilised by non-traditional students, and is therefore an important avenue to fulfil Australian government policies aimed at equity of access. Without online access many successful students would remain excluded from university study. Within a Qualitative/Interpretivist approach, my research utilises in-depth interviews and an analysis of students’ reflective work to develop a complex and nuanced picture of their experience with online study. The focus is on a core, first-year unit, designed to facilitate the successful transition of new-to-university students into academic life in an online environment. This acts as an instrumental case study (Stake, 2008) for examining the experience of online, non-traditional students within the learning environment formed by these broader policy-related trends in higher education. Findings point to the transformative power of participation in university level study for successful online students.

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## **Introduction**

Over the last few decades, the teaching and learning carried out in Australian higher education institutions has seen significant changes, reflective of similar changes internationally. Three policy-related trends which are driving these changes in Australia are: wider student participation; flexible, online learning; and an increasingly casualized academic teaching staff. These trends work together to create conditions of teaching and learning which are quite different to those of perhaps thirty years ago. My research is concerned with understanding how these conditions affect the experience of participants in the contemporary higher education 'classroom'. Using a qualitative research methodology, I focus on a first-year core unit offered online through Open Universities Australia (OUA) as an instrumental case study. The unit, pseudonymously named Academic Transition Unit or ATU100 for research purposes, can be seen as a representative microcosm of the conditions produced by these three major trends.

In Australia, OUA works with partner universities to enable its students to graduate with a degree which is completely equivalent to that obtained by students who enrol in these universities directly. Students study fully online within the learning management system (LMS) of the university offering the degree, but have the opportunity to mix in units from other partner universities, to study over four study periods per year rather than two semesters, and, in some cases, to enter without any academic pre-requisites. Consequently, units offered through OUA, such as ATU100, become highly representative of the first two trends mentioned above, as students from diverse backgrounds enrol to take advantage of this flexible, online structure. Further, up to 90 to 100% of the teaching staff in ATU100 consists of casual tutors in any given study period, which is in line with the third major trend. While not wanting to diminish the work of these tutors, which is addressed in another article (Dodo-Balu, in press) this paper has a primary focus on the students. Utilising in-depth interviews and other qualitative research methods, my research aims to construct a complex and nuanced picture of the student experience within the learning environment formed by these broader trends in higher education. My research findings point to the transformative power of participation in university level study for successful online students. This is the story behind the screens.

## **From the literature**

Recent Australian government policy has placed an emphasis on increasing the participation of students in higher education, particularly those from disadvantaged and low socio-economic backgrounds (Bradley, Noonan, Nugent, & Scales, 2008). From 2012, the government has removed caps on student university places for most degrees (Norton, 2013) creating a demand-driven system in which higher education providers are free to enroll as many students as they wish (James, 2010). It is these policies that are effectively driving the trend towards wider student participation. According to James (2010) Australian universities have now entered a phase of creating a universal higher education system.

One way to facilitate a universalizing system is to make available more flexible modes of course delivery. In a demand driven system, government funding is directly linked to the success with which an institution can reach and enroll an increasing number, and a broader range, of new students (Edwards, 2011). Many universities

offer fully online or blended courses in addition to their on-campus offerings, as a way to attract further enrolments. The choice to study online is often made due to the student's location, employment obligations, family commitments, or medical related reasons. There is therefore a high representation of 'non-traditional' students in online units, particularly those classified as mature-age, regional or remote, low socio-economic status or with physical or mental health issues.

It is evident that the opportunities afforded by online education have created a de-facto equity pathway (Cupitt & Golshan, 2015) without which many successful students would remain excluded from university study. As stated by Stone, O'Shea, May, Delahunty and Partington (2016, p.146), '[o]nline learning has an important place in widening access and participation in higher education for diverse student cohorts'. This indicates a significant conflation between the trend of wider student participation and the availability of flexible, online learning. These two trends work together to create a large and varied online cohort, consisting of students who may enter university with widely different levels of academic preparedness.

There is a recognition that it can no longer be assumed that all students enrolling in university courses will be equipped to succeed in their degrees. As James states, '... universities must accept that one of their roles is to address shortfalls in schooling for some people' (2010, p.10). The growth in academic transition units such as ATU100, the focus unit for my research, is a response to this. However, the literature still tends to convey an overall bleak picture of the multiple challenges facing non-traditional students who are new to university. Yorke and Longden (2004) found that these students are likely to have a 'fragile self-belief' (p.83) about their capacity to succeed in an academic environment. Non-traditional students, particularly those from low socio-economic backgrounds, are less likely to believe that they belong in a university environment, creating a sense of a disjunction and isolation (Berger, 2000), and are more likely to be intimidated and overwhelmed by their first year (McInnes & James 2004). Moreover, Bach, Haynes and Lewis-Smith (2007) outline the additional challenge for online students of having to acquire technical proficiency in navigating the online learning site, at the same time as they are developing academic competence. While most universities offer physical spaces on campus where students can find academic support, these are not generally accessible to online students (Muldoon & Wilyegewardene, 2012), putting them at a further disadvantage. Thus, the literature suggests that the students participating in ATU100 and similar online units may be operating from the worst possible position regarding retention.

It has certainly been widely noted that the levels of attrition in fully online units are much higher than for units studied on campus (Cupitt & Golshan, 2015). However, Nichols (2010) points out that the measurement of retention and attrition in online courses is a complex issue and that a certain level of attrition is normal. 'Difficulties arise in terms of who to count as having dropped out' (p. 95). It is more likely, for example, that students may '...drop out before the course even begins' in the online environment, which can falsely inflate attrition figures (Nichols, 2010, p. 95). This indicates that the prospects for non-traditional, online students may be less bleak than they first appear. Stone et al. (2016, p.163) outline the positive benefits of online learning where a '...growth in confidence and self-esteem [is] evident as the students progress through their studies'.

Personal determination is a key element cited by successful online students (Nichols, 2010; Beck & Milligan, 2014). Cuppit and Golshan (2015) cite 'grit' as the most important quality that online students need to overcome challenges and achieve success. Grit is defined by Duckworth, Peterson, Matthews and Kelly (2007) as 'perseverance and passion for long-term goals'. Further elements identified as important for online students are institutional and peer support (Cuppit and Golshan, 2015). In online learning environments, '...tutors... act as the human interface between the university and its students' (Quartermaine, O'Hare, & Cooke., 2012, p. 66) and are therefore the main actors in the provision of institutional support. According to Garrison, Cleveland-Innes, and Fung (2010), teaching presence has emerged as key to the quality of the student experience. Also important is the excitement generated by the opportunity to participate in university study (Stone, 2008) and join an active learning community, which for many students is only possible because of the availability of online courses (Stone et al., 2016).

### **Methodology and method**

This paper is based on a qualitative /interpretivist case study of a particular university unit, ATU100. The focus of qualitative research is on meaning and interpretation (Liamputtong, 2009), allowing the researcher to develop more complex and richer insights than can be drawn from quantitative studies (Creswell, 2008). Interpretivist research seeks to '...get into the head of the actor' (Schwandt, 2000, p. 192) in order to gain a deep understanding of their lived experience. However, the extent to which this is an objective understanding is questionable (Schwandt, 2000; Lavery, 2003). "Understanding is always more than merely re-creating someone else's meaning" (Gadamer, as cited in Lavery, 2003, p.25), but is necessarily combined with the meanings brought by the researcher. The act of interpreting is influenced by the socio-historically inherited traditions and personal experiences of the researcher (Lavery, 2003). This is an important point in relation to my research as I have participated in ATU100 as a tutor, which adds a subjective, insider lens but may also influence data interpretation.

Constructive Grounded Theory is a method of data analysis which acknowledges the place of researcher subjectivity (Creswell, 2008). This method moves away from the positivist view that theory is something external to be discovered, but rather sees theoretical understanding as a construction (Charmaz, 2014). Grounded theory method complements other qualitative approaches to data analysis. My research makes use of grounded theory method in the context of an instrumental case study. Instrumental case studies serve the purpose of illuminating a wider issue (Creswell, 2008) or deepening our understanding of a particular concern by allowing an insider's view (Stake, 2008). The case of ATU100 serves to bring insight into the conditions of teaching and learning created by macro level trends related to current policies in Australian higher education and to develop an in-depth understanding of how participants experience these conditions within their learning.

Data collection and analysis was conducted following the processes of *emerging design*, *initial sampling*, and *theoretical sampling* in accordance with Constructivist grounded theory method. Emerging design is a process by which the researcher collects data, immediately analyses it, and makes decisions about the next step in the research process (Creswell, 2008). Engaging with early findings is an important step

in emerging design as these findings initiate the process of theoretical sampling which continues throughout the study, and guides the researcher in designing the next phase. “Initial sampling in grounded theory gets you started; theoretical sampling guides where you go” (Charmaz, 2014, p. 197). Theoretical sampling allows the researcher to collect strategic, specific data in order to elaborate and refine theoretical categories as they emerge and is a “...pivotal grounded theory strategy” (Charmaz, 2014, p. 199).

The first stage of the study utilized initial sampling to start the process of identifying theoretical categories and refining the research design. According to Charmaz (2014), initial sampling involves establishing sampling criteria relevant to the study before entering the field, and selecting research participants who reflect the criteria. Three students were included in the initial research sample (as well as three tutors). The students had completed the focus unit in recent study periods, and were chosen in response to the ideas that had emerged from the literature regarding the effect of self-belief and personal determination on the success of students in the online learning environment. During their study periods, the three students had expressed doubts to their tutor about their capacity to complete the unit but were subsequently successful. After completion, they were emailed a survey consisting of a mix of open-ended questions, and statements with Likert scale responses along with a personal invitation for participation in one or more interviews. Survey and interview questions aimed to explore their experience and elicit key factors which facilitated their completion of the unit. Data from their completed surveys and recorded interviews were then analysed and coded for emerging themes.

For subsequent stages of the research both targeted and generalised invitation emails were sent to students who had previously enrolled in the unit, resulting in responses which yielded qualitative data from a further nine students. These stages made use of survey and interview questions which were refined towards validating the coded themes. Document analysis of participating students’ emails, reflective work and other assignments was also conducted.

This research also made use of data from a large online survey involving ATU100 students which was conducted by the National Centre for Student Equity in Higher Education (NCSEHE) from 2014 to 2015 (used with permission), and an analysis of retention and attrition figures from the unit’s LMS in a representative study period.

### **The relevance of ATU100**

ATU100 is a large unit offered in all four of the study periods that make up the OUA academic year, with more than 300 students enrolling per study period. In general, students enrol in ATU100 as the first unit towards their bachelor degree, which makes this unit an important gateway to a positive and successful university experience. ATU100 aims to introduce students to the learning, thinking and communication processes that are important in the university setting. In addition to practical academic skills, critical thinking and reflection are foregrounded in the unit. Students complete reflective tasks over the course of the unit, including critical analysis of academic material and their own learning and thinking. Thus, the unit lends itself well to in-depth examination of the student experience.

ATU100 is highly representative of the conflated trends of wider student participation and online, flexible delivery. Data for the Online Learner Engagement Survey conducted by NCSEHE reveal a largely non-traditional cohort. The survey received 126 responses from ATU100 students. Of the respondents, students over the age of twenty-five accounted for 78% of the cohort, with 46% aged between thirty and forty-nine. Many of the respondents owned their own home, 43% compared with 22% who stated that they lived with their parents. These figures suggest that students have other important responsibilities in addition to their studies. Information on their previous educational attainments compared with the age groups stated above, indicate that many students have been away from study for some time. 31% of respondents stated that their highest level of education was high school, while 14% had attempted university previously but not completed. In addition, 37% of respondents indicated that they were the first in their family to study at university. These figures point to a large number of ATU100 students who are likely to be unfamiliar with contemporary university level study. This makes the development of the academic skills and understandings taught in the unit crucial to their subsequent success.

Statistical figures from the LMS of a representative study period indicate a very high attrition rate for ATU100, but also reveal a pattern of non-participation which supports the contention of Nichols (2010) that in order to understand the issue of retention and attrition in online learning, the surrounding complexity must be considered. For the study period in question, of all the students who enrolled in the unit, only 39% completed, indicating a 61% attrition rate. However, a closer look raises questions as to whether many of the enrolling students had the intention of participating. 17% of the enrolments did not log into the LMS, with a further 30% submitting no assignments. Thus, 47% of enrolling students may be regarded as not having begun full participation in the unit. This indicates that some students may enrol in the unit without making a firm decision to undertake a degree. Taking the remaining students, who attempted at least the first assignment, as the participating cohort, the rate of non-completion falls to 28%. Further, the figures show that the majority of the participating students successfully completed the unit, with a 77% pass rate. 25% of these students achieved a grade of High Distinction, awarded to those students who achieve a mark of 80 or above. These kinds of achievements may be linked to the transformational power of online study noted by Stone (2008) and Stone et al. (2006) in their research.

### **Students' own words**

Qualitative data from twelve students who had previously participated in ATU100 were gathered through open-ended survey questions, personal interviews, personal email responses, and an analysis of students' assignment submissions for the unit. Findings are outlined below with the stories of some individual students given a special focus. For ethical reasons, personal names have been altered and no identifying details have been used.

### **Online, flexible study is the only way**

It is very clear that online study provides an opportunity of obtaining a university degree to people who would otherwise be excluded from higher education study, supporting the idea that it creates a significant equity pathway. All the students in the

study stated that online, flexible learning was their only option. The reasons given encompass many of the characteristics of particular target student equity groups as defined by the Australian government (Department of Education and Training, 2015), specifically low socio economic status (SES) students, regional and remote students, and students with disabilities.

### **Low socio-economic status (SES)**

Low SES impacts on students' ability to finance themselves to undertake studies on campus and makes the option of leaving work for study unfeasible. Furthermore, mature-age students often have families to support and financial commitments to meet. These points combine to create a situation for many students in which time and financial resources are limited. As Janelle (not her real name) shared in her survey response:

“Splitting my time between being a mum, and part-time work, leaves me with very few daylight hours to attend a normal on-campus study regime. Online study gives me the flexibility to study at night, between shifts and during nap time, without having to travel out of my way” (Janelle).

Janelle stated her income as being between 20,000 and 40,000 dollars per year and that she had one son. Her son was a major inspiration for her return to study and improve her financial circumstances.

“I hope to be a positive role model for my son, showing him that through hard work, you can achieve a career you can be proud of and enjoy.” and “I hope to be a better provider by finding a career more financially stable...” (Janelle).

### **Regional and remote**

Living in a regional or remote area is a commonly cited reason for choosing online study. Four of the students interviewed stated that online study was their only option because of their home location, with family responsibilities and/or financial pressures precluding moving away from home or travelling significant distances to study at a university campus. For Ayla, “it just doesn't make sense” to make the half day trip to and from her closest university to attend campus, so she felt that she had to make online study work for her. Lina too acknowledges that “online study is my only option due to the remote location of my home”. Melissa is a mother and a practicing artist whose closest university is over an hour away by car, but this small, regional campus, doesn't offer an art degree. However, in her own words:

“The [closer universities] weren't an option... even to travel. I've got children at home, or one child still at home at this point and I've got an art practice to keep up as well and to foresee that I would be able to travel... for lectures and things it just wouldn't be viable, I know that” (Melissa).

## Disabilities

Students with physical or mental health issues are highly represented in ATU100 and online courses in general. The availability of online study provides them with the opportunity to not only gain university qualifications but also to be involved in a diverse and active learning community where their disability is not a focus. Ill health makes it difficult to commit to activities outside the home. Moira's health issues make following a regular on-campus timetable problematic "...as I don't know from one day to the next how I will be feeling" (Moira). This also indicates that the flexibility offered by OUA to opt into or out of particular study periods is another important facilitator into study for these students. "Studying online meets my need for flexible learning as I can set my own pace and study calendar (and) minimise any disruption to my medical treatment" (Moira). In the online environment of the unit, Moira was energetic and engaged. She took the initiative to set up an online 'motivational lounge' for students to support each other. "This space was envisaged as a forum for sharing our 'real' life experiences whether they were positive or negative" (Moira).

Amanda is a single mother who suffers from bipolar disease. She had attempted university before but did not complete due to the stress of interacting with groups of people.

"I think that (on campus study) was a bit of an impediment for me personally. Studying in groups of people (face-to-face) where I had that stress of being in groups...wasn't ideal for me" (Amanda).

Being able to study online has given Amanda the opportunity to continue with her studies.

"In spite of having greater stability, if I'd attempted to do a real time course rather than on online course... I think the pressures probably would have been too much for me even at this point" (Amanda).

For Amanda too, flexibility is important. She took a study period off after completing ATU100 when her daughter had a serious accident and to attend to impact on her own health. "That was handy to know that I hadn't lost too much time... that I could take that... break and then re-enrol for the next study period" (Amanda).

Louise's survey response clearly conveys the importance of online learning to her study. "I am housebound – online was really the only way it would happen" (Louise). For Louise, it is not only her own illness that makes attending campus impossible, but also the fact that she is a carer for other members of her family, who all have health issues which require significant amounts of her attention, support and time. Online study provides relief. In an email she writes, "But I love studying so much - I'm hoping that it will become an anchor in my life - something I can cling to" (Louise).

The responsibility of caring for family members with ill health is also the major reason for younger students to enrol in an online cohort. Christiana enrolled in ATU100 straight out of high school. Her circumstances really combine all three of the equity categories discussed here, as she puts her income at between 20,000 and 40,000 dollars per year, lives in a rural location, and is the primary carer of her invalid

mother while suffering from ill health herself. While many young people from rural areas are able to move to a city to attend university, Christiana found her opportunity through online learning. She also appreciates the flexibility to alter her study pattern when her mother's illness worsens.

### **Transformation of students' self-perceptions**

It seems clear that online learning is an important access gateway to higher education for students in equity categories. However, the experience of being a university student needs to be a positive and successful one to make this access worthwhile. The ATU100 students involved in this study have strongly indicated that this is the case which contrasts to the cautious tone prevalent in the literature. As a first unit towards their degree, participation in ATU100 appears to trigger transformational learning for successful students. Transformational learning involves the construction new meaning structures which can incorporate students' changing world and the changes within themselves (Willans and Seary, 2015). Moira began to critically question her own beliefs and those of others. In her interview she states, "...the unit...altered my perception even of who I am as an individual and where I fit within the social norm-my stereotypes..." (Moira).

Students found greater confidence in themselves and in their interaction with others. Joanna, describes herself as a disabled, single mother of four who had been away from study for twenty years. She was "very nervous and easily overwhelmed" when she first joined ATU100, but states that "I transformed from a student unable to participate, to one who really looked forward to reading and participating in the discussion threads" (Joanna). There is a strong sense of belonging to a learning community, of students feeling connected to and supported by their peers and tutors, and finding courage in their own voices. "I'm a different person now. I feel now that I have something to say" (Melissa).

### **Finding personal strength and perseverance**

The idea that personal determination, or grit, is the major factor for completing the unit successfully has emerged strongly from this study. All of the successful students who participated in the research emphasise the importance of determination. The comments of students echo each other: "If I wasn't determined to study, it simply wasn't going to happen" (Joanna); "This is what drives me the most. Determination to do my best" (Lina); "That was my main motivator. That was my determination to finish the unit" (Amanda); and "Determination is the one most important aspect of getting me through online study" (Melissa). Grit is especially important for students battling with health issues. Christiana feels she could not have completed the unit without it.

"I was and still am suffering from what is sometimes called brain fog, and a lack of motivation due to my illnesses which makes it easy to just want to throw the towel in, but that determination helps drive you through the bad days" (Christiana).

Discovering the personal strength and perseverance to finish the unit seems to be one of the most beneficial outcomes for students. In her reflective journal Amanda writes:

“my life has followed a pattern of allowing difficulties or mistakes to be translated into failure and lack of self-worth. This course has proven to be vital ...in changing that...despite any setbacks I might face in the future. It’s a lot easier now to see that my weaknesses don’t automatically cancel out any strengths that I have” (Amanda).

### **Perspectives of non-completers**

Although there is some uncertainty as to how to accurately measure attrition for online students, it is substantial and cannot be dismissed. While my study concentrates primarily on successful students, two responses came from non-completers which may give a glimpse into another side of the story behind the screens. It is clear that both these students feel let down by their experiences but also that the circumstances leading to non-completion were beyond the scope of the university’s control. Elise is bedridden after a number of strokes but had always had a sharp intellect. After she was given a second hand iPad, she decided to enrol in ATU100 and start a university degree. Unfortunately, there is a sense of confusion here about online study produced primarily from inadequate technology, and unrealistic expectations. Georgiana is a non-completing student who gave permission to use her email responses although she declined to complete the survey or be interviewed. She makes it clear that her reasons for withdrawing were “mostly personal” and not related to the nature of online study, but she was “not eager to discuss” them (Georgiana). However, a sense of personal injury is expressed regarding the OUA administrative process surrounding her withdrawal. “...I feel punished and completely inadequate” (Georgiana). It seems that not completing the unit may have a strong negative impact on the students’ sense of self-worth.

### **Conclusion**

Current Australian higher education policies are creating teaching and learning spaces and experiences which are very different to the traditional university model. The policy-related trends of widening student participation and flexible online delivery conflate to provide the opportunity of a university education to a large and diverse ‘non-traditional’ cohort of students who would otherwise be excluded, creating a significant equity pathway. Findings from qualitative data from students who had completed the online case unit (ATU100) through Open Universities Australia indicate that the availability of online university study offers a gateway to personal transformation, as students’ self-identities expand to include their higher education success and incorporate new-found strength, personal confidence and belief in their own capabilities. Cautions in the literature regarding the challenges particular to this cohort, such as a fragile self-belief, lack of belonging and technical barriers (Yorke and Longden, 2004; Berger, 2000; McInnes and James 2004; Bach et al., 2007), appear to be surmountable for the majority of fully participating students. Attrition figures for online courses can be falsely inflated when including all those who enrol, as a significant proportion appear to have little intention of undertaking a degree. The reasons for this are difficult to ascertain as these students may be the least likely to participate in research. Responses from two non-completing students suggest that having to withdraw is extremely disheartening, but also show that external circumstances impacting the decision may be beyond anyone’s control. In the main,

students who respond to research invitations are likely to be among the most motivated but statistics from the unit Learning Management Site indicate that their positive experiences, as reported in this paper, may be widely shared. Online learning, therefore, plays an important role in furthering the public good by effectively facilitating access to a tertiary education for 'non-traditional' students.



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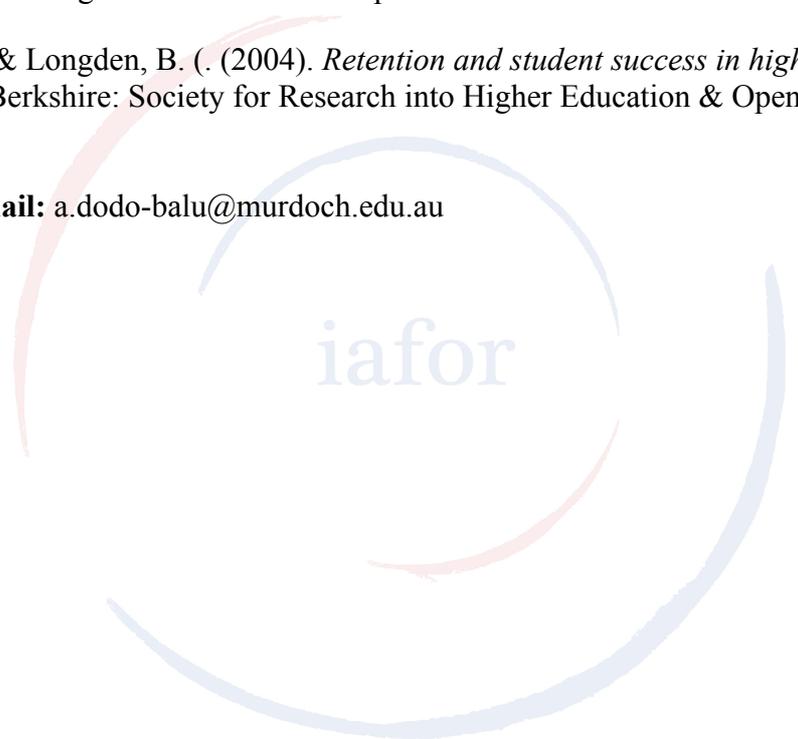
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The logo for the International Association for Frontiers in Research (iafor) is centered on the page. It features the lowercase letters 'iafor' in a light blue, sans-serif font. The text is surrounded by several overlapping, curved lines in shades of blue and red, creating a circular, abstract design that suggests a globe or a network of connections.

***The Role of International Student Mobility in Hybridized STEM and Interdisciplinary Programs in Japanese Higher Education: The Empowerment Informatics Program***

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The Asian Conference on Society, Education & Technology 2016  
Official Conference Proceedings

**Abstract**

Motives of international student mobility include education policy, globalization and migration policy, responsible for the labor flows of the 21<sup>st</sup> century. It follows that universities are forced to compete globally for foreign talent. The economic, political and societal forces of globalization leveled the playing field for students via education policy and an increase of students' choices. Establishing degree programs that hybridize STEM and interdisciplinary studies can attract foreign talent that seeks real skills applicable to industry. Policy diversifies degree programs not only on a basis of subject matter, but also by student demographic diversification. After establishing existing theories and examples of international student mobility and STEM and interdisciplinary hybrid programs, this article will describe how the EMP program effectuates both and offers direction on future research comparing such programs.

Keywords: International student mobility, globalization, STEM, interdisciplinary studies, higher education, Tsukuba, empowerment, informatics, cultural diversity, JSPS, MEXT, NSF

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## Introduction

Across the world, higher education faces the major issue of adapting to the changes brought about by modern globalization. The growth of a knowledge based economy and changing demand for skills attained at universities are especially remarkable in the fields of science, technology, engineering, and mathematics (STEM). In order for higher education institutions to compete at the global level, international student mobility is key to the acquisition and development of talented students who can succeed globally. In the past, migration as a form of mobility was largely motivated by political, economic and historical factors. However, Altbach and Knight (2007) define globalization as the “economic, political and societal forces pushing 21st century higher education toward greater international involvement” (p. 290). Modern migration has undergone a paradigm shift and is now not only motivated by traditional factors, but also by educational policies, rapid globalization, and reforms in the policies and practices controlling and encouraging migration. Universities must now deal with upgrading excellence in internationalization of research, teaching learning, and advertising in programs at the domestic and international levels.

Today, as students are becoming more mobile domestically and internationally, Japanese higher education faces the challenge of attracting foreign students and retaining domestic students to study in undergraduate and graduate Japanese university programs. Japanese universities need to offer programs designed with globalization and the knowledge based society in mind. Higher education institutions confront the challenge of producing students who possess global citizenship skills that allow them to succeed domestically and internationally. This entails global human resource development strategies to foster students possessing linguistic and communication skills, an understanding of diverse cultures and a sense of identity. “International intellectual contribution” and “mutual international understanding” have been raised as important keywords for Japanese higher education policy.

The apparent chicken and egg problem inherent in diverse student population can be bootstrapped and solved by funded pilot programs, like the University of Tsukuba Ph. D. Program in Empowerment Informatics (EMP program). As part of the The Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT) Program for Leading Graduate Schools, it is funded to develop educational policies which drive international student mobility to create a diverse and interdisciplinary student body. This program drives interdisciplinary and global competency across industrial, academic, and governmental sectors. The EMP program exemplifies how a Leading Graduate School can assure quality with a focus on international student mobility and hybridization of STEM and interdisciplinary studies.

## Literature Review

Per the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2016), 4.1 million students went abroad in 2013, up from 2 million in 2000. As the trend toward increased globalization and student mobility continues, Gürüz’s (2008) *Higher Education and International Student Mobility in the Global Knowledge Economy* provides a basis for discussion of this topic. He explains “internationalization of higher education in today’s global knowledge economy includes, in addition to increased international content in curricula, movement of

students, scholars, programs, and institutions across borders” (2008, p. 20). Globalization has changed student mobility in several ways, leveling the playing field for higher education institutions across the world. Higher incomes in emigrant nations combined with need-blind admissions and merit-based institutional (as opposed to private) scholarship initiatives, new migratory policies worldwide allow meritorious students easier access to foreign institutions, and increased institutional awareness of the benefits of a diverse student population are all ways globalization leveled the playing field for students. In turn, increasing equalization of access forces universities to compete, domestically and internationally for the growing influx of foreign talent. Similarly, essential and planned forces, such as the economic, political and societal forces of globalization leveled the playing field for institutions directly and indirectly. Leveling was direct through educational policies and indirect through the rising international student segment with an ever-increasing number of options. Gürüz (2008) also highlights the emergence of a global higher education market for human resources that can operate globally and supplement domestic students and scholars. Combined with the impact of globalization and the development of the global “knowledge based society,” these competitive forces have resulted in the global competition that is currently reshaping higher education. To remain competitive in a knowledge based society it is now essential for higher education institutions to enact policy changes to attract and develop a globalized pool of talented students and researchers.

Gürüz (2008) argues that the rise of the knowledge economy further has led to the demand for education programs that directly meet the commercial sector demands. To compete in the modern knowledge based economy, a workforce needs intercultural skills and the ability to lead and act upon knowledge in domestic and international contexts. Higher education institutions are enacting policies to cope with competition caused by globalization in several ways. First, institutions begin to nurture high level skills like team-based innovation, comprehensive problem solving, cultural awareness, globally focused ethics, and leadership, in addition to traditional field specialization studies. Second, higher education prepares engineers for the global workforce by providing a diverse and interdisciplinary environment. Third, higher education extends its reach beyond national boundaries as a matter of policy. Funding policies that require donors and sponsors to not restrict the origin of technologies procured effect open access to technologies worldwide. Creation of diverse environments institutionally breaks the national cultural barrier. Equalization of scholarship funding for the international segment breaks the national socio-political barrier.

Numerous studies support the ongoing efforts toward intercultural and globally focused engineering curriculum outcomes. For example, Ragusa, Matherly & Phillips’ (2014) study focused on students participating in two Research Experiences for Undergraduates (REU) programs allowing U.S. engineering students to partake in Japanese research internships. Participants results showed noticeable improvement on a scale of global preparedness in line with Gürüz’s (2008) points on global human resource development necessary to operate in a global knowledge based society. Additionally, Ravankar et al. (2016) supported the benefits of creative and critical thinking using problem finding while developing global competencies in interdisciplinary teams under the Top Global University Project at Hokkaido University. In the United States, there are other examples of ad-hoc and systematic programs for STEM and interdisciplinary study hybridization. For example, the S-

STEM program at Louisiana State is one example of a one-off program in the United States. Regarding, there is a program of National Science Foundation (NSF) grants under the Integrative Graduate Education and Research Traineeship (IGERT) program, superseded by the NSF Research Traineeship Program (NRT) in 2013.

Though Japan was previously perceived as indifferent towards supplementing its shrinking and aging population, and its reluctance toward internationalization strategies (Gürüz, 2008), examining MEXT policies since 2008, it is clear there is a commitment to attract foreign talent while bolstering the global competency of domestic students. Regarding the state of Japanese international student mobility, foreign higher education enrollment has expanded by 16,543 students since 2013, bringing the total hosted international students to 152,062 (Japan Student Services Organization, 2016). This represents a significant recovery from stagnation that preceded since 2011 due to the Great East Japan Earthquake. However, the top nine sending countries are all within in Asia, with China, Vietnam, Nepal, South Korea, representing 78.9% of international students in 2016, indicated there is still much room for improvement. Japan's policy planning recognizes the importance of increased internationalization and human capital development, and seeks to rectify points of weakness:

[To] maximize Japan's potential for create innovation, it is important to: secure [diverse human resources] with different views, knowledge, and ways of thinking; increase the mobility of human resources; and, advance cooperation between different fields, between industry, academia, and government, and between countries. (Council for Science and Technology, 2015).

This vision manifests in numerous MEXT budgeted programs, including the Program for Leading Graduate Schools, Top Global University Project, Go Global Japan, Re-Inventing Japan Project, and promotion for student exchange. International student mobility towards Japanese universities presents an opportunity to reach this vision for internationalization. For instance, the Top Global University Project started in 2014. This project sets extensive internationalization goals for the 2013-2023 period, including more than tripling the number of students who meet foreign language standards, more than doubling the percentage of international students, and more than quadrupling the number of Japanese students who have earned credits abroad, to name a few (Matsumoto, 2015).

Given the worldwide trend of education reform to meet needs of global competency, this paper will look at how the MEXT Program for Leading Graduate Schools implements this reform while using the University of Tsukuba Ph.D. Program in Empowerment Informatics as a case study.

## Methods

This article used several methods to establish the status quo in the literature and collect data on the EMP program. First, the author reviewed existing literature on international student mobility and hybrid STEM and interdisciplinary programs. She conducted literature review both in periodicals and in primary source matter (government and institutional documentation). Second, this article relies on the

author's first-person experience as a policy-maker in the EMP program. Finally, the article relies on the author's experience as an implementer of these policies, and specifically as a dedicated faculty member of the EMP program.

## **Results and Discussion**

First, the author discusses how the formation, organization and maintenance of the EMP program indirectly promote international student mobility and STEM and interdisciplinary studies hybridization. Next, the author examines how the EMP program directly encourages international student mobility and STEM and interdisciplinary studies hybridization.

### **Conceiving and funding the EMP program**

The initial authorization for the Leading Graduate School program was included in the DPJ coalition government's regular budget in 2011 and continued even after LDP returned to power. Formation of these programs remained a priority despite fiscal pressure related to recovery efforts after the Fukushima earthquake in 2011. The University Promotion Division of the Higher Education Bureau in MEXT announced information sessions regarding a request for proposal (RFP) for the establishment of "Leading Graduate Schools" to all public and private university presidents of Japan on June 14th, 2011. The RFP is for new graduate schools to operate for a period of up to seven years each. Per the Japan Society for the Promotion of Science (JSPS, 2011) RFP (the author translated the Japanese original):

The Leading Graduate Schools program will gather first class faculty and students domestically and abroad, with the participation of industry, academia and government to form world-class and accredited M.S.-Ph.D. interdisciplinary degree programs. These degree programs will nurture excellent students who possess creativity and wide perspective into leaders that act globally in industry, academia and government. The program aims to form graduate schools that belong to the highest academic spheres by fundamentally revolutionizing graduate education with these new degree programs.

Therefore, the programmatic goals of this enterprise already demand elements of international student mobility and interdisciplinary studies in each degree program.

Likewise, the student development goal of these Leading Graduate Schools per the RFP is to educate global leaders with the:

1. [a]bility to collaborate with others while possessing a solid set of values, and to act globally with firm resolve [; the]
2. [a]bility to identify issues and independently challenge them by developing hypotheses and applying knowledge in testing them [; and the]
3. [a]bility to ascertain the essence of matters by applying a wide range of knowledge buoyed by high levels of specialization and international perspective

as set out in the initial RFP (JSPS, 2016a). Establishing global perspective and broad and specialized knowledge as expected learning outcomes in the bid phase of these new graduate schools enshrines international mobility and hybridization at the student level.

Three categories of programs were set forth: all-around programs, only-one programs, and composite (multidisciplinary) programs. Composite programs are further divided into the MEXT held the information sessions one week later in Tokyo and Osaka on June 22nd and 24th, 2011. Another series of information sessions was held in 2012, and RFPs were issued in 2012 and 2013 as well. Prof. Dr. Hiroo Iwata, an engineer by training but a device artist by trade, submitted a bid for the EMP program at the University of Tsukuba in the 2013 round as a composite program in information sciences. Consequently, the EMP program was selected as a Leading Graduate School in late 2013. The EMP program is one of two Leading Graduate Schools at the University of Tsukuba, the other being the Ph.D. Program in Human Biology. Prof. Dr. Iwata became the EMP program leader.

The budget of the Program for Leading Graduate Schools nationwide oscillates around 17.8 billion JPY per annum (160 million USD on November 21st, 2016). The budgets in 2011 (3.9 billion JPY) and 2012 (11.6 billion JPY) appear smaller but are relatively consistent because MEXT had not selected all the participating programs yet. A breakdown of the annual budgets since program inception in JPY and USD is listed in the table below. These figures are on the JSPS overview web site (2016b) and are corroborated with MEXT section reports (2014, 2016).

Year	Annual budget in JPY	Annual budget in USD
2011	3,900,000,000	\$35,090,876.37
2012	11,600,000,000	\$104,372,863.06
2013	17,800,000,000	\$160,158,358.83
2014	18,500,000,000	\$166,456,721.25
2015	17,800,000,000	\$160,158,358.83
2016	17,000,000,000	\$152,960,230.34

Table 1: Program for Leading Graduate Schools Annual Budget

Of the total budget for Leading Graduate Schools in 2016, 107 million USD (11.8 billion yen), or more than two thirds of the total budget was allocated to programs in the composite category, based on averages derived from the maximum funding per program in each category for 2016 and the total numbers of programs per category. Again, the average funding per program in the EMP program's category in 2016 is 2.7 million USD by the same logic. This derivation is necessary because the author confirmed that MEXT does not publish the award amounts to each individual program. The table of calculations used to arrive at the average budget of 2.7 million USD per program in the composite category is listed in the table below.

	Funding limits per program in 2016 (JPY)	Category total if programs are funded to the maximum (JPY)	Weighted annual budget per category (JPY)	Average funding per program per year (JPY)	Average funding per program per year (USD)
All around	540,000,000	3,780,000,000	2,487,804,878	355,400,697	\$3,197,774.85
Composite	450,000,000	18,000,000,000	11,846,689,895	296,167,247	<b>\$2,664,812.37</b>
Only one	270,000,000	4,050,000,000	2,665,505,226	177,700,348	\$1,598,887.42
2016 budget if programs are funded to the maximum (JPY)				25,830,000,000	
2016 budget as a percentage of this theoretical budget				65.815%	

Table 2: Leading Graduate Schools Budgeting

The EMP program's budget covers the matriculated students' tuition and stipends, the salaries of dedicated faculty and staff, prorated salaries for shared faculty and staff, domestic and foreign travel for research, publication and recruitment, capital expenses, operational expenses and other miscellaneous cost. Even taken in the average, this budget is much larger than the annual budgets of the large (awards greater than one million USD) active NSF IGERT/NRT programs (all funded at approximately 500k - 600k USD per annum for five years), with one exception. There exists an active NSF grant, numbered 1425989, a six year grant at Princeton funded at 2.9 million USD per year (see Appendix).

The fact that the EMP program's budget is specifically allocated to an independent graduate school overcomes the crux of the issues experienced by most interdisciplinary programs worldwide. Schmidt et al. (2012) note that "cultural and methodological differences, competing departmental requirements and advisors and difficulty becoming fluent in multiple academic cultures" all impede effective interdisciplinary training (p. 297). The EMP program makes a point of enforcing cultural (national) diversity in the program by aggressively recruiting foreign students and faculty trained abroad. The EMP program enforces disciplinary diversity in the student and faculty bodies in the same way; inbound students have backgrounds including computer science, mechanical engineering, art and design. Likewise, the faculty are drawn from many faculties, as described in the organizational structure section that follows. The EMP program has the flexibility to self-determine its composition because it has an independent budget with interdisciplinary studies in mind. Again, as the EMP program is an independent graduate school with dedicated faculty, it does not encounter problems like competing departmental requirements or multiple advisors, as there is only "one" interdisciplinary department and one "advisor" in that department. Finally, the EMP program makes a point of instructing all students in the methodology of all disciplines to create a common language for

students. For example, in addition to quantitative methodologies of experimentation and measurement prevalent in STEM fields, like statistics, the author was responsible for instructing students of multiple cultural and educational backgrounds in the qualitative methods required to conduct a survey.

### **Organizational structure of the EMP program**

The University of Tsukuba created a new graduate school named the School of Integrative and Global Majors (abbreviated as SIGMA) to house the two Leading Graduate Schools of the University of Tsukuba, the EMP program and the Ph.D. Program in Human Biology.

The EMP program employs more than sixty faculty members on a full or part time basis. Aside from the seven faculty members fully employed by the program, the faculty shared with other schools hail from the graduate schools of Systems and Information Engineering, Business Science (systems management and business law) and Comprehensive Human Sciences (clinical sciences, kansei, behavioral and brain sciences, psychology, and nursing science). The EMP program is interdisciplinary by nature (MEXT and JSPS mandated that the program be interdisciplinary, especially because of its placement in the composite category) and by composition (the faculty hail from many schools). Finally, EMP program leadership consists of three people: the program coordinator, Prof. Dr. Iwata; the university president who applied for the award, Prof. Dr. Kyosuke Nagata; and the program executive officer, Prof. Dr. Yuichi Ohta, emeritus. Prof. Dr. Iwata oversees the day to day operation of the program, and his device art concentration supports a focus on hybridizing interdisciplinary studies and STEM.

### **Continuing the EMP program**

MEXT and Japan Society for the Promotion of Science (Japanese equivalent of the US National Science Foundation) guidelines for the Leading Graduate School programs allows unilateral funding reduction or removal for programs that do not achieve or surpass the planned outcomes described in the respective proposals (JSPS, 2016b). JSPS and MEXT plan periodic evaluations that begin in the third year of each program and are repeated, assigning grades of S, A, B, C, or D each time. The meaning of each grade is listed in Table 3 below (JSPS, 2016c).

Rating	Description
S	Surpasses expectations and will meet programmatic goals if current efforts are sustained
A	Meets expectations and will meet programmatic goals if current efforts are sustained
B	Meets or surpasses some expectations but falls short as a whole, and needs to redouble efforts based on advice on how to meet programmatic goals
C	Delay-ridden and hindered, the program falls short of expectations and needs a fundamental reduction and redefinition of scope to meet programmatic goals
D	Based on progress to date, the program has no chance of meeting programmatic goals, and therefore financial support needs to be cancelled.

Table 3: Leading Graduate School Program Grading Rubric

The Japanese-American entrepreneur William Hiroyuki Saito serves as the program officer for the EMP program (JSPS, 2015). Mr. Saito took part in the midterm evaluations that occurred in October 2016. Even before the official midterm evaluation, MEXT and JSPS evaluated the programs based on their proposals and based on an on-site visit. The continuous feedback loop ensures that each program, the EMP program included, continues to meet goals involving international student mobility and STEM/interdisciplinary study hybridization.

Aside from the official evaluations, the Japanese government have decorated the EMP program and many of the Leading Graduate Schools in general since inception. The EMP program was selected as a member of MEXT's Top Global Universities program, which aims to internationalize Japanese universities through Anglophone programs and extensive recruitment and support of international students and faculty. Finally, since inception, the Leading Graduate Schools have received positive mentions by MPs in the two houses of the Japanese Diet. On November 12th, 2014, MP Hideki Niwa, the vice-minister of MEXT also referred to the programs in the Special Committee on the Promotion of Science, Technology and Innovation of the House of Representatives as follows.

MEXT, in addition to supporting excellent doctoral students research with special researcher financial support programs, we can cover the living expenses for doctoral students in the form of scholarships provided by the Leading Graduate School programs... we at MEXT argue that it is important to enable skilled and hungry students to become doctoral students with financial aid, without making them choose between research and living expenses, a very fine line.

The EMP program prioritized allowing students to focus on learning and research, without having to worry about living expenses. As per the 2014 self-report, the university paid 180,000 JPY per month to each student in residence for living

expenses. Additionally, to further lessen their financial burdens, the university halved or nullified student tuition, and postponed tuition due dates for these students far in the future (JSPS, 2014).

The specific ways the EMP program implements mobility and hybridization are discussed in the following two sections.

### **International student mobility in the EMP program**

The EMP program aggressively seeks out international student participation, both through student recruitment and through individual exchanges and MOU's with other higher education and research institutions. Finally, after initially exporting this degree program to inbound international students, EMP curricula holds students to a high bar of international exposure by requiring students to present at select international conferences and competitions as part of their candidacy. For example, every year students present papers and posters at IEEE and ACM conferences domestically and abroad, and submitting device art works to the Prix Ars Electronica competition held in Linz, Austria as well as to the Tsukuba Media Art Festival annually has practically become a tradition for the EMP program. Finally, some students even won themed awards in the Microsoft Imagine Cup Japan in 2015 with the Childhood project, and the national grand award in 2016 with the Bionic Scope (Microsoft 2015, 2016), continuing to represent Japan at the finals in Washington state.

The EMP program has six international education points of contact in Europe and the United States (JSPS, 2013a). As per the JSPS (2013b) self-report, EMP program leadership planned for recruiting students abroad, and lowered the barrier for them with Anglophone application websites, and conducting candidate interviews abroad. International student recruitment activities, like interviews held in the United States and the Netherlands were carried out in 2014 as well (JSPS, 2014), resulting in five international students being offered seats in the program. The EMP program, increased its exportability to international students by expanding availability of instruction in the English language (JSPS, 2013b, 2014).

### **Hybridization of STEM fields and interdisciplinary studies in the EMP program**

Per the 2013 EMP self-report, “students create a portfolio of their scholarship, consisting of self-evaluations and measured learning outcomes along six axes:

1. broad experience and domain knowledge
2. rich education and interdisciplinary perspective
3. excellence in specialization and creativity
4. global interpersonal skills,
5. leadership, and
6. on-point technology development skills and entrepreneurship.

This portfolio helps students gauge their progress” (JSPS, 2013b). Of these axes, the interdisciplinary perspective axis embodies the EMP program's early commitment to hybridization of STEM and interdisciplinary studies.

Another example of hybridization is the international symposium students attended in March 2013. The initial industrial partners (JSPS, 2013a) participated in the 2013 International Symposium, deepening students' and industry's mutual understanding of the EMP program goals, and thus some of these instructors were appointed as visiting instructors to formalize their advisory role in the program. Connecting students to industry is one of the pain points in Japanese higher education today. The director of the Higher Education Bureau, Yutaka Tokiwa referred to the Leading Graduate Schools in the MEXT standing committee of the House of Councillors on April 19th, 2016 as he replied to a comment by the committee chair that justified the decline of graduate student enrollment with the lack of clear career paths.

...[we] reacted to the reality that narrow fields of specialization greatly limit graduate students when applying for jobs by introducing the Leading Graduate School programs. We [cultivate] human resources from graduate students that can approach research with a wider view with these programs...

In other words, the effects of programs like the EMP program to curtail a decline in matriculation to doctoral programs is expressively felt at the highest levels of national government. The EMP program's engineering residency (a requirement for graduation) is another vehicle used to force students to bridge the gap with industry: industrial partners provide placement locations, and the EMP program provides funded students, ready to hit the ground running (JSPS, 2013b).

Other mechanisms the EMP program uses to advance hybridization is the formulation of classes where first year graduate students collaborate to create device art and submit it for consideration in the Prix Ars Electronica. One example of a work of device art that was submitted to Ars under these auspices was the idMirror interactive installation, later published in CHI EA 2016 (Jazbec & Erich) and the EMP Studio Symposium (University of Tsukuba, 2015). Another highly acclaimed research effort at the crossroads of STEM and interdisciplinary studies was the Bird Song Diamond project, directed by Professors Iwata, Vesna, and Takashi Ikegami of the University of Tokyo. The PIs engaged multiple students in engineering and art to create an immersive experience of bird migratory patterns in the EMP Large Space (Taylor, Vesna & Ikegami, 2015).

## **Conclusions and future directions**

This article demonstrates how the EMP program, a member of the Graduate Leading Schools program of the Japanese MEXT, effectively increased international student mobility and hybridization of STEM and interdisciplinary studies. Fully funding all students, English language instruction, and recruitment efforts abroad reaped fruit in international student enrollment. Again, traditional inhibitors of interdisciplinary programs were not present because the EMP program is in an independent school with a dedicated budget and staff. Comparing many more NSF IGERT/NRT programs systematically with Graduate Leading Schools in Japan may offer another dimension of analysis in program outcomes. More research and comparative analysis is necessary after the rating and report from the EMP program's first midterm evaluation become available.

## Appendix

Active NSF IGERT/NRT awards greater than one million USD, an abstract of results retrieved from the National Science Foundation (NSF, 2016).

Award	Start Date	End Date	Awarded Amount To Date	Years	Amount per year
1425989	09/01/2014	08/31/2020	\$17,194,857.00	6	\$2,865,809.50
1144843	07/01/2012	06/30/2017	\$3,199,979.00	5	\$639,995.80
1450006	04/01/2015	03/31/2020	\$3,105,701.00	5	\$621,140.20
1449815	04/01/2015	03/31/2020	\$3,069,340.00	5	\$613,868.00
1545261	09/01/2015	08/31/2020	\$3,057,337.00	5	\$611,467.40
1450053	04/01/2015	03/31/2020	\$3,040,967.00	5	\$608,193.40
1144804	07/01/2012	06/30/2017	\$3,033,953.00	5	\$606,790.60
1633557	09/15/2016	08/31/2021	\$2,999,055.00	5	\$599,811.00
1633299	09/15/2016	08/31/2021	\$2,993,930.00	5	\$598,786.00
1144584	07/15/2012	06/30/2017	\$2,993,020.00	5	\$598,604.00
1633608	09/15/2016	08/31/2021	\$2,989,899.00	5	\$597,979.80
1450032	04/01/2015	03/31/2020	\$3,013,779.00	5	\$602,755.80
1144616	07/01/2012	06/30/2017	\$3,006,642.00	5	\$601,328.40
1449785	04/01/2015	03/31/2020	\$3,006,000.00	5	\$601,200.00
1633216	09/01/2016	08/31/2021	\$3,000,000.00	5	\$600,000.00
1144726	07/01/2012	06/30/2017	\$3,000,000.00	5	\$600,000.00
1144807	07/01/2012	06/30/2017	\$3,000,000.00	5	\$600,000.00
1144635	07/01/2012	06/30/2017	\$2,999,984.00	5	\$599,996.80
1633831	09/01/2016	08/31/2021	\$2,999,932.00	5	\$599,986.40
1633740	09/15/2016	08/31/2021	\$2,976,889.00	5	\$595,377.80
1144860	07/01/2012	06/30/2017	\$2,999,713.00	5	\$599,942.60
1144752	07/01/2012	06/30/2017	\$2,999,589.00	5	\$599,917.80
1144901	07/01/2012	06/30/2017	\$2,999,533.00	5	\$599,906.60
1144885	08/01/2012	07/31/2017	\$2,999,501.00	5	\$599,900.20
1633098	09/01/2016	08/31/2021	\$2,999,263.00	5	\$599,852.60
1144646	07/01/2012	06/30/2017	\$2,999,154.00	5	\$599,830.80
1545220	09/01/2015	08/31/2020	\$2,999,999.00	5	\$599,999.80
1545188	10/01/2015	09/30/2020	\$2,999,829.00	5	\$599,965.80
1545481	09/01/2015	08/31/2020	\$2,999,767.00	5	\$599,953.40
1545362	09/01/2015	08/31/2020	\$2,999,328.00	5	\$599,865.60
1144676	07/01/2012	06/30/2017	\$2,996,937.00	5	\$599,387.40
1545433	09/01/2015	08/31/2020	\$2,997,528.00	5	\$599,505.60

1633631	09/15/2016	08/31/2021	\$2,967,150.00	5	\$593,430.00
1449617	04/01/2015	03/31/2020	\$2,990,339.00	5	\$598,067.80
1632976	09/15/2016	08/31/2021	\$2,959,866.00	5	\$591,973.20
1545403	09/01/2015	08/31/2020	\$2,976,937.00	5	\$595,387.40
1545399	09/01/2015	08/31/2020	\$2,975,376.00	5	\$595,075.20
1633213	09/15/2016	08/31/2021	\$2,943,562.00	5	\$588,712.40
1449828	04/01/2015	03/31/2020	\$2,965,341.00	5	\$593,068.20
1633336	09/15/2016	08/31/2021	\$2,922,930.00	5	\$584,586.00
1633722	09/15/2016	08/31/2021	\$2,921,681.00	5	\$584,336.20
1633516	09/01/2016	08/31/2021	\$2,928,842.00	5	\$585,768.40
1545287	09/01/2015	08/31/2020	\$2,908,825.00	5	\$581,765.00
1449999	04/01/2015	03/31/2020	\$2,873,955.00	5	\$574,791.00
1545453	09/01/2015	08/31/2020	\$2,866,938.00	5	\$573,387.60
1631776	09/15/2016	08/31/2021	\$2,721,142.00	5	\$544,228.40
1633756	09/15/2016	08/31/2021	\$2,689,908.00	5	\$537,981.60
1144591	07/01/2012	06/30/2017	\$2,709,035.00	5	\$541,807.00
1633587	09/15/2016	08/31/2021	\$2,555,633.00	5	\$511,126.60

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## *A Mobile Software Development Using Aspect Orientation Approach*

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### **Abstract**

Today mobile devices are widely used everywhere, and have rapidly changed. One of the major characteristics of the mobile software is to continuous need and demand for faster development. Separation of concerns in the mobile software development is essential for adaptability and extensibility. An adaptability is a capable to adapt with respect to the environment that will need to perform. An extensibility is a capable to extend with respect to the new features or requirements that will add in a mobile software. Most software deficiencies and deteriorations are caused by changes in software. Generally, these deviations cannot be avoided. Such changes are often the result of the mobile software evolution and changes in the underlying requirements of mobile software development to meet these evolving needs. Certain refinements can be applied to traditional object-oriented analysis and design techniques. However, refinements are very complicate. A simplicity of software development is considered an important characteristic of a good software development model. Mobile software engineering approaches are a midlife with many accomplishments already achieved, but with many significant works yet to do. An aspect orientation approach have shown to be an effective means of capturing, communicating, and combining software components. We believe that an aspect orientation approach can be applied to a mobile software development on several aspects. To demonstrate the simplicity and practical of the adaptable and extensible mobile software model, we propose a separation of concerns in a mobile software development using an aspect orientation approach.

Keywords: Aspect Orientation, Adaptability, Extensibility, Framework, and System Software.

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## Introduction

The recent expansion of smart devices has abundantly created a unique opportunity for researchers to use all their capabilities to provide new application software. Mobile application software development is rapidly changing the way we have commonly worked and interacted. Mobile software development has to comprehend how separation of concerns can be achieved and how individuals choose to properly develop mobile software to effectively utilize a separation of concerns. At present there are more than hundred thousand of application software available through the various stores, some of which are available for multilingual and multiple types of devices. Most of mobile application software divide between native and web applications (Ali, N., & Ramos, I. 2012; Wasserman, 2010). Native applications run entirely on the mobile device. Web applications consist of a remote server and a small device-based client executing and interacting user's commands through communication networks. There are several of comprehensive mobile application design and development available for the major mobile platforms. iPhone developers use Xcode package across all Apple products (Apple Developer Connection, 2015). Android developers uses the Android development tools (Android Developer site, 2015) or eclipse programming tools (Eclipse website, 2016). Windows phone developers use Microsoft Studio for mobile development (Windows Phone Developer site, 2016). These dominant development gears and structures greatly simplify the task of design and implementation of a mobile application software. However, they are based on object-oriented design and implementation. The intra-concern system properties are associations and necessities over confined state of processes or components of states. The inter-concern system properties are associations and necessities over dissimilar confined processes or components of states that describe the reliabilities and collaboration among a collection of supportive processes or components. Both processes and components of system properties are critical for a system development and verification. The intra-concern properties are relatively easier to express and carry on through a system development life cycle. One of the major characteristics of the system software is to continuous need and demand for faster adaptability and extensibility. Adaptable system software is system software that can be adapted with respect to the environment that will need to perform. Extensible system software is system software that can be extended with respect to the new features or requirements that will add in system software. Most software defects and deterioration are caused by changes in software (Fayad, M. & Altman, A., 2001). Generally, these changes cannot be avoided. Such changes are often the result of the system software evolution and changes in the underlying requirements of system software to meet these evolving needs. Certain refinements can be applied to traditional object-oriented analysis and design techniques. However, such refinements must not complicate. Simplicity is considered an important characteristic of a good model.

A mobile software consists of separating multiple concerns crosscutting many components of the system. A mobile software is notorious of many crosscutting concerns such as synchronization, scheduling, fault tolerance, logging, and etc. We refer to these crosscutting concerns as system properties. System properties are aspectual. By supporting separation of concerns in the system software, we can provide a number of benefits such as easy to comprehension, reusability, extensibility, and adaptability for system software. In both the design and implementation of system

software, the system designer has to consider how a number of system properties can be captured, and how a separation of concerns (Parnas, D., 1972) will be addressed. Functional decomposition has so far been used as well as achieved along two dimensions - based on the components and layering paradigm. In object-oriented programming, these dimensions are layers and components; included methods, objects and classes. Current programming languages and techniques have been supportive to functional and object-oriented decomposition. However, languages are specific domain. Furthermore; a mobile software design has also been aligned with traditional functional decomposition techniques. No functional decomposition technique has yet managed to address a complete separation of concerns. Object-oriented programming seems to work well only if the problem can be described with relatively simple interfaces among objects. Unfortunately, this is not the case when we move from sequential programming to concurrent and distributed programming. As distributed systems become larger, the interaction of their components is becoming more complex. This interaction may limit reuse, make it difficult to validate the design and correctness of system software, and thus force reengineering of these systems either to meet new requirements or to improve the system. Certain system properties of the mobile software do not localize well. They tend to crosscut groups of components or services (functions or methods) in the system. System properties tangle in components or services making the system difficult to adapt and extend. Changing needs to understand and correctly identify both system properties and core services of components. It is tightly couple design and implementation between components and system properties. In this paper we focus on adaptability and extensibility by proposing an adaptable and extensible model that is the basic of a framework for the system software development. This adaptable and extensible model, using the aspect-oriented techniques (Kiczales, G., Lamping, J., et al 1997; Lopes, C., Tekinerdogan, B., et al, 1998) provides a declarative way of developing, handling, and characterizing adaptable and extensible system software and represents a novel attempt to decompose and compose the system properties and components.

## The Architecture

In this section we briefly describe the framework (Netinant 2006; Netinant, 2001). We have designed the framework in order to support the development and deployment of adaptable and extensible system software. Figure 1 shows the overall framework architecture, which is composed of the following components:

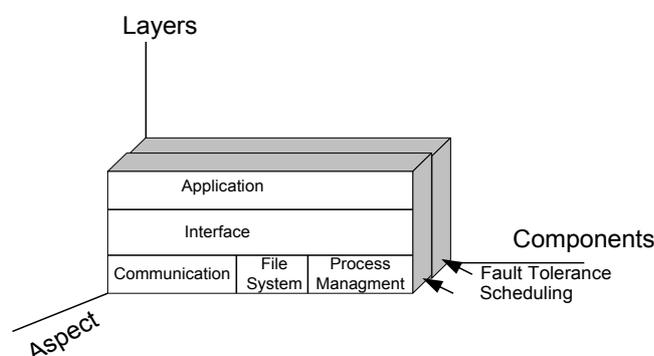


Fig. 1 The Framework Architecture

Our framework is based on aspect-orientation, which is a three-dimensional system design consisting of components, aspects, and layers. Components consist of the modules that provide the basic functionality of the system such as the file system, communication, and process management, etc. Aspects are crosscutting system properties, and they can be a fault tolerance, synchronization, and scheduling, naming, etc. Layers consist of the components and system properties. In general, lower layers deal with a far shorter time scale. The lower the layer, the closer it is to the hardware. The higher layer deals with interaction with the user.

By adding the aspect dimension to a two-dimensional model, system properties and functional components are separated from each other in every layer. It makes the system software design and implementation more modular, but makes it loosely coupled. Each layer has well-defined functionalities, system properties, and input-output interfaces with the two adjacent layers. Each layer can be designed, implemented, and tested independently. The upper layer can reuse the layer beneath without knowing how the lower aspects or components are implemented. The upper layer does not have to build own system property components from scratch. However, new aspectual property components can be added to a layer without interfering with system property components or functional components in the layer underneath. It gives the system software easier extensibility and adaptability. Adding new system property components, which are orthogonal, requires no changes in functional components or system property components in other layers. Modifying a system property component needs no changes in system property components in the other layers. With current growth and rapid change, in technology and the features of system software, this architecture allows both functional components and system property components to be added into the system software more easily. The three-dimensional model makes it possible to manage both system property components and functional components in each layer.

By isolating the different system property of each component, we can separate functional components, system properties, and layers from each other (components from each other, system properties from each other, layers from each other, functional components from system properties, functional components in each layer, and system property in each layer). It would thus be possible to abstract and compose them to produce the overall system. This would result in the clarification of interaction and increased understanding of system properties of each functional component in the system. A high level of abstraction is easier to understand. Further, the reusability achieved by the higher level can use the lower level of the implementation not only to promote extensibility and refinement, but also to reduce cost and time in system development. A change in the implementation at a lower level would not result in a change at the higher level if the interface level has not been changed. Thus the design can achieve stability, consistency, and separation of concerns as well. A system property may have multiple domains. Some system properties (scheduling, synchronization, naming, and fault tolerance, e.g.) are scattered among many components in the system with varying policies, different mechanisms, and possibly under different applications. To reduce the tangling of system properties in system software each system property can be considered and analyzed separately. For example, a system property of scheduling in file systems can be considered in different domains in each layer. This would separate policy from a system property of each layer. A system property interface would represent the general specifications needed to

provide the abstraction. Further, a policy can be added or modified in each layer for each specific domain. This approach can support reusability to achieve adaptability.

## The Framework

One way of structuring system software is to decompose it into layers. Each layer is decomposed into its components. This decomposition of the system design both horizontally and vertically helps to deal with the complexity and reusability of system software. The layered architectural design decomposes a system into a set of horizontal layers where each layer provides an additional level of abstraction over the next lower layer and provides an interface for using the abstraction it represents to a higher-level layer. Every layer is decomposed into system components and system properties. System components and system properties are separated from each other. Changing either system components or system aspectual properties does not affect the other. The advantage of this decomposition is that system software tends to be easy to understand, adapt, extend, and maintain. Each layer can be understood, adapt, extend, and maintained individually without affecting other layers. However, it may be bad for performance and traceability because of using lower layer components.

The framework expresses a fundamental paradigm for structuring system software, a vertical composition of each layer where system components and system aspectual properties are composed into an abstraction of the layer. The framework structure can be described by the design pattern (Gamma, E., Helm, R., Johnson, R., & Vlissides, J., 1995). The framework uses a client-server model in which the server components (Functional Components and System Components) are composed by the Aspect Moderator and make their services available to clients. Clients access the server component services by sending requests to the Proxy component. The Proxy component intercepts a requesting message from clients and forwards the message to the Aspect Moderator component. The Aspect Moderator component locates and instantiates the composition rules defined by *pointcut(s)* – a collection of join points consists of join points between functional components and system property components. Figure 2 illustrates the modeling of the adaptable and extensible framework.

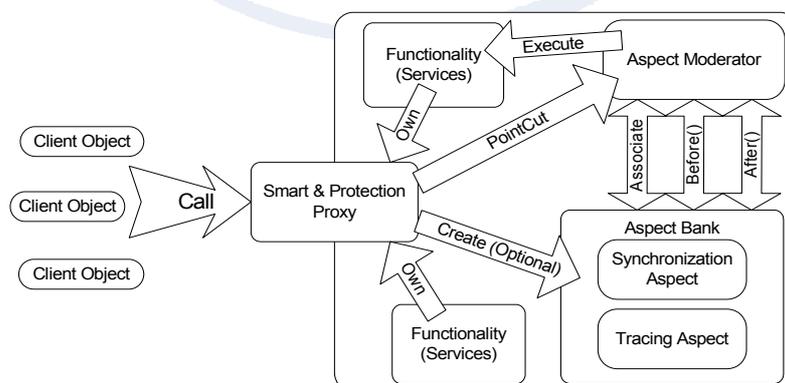


Fig. 2 The Model of the Adaptable and Extensible Framework

The framework supports both vertical and horizontal reusability. Reusable assets in the framework can be found in the vertical composition, where the upper neighbor layer can reuse a functional component or an aspectual property component from the lower

layer. There are two levels of reuse in the aspect-oriented framework: Inter-layer reuse: reuse of functional components or aspectual property components from the lower layer, such as using an aspectual component derived from an abstract aspect. Intra-layer reuse: reuse of functional components or aspectual property components from the same layer, such as using an aspectual component to solve another problem. The aspect-oriented framework provides a better way to reuse both design and implementation code. Both inter and intra-layer reuse can be divided into three levels of reuse in the aspect-oriented framework as follows:

Functional component: Reuse of functional component(s), such as reuse or redefinition of the functional component.

System property component: Reuse of an aspectual property component, such as reuse or redefinition of the aspectual property component.

Framework reuse: Reuse of a framework provides a set of classes that manifest as an abstract design and implementation for solutions to a set of related problem.

The aspect-oriented framework supports both vertical and horizontal compositions. Functional and aspectual property components in the framework can be composed vertically or horizontally. In vertical composition, the upper layer can use the lower functional or aspectual property components from the lower layer. In horizontal composition, functional and aspectual property components in the particular layer only use to be composed. The framework is based on system aspectual decomposition of crosscutting concerns in operating system design and implementation. The framework consists of two frameworks: the Base Layer and the Application Layer Framework. A system aspectual property is implemented in the SystemAspect class, while a component of the system is implemented as a Component class. The framework uses PointCut, Precondition, and Advice. The AspectModerator class, where the point cut is defined, combines both system aspectual properties and components together at runtime. Pointcuts are defined collections of join points, where system aspectual properties will be altered and executed in the program flow. Every aspectual property can identify and implement preconditions. A precondition is defined a set of conditions or requirements that must hold in order that an aspect may be executed. Advice is a defined collection of methods for each aspectual property that should be executed at join points. Advice can be either before or after advice. Before advice can be implemented as blocking or non-blocking. Before advice is executed when the join point is reached, before the component is executed, if the precondition holds. After advice is executed after the component at the join point is executed. Every aspectual property will define advice methods.

One important aspect of the framework is that it can separate functional components and system property components (system and application depending on the layer of a framework). A client object calls the services from the servers through a proxy object, rather than having services called directly from a client object. Then the framework creates necessary objects and calls the appropriate system properties to perform a specific service. In other words, the framework is like a mixer that combines and coordinates the crosscutting concerns of a specific service. The rules are used to combine and coordinate a functional component (a service of the system) defined by the pointcuts. Thus, for a particular system or application, it can adapt the generic functional components or system property components defined in the framework. The framework supports adaptability and extensibility in either of two ways:

Extensibility: Derive new components from the framework: They can be either functional components or system property components.

Adaptability: Instantiate and compose existing classes: They can be either functional components or system property components.

### **Implementation of the Framework**

The framework consists of four components comprising the architecture of the framework. Each functional object (component) provides its services (methods) stripped of any aspectual properties (for example, no synchronization is included in Buffer objects).

A proxy object intercepts called methods and transfers the calls to the AspectModerator.

An AspectModerator object consists of the rules and strategies needed to bind aspects at runtime. Aspects are selected from the AspectBank. The AspectModerator orders the execution of aspects. The order of execution can be static or dynamic. Then, each precondition will be checked whether it is satisfied or not.

An AspectBank object consists of aspect objects that implement different policies of a variety of aspects.

This section presents the design and development of aspect-oriented framework. The model is presented to demonstrate horizontal composition of the framework. The system service must be implemented as a Component class. The system aspectual property (SystemAspect class) must be derived from the SystemAbstractAspect interface to implement the required behavior of a system aspectual property. A SystemAspectFactory consists of many system aspectual properties such as synchronization, tracing, logging, and reliability. The SystemAspectFactory, derived from the SystemAbstractAspectFactory interface, is known as an aspect bank. During runtime, each SystemAspectFactory will be associated with one SystemAspect. The AspectModerator class must be derived from the AspectModerator interface to implement the required behavior. The following points are important about the aspect-oriented framework:

A client object requests a service through a ProxyObject object of a framework.

A functional component is implemented as a Component class without any aspectual property.

A SystemAspectFactory object consists of various SystemAspect objects. A SystemAspect object is controlled by a SystemAspectFactory object.

Each system aspectual property must be implemented as a SystemAspect object.

Each crosscutting between Component object and a SystemAspect object must be defined in AspectModerator object as joinpoints in a Pointcut method.

A client requests a service by sending a message to a ProxyObject object. The ProxyObject object changes the request to a specific pointcut method, and forwards it to the AspectModerator object.

The Proxy class is responsible for intercepting and forwarding the message sent from Client object to request a service. The Proxy class must implement the behavior of intercepting a service request. A client object of an aspect-oriented framework must

request a service by calling the call() method. A call() method consists of at least two parameters: object name provided a service and a service requested to serve. The first parameter is of type string, and the second is type of string as well. The ProxyObject class will forward a request to the AspectModerator object by calling a PointCut() method. A PointCut() method must have the same number parameters and the same parameter type as the call() method.

The SystemAspectFactor class must be derived from the SystemAspectFactoryAbstract interface to implement the required behavior. The AspectModerator class is responsible for composing the functional components and the system aspectual property into a service request. The AspectModerator class acts like a coordinator between functional components and system aspectual properties, when and where system aspectual properties will be composed into a functional component. The composition of system aspectual properties and functional components must be guided and defined as PointCut() method. Each PointCut() method must have at least two parameters: component name and service name (methods of the component) that will be composed. The first parameter is of type string, and the second is type of string as well.

## **Conclusion**

In this paper, we stressed the importance of the better separation of concerns within the context of an adaptable and extensible framework. We show how this technique could provide an alternative to system software design and implementation, and show how our approach can be achieved separation of crosscutting concerns of the system. Our work concentrates on the decomposition of system properties crosscutting functional components in the systems implementation of system software to separate the crosscutting concerns.

Our design framework provides an adaptable model that allows for open languages and our goal is to achieve a better design and architectures where new system property and components can be easily manageable and added without invasive changes or modifications. The framework approach is promising, as it seems to be able to address a large number of system software and system property components. The advantage of decomposing of functional components and system property in every layer is to promote reusability, adaptability, manageability, and extensibility of both components and system property in system software easier without interfering each other. In the future, the framework will be extended and demonstrated for distributed object environment.

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***Electronic Learning for Preschool Preparation under Parental Guidance:  
A Case Study of Thai Educational System***

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**Abstract**

Failures in human development lead to many problems in many countries. Effective child development is a cornerstone of human resources and useful knowledge and skills gained during childhood will be the foundations of later learning. But preschool education is not available in every country. Some countries still lack good systems for child preparation before elementary schools. Preschool in Thailand varies from school to school since it is not compulsory and there is no national standard framework. Therefore, some children do not have access to preschool preparation. Nowadays, the Internet and web technology are widely available. Electronic learning could be used to reduce knowledge gap between children who are starting elementary schools. However, children at this age still lack skills in reading, listening, speaking, and writing. Hence, the proposed system focuses on an assisted learning environment under parents, teachers, or other assistants who can guide children in the learning context. The educational content covers a range equivalent to the preschool or pre-elementary school level-1 to level-3 of a selected case study school (kindergarten school). Therefore, the goal of the proposed system is to enable children to acquire their competencies for learning at the first elementary level. In addition to knowledge gap reduction, the system can be adopted as the learning media for home education or a learning center in any community.

Keywords: Child development, Electronic learning, Preschool preparation, Web-based classroom

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## Introduction

Education is very important for human resource development in every country around the world. Failures in human resource development lead to many problems. Therefore, each country needs a well-organized system for human resource development. Effective child development plays a key role and is one of key success factors for human resource development. Late problem resolution would make the problems more complicated and more expensive to manage such as poor quality children caused by poor quality education systems. Knowledge and skills gained during childhood will be the foundation of later learning. Preschool education is important for preparing these knowledge and skills. Preschool education is not mandatory in every country. Some countries still lack good systems for child preparation before elementary schools. Preschool education in Thailand is not mandatory although recently the Thai government announced its policy to extend formal education to cover preschool education. Many parents do not have awareness of this policy. National education framework for preschool curriculums is still unclear in terms of learning areas and quality assurance management. Preschool education management in Thailand varies from school to school. Low-income parents pay less concern in preschool education for their children and low educated parents have less engagement of early childhood development. Therefore, this study proposes an electronic learning system for preschool preparation in order to reduce the gap of knowledge among children when starting at the first grade of elementary level since nowadays, the internet and web technologies are widely used.

## Background

Child development can be started from infants to adolescents or teenagers. Four perspectives of child development should be concerned [Cook, 2005; UNICEF, 2001] such as physical development, social and emotional development, intellectual development, and communication and speech development. Children during infancy and early childhood need a lot of supports from their parents or assistants. Parental engagement in early childhood learning will lead to strong foundation of their children's academic development and achievement [Daniel, 2016; Huntsinger, 2016]. Children during early childhood also show some specific characters [Cook, 2005], for example: enjoy learning new skills; learn language rapidly; talk and ask many questions; enjoy co-operative; intuitive thought and respond to reasoning, and symbols in language, artwork, and play. There are also some limitations of children during early childhood such as an inability to use more forms of logic, conservation problems, lack of reversibility, still makes errors of tenses, and fear loss of care. Background knowledge gained during early childhood has potential significance to later learning. Quality of learning and experienced environments from preschool education affect childhood development during elementary education [Broekhuizen, 2016; Buckrop, 2016; Lehl, 2016; Li, 2016]. However, self learning processes are very important for child development. Some findings from the study reported in [Lerikkanen, 2016] claim that better reading skills upon entering schools were associated with a higher level of child-centered teaching practices in the classroom. Nowadays, the Internet and web-based applications are widely used in many activities. Several learning activities have been adopted via the Internet and web technology. Technologies, especially computer-based technologies, have been

successfully used to assist parents involving with their young children's learning [Hall, 2015; Liaw, 2007]. Electronic learning or e-learning is one of these technologies that are often used to deliver learning materials to learners and have potential to enhance child development. Young children are very keen to use computers. However, some factors influencing learner satisfaction for e-learning should be concerned as follows [Sun, 2008]:

- Learner computer anxiety
- Instructor attitude toward e-learning
- E-learning course flexibility
- E-learning course quality
- Perceive usefulness
- Perceive ease of use
- Diversity in assessments

### Case Study

Thai education system [Office of the Education Council, 2013] consists of formal education and non-formal education. Formal education consists of two levels: basic education and higher education. The basic education system called the 6-3-3 formal school system comprises six-year primary education, three-year lower secondary education, and three-year upper secondary education. In addition to the formal school system, vocational education comprises three-year upper secondary education leading to the lower certificate and three-year post secondary education leading to a diploma. The upper secondary level in vocational education is equivalent to the upper secondary level in the formal school system. Twelve years of free education due to the constitution cover from primary education to upper secondary education. The basic education curriculum consists of eight learning areas as follows:

- Thai language
- Mathematics
- Science
- Social studies
- Religion and culture
- Health and physical education
- Arts
- Occupation and technology
- Foreign languages

As mentioned before that preschool curriculums and preschool learning management in Thailand vary from school to school, some learning plans and activities at preschools and kindergartens were investigated via the Internet. The local municipal school, Wat Klong Rian School, was also selected as the case study. This school focuses on activity-based learning and integrated knowledge rather than disciplinary knowledge. Its preschool education is divided into three levels: Level-1 or Anuban-1, Level-2 or Anuban-2, and Level-3 or Anuban-3, offering to children of the age from around 3 years to 5 years. Content design for the proposed system is based on investigated data from reviews, related research, and the case study.

### Proposed System

Since the target goal is to reduce the gap of basic knowledge among children who are starting elementary schools. Therefore the proposed electronic learning system is based on early childhood development or suitable for children of ages around three to six years. Learning activities are under parental guidance or assistance and learning environments for the proposed system can be at homes or nurseries or child care centers or schools where the Internet is available. Some knowledge from our case studies is also taken to account. Many preschool kindergartens in Thailand design their curriculums divided into core learning areas such as Thai language, Mathematics, English, Science, Social Studies while some schools focus on activity-based learning with integrated knowledge for real world activities. Figure 1 shows the system conceptual framework and Figure 2 shows the system use-cases from an analysis process.

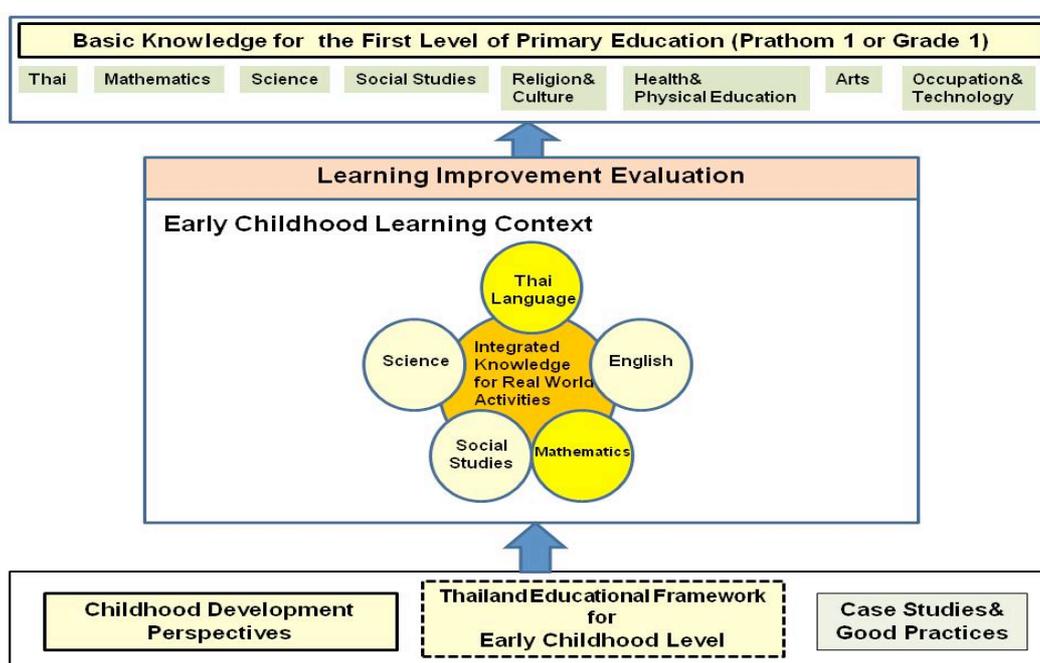


Figure 1: The system conceptual framework

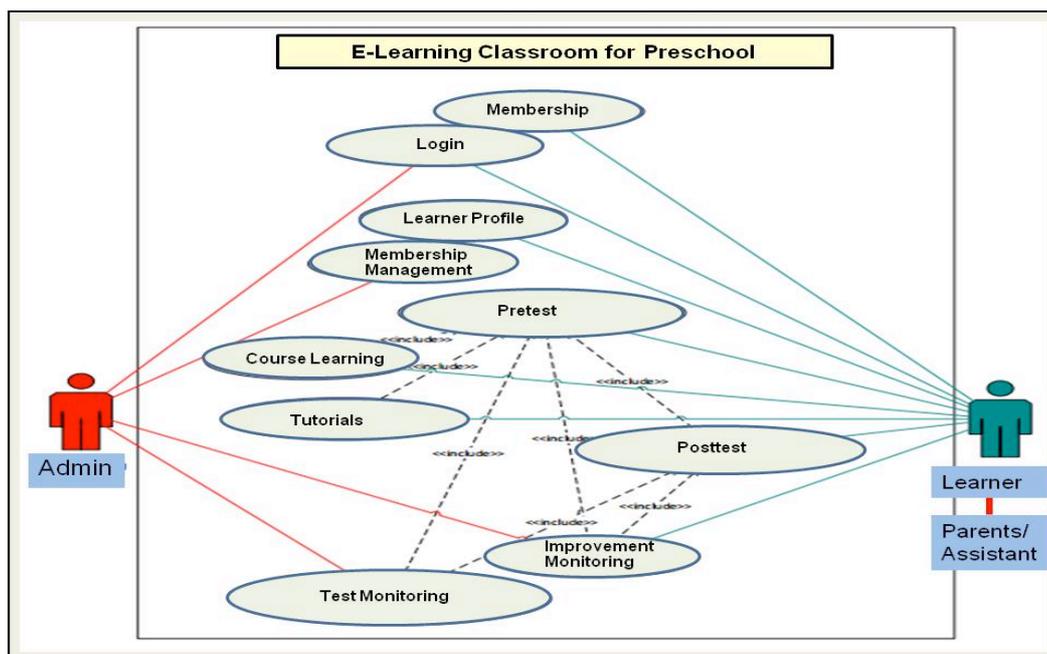


Figure 2: The system use-cases

## Results

The proposed system was prototyped according to the conceptual framework and two learning areas: Thai language and Mathematics were selected as the pilot study. Three levels of preschool kindergarten, Level 1 to Level 3, were analyzed and designed for the selected learning areas. Learning materials consist of the learning contents for children and the parental guide. Since English is not mother-tongue and an official language in Thailand, all user interfaces were designed using mainly Thai language. Figure 3 shows the menu for selecting a learning level while Figure 4 shows the menu for selecting a learning area. Some examples of the user interfaces for learning Thai language as shown in Figure 5 to Figure 8. Figure 9 to Figure 13 show some examples of the user interfaces for learning Mathematics. Parents or assistants can monitor the learning improvement of their children from the pre-test and post-test bar graphs as shown in Figure 14.



Figure 3: The menu of learning level selection



Figure 4: The menu of learning area selection

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Figure 5: The menu of Thai alphabet listening

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Figure 6: The menu of Thai alphabet reading

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Figure 7: The menu of Thai alphabet writing

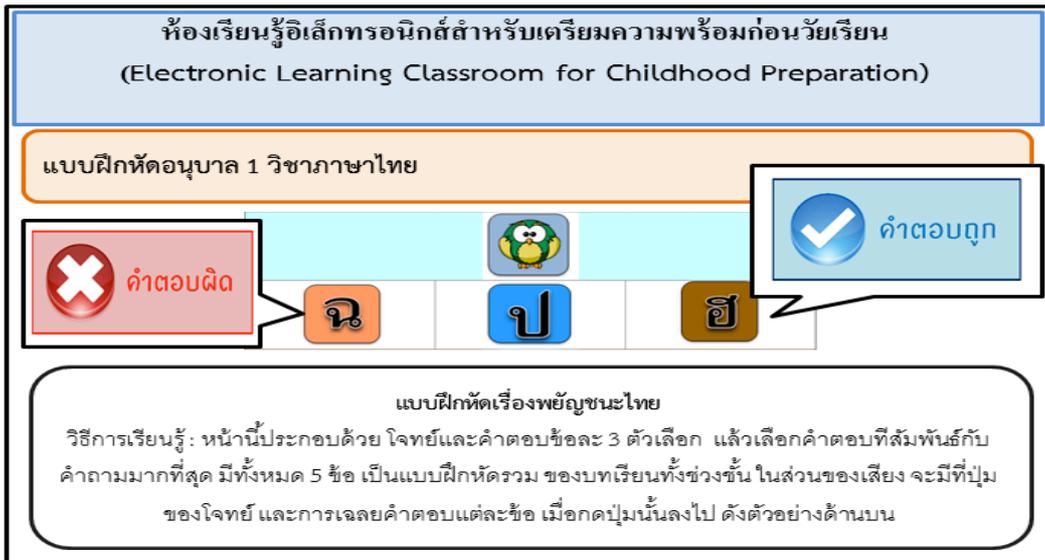


Figure 8: The menu of Thai language exercise

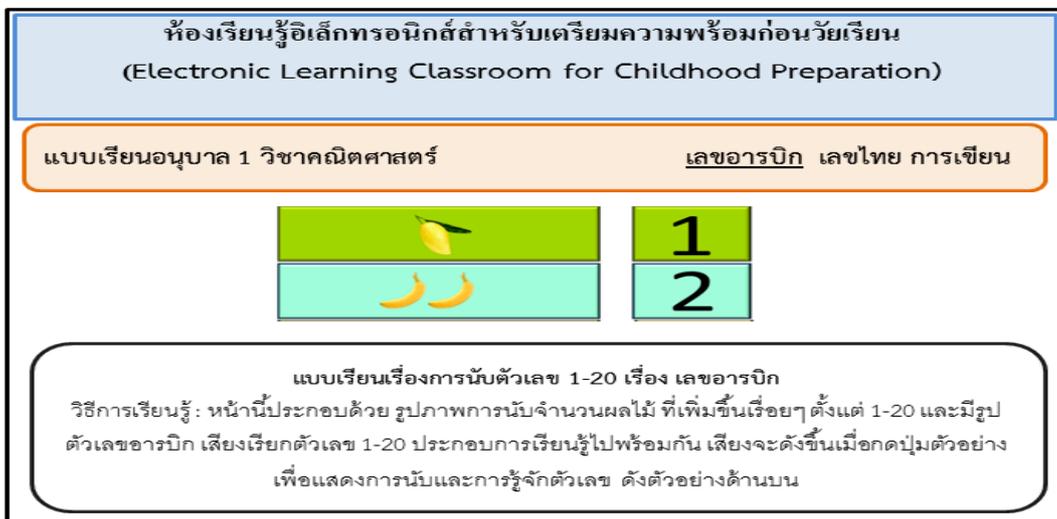


Figure 9: The menu for learning Arabic numbers

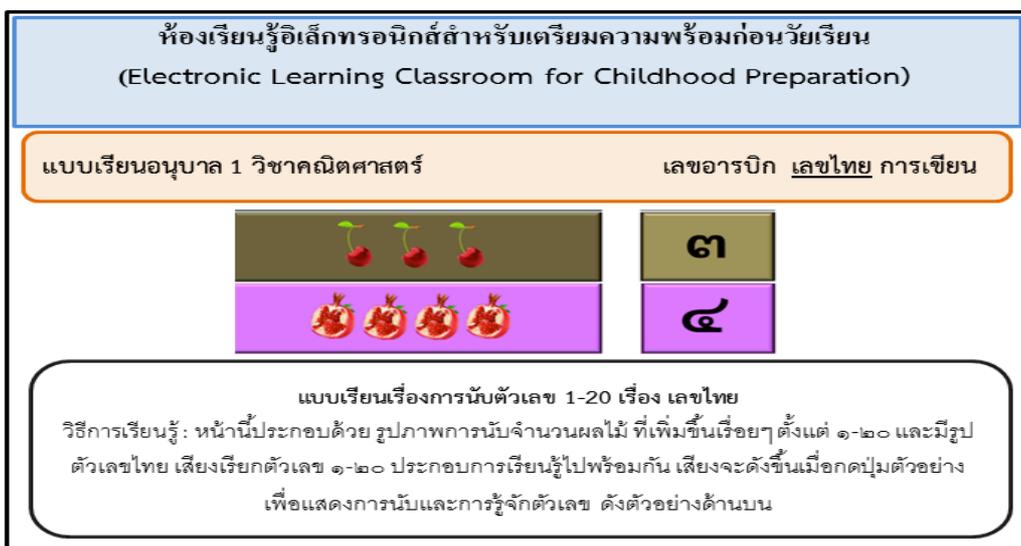


Figure 10: The menu for learning Thai numbers

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แบบเรียนอนุบาล 1 วิชาคณิตศาสตร์ เลขอารบิก เลขไทย การเขียน

เลขอารบิก



เลขไทย



แบบเรียนเรื่องการนับตัวเลข 1-20 เรื่อง การเขียน  
วิธีการเรียนรู้: หน้านี้ประกอบด้วย วิธีการเขียนตัวเลขแบบวนตั้งแต่ ๑-๒๐ ที่มีทั้งเลขอารบิกและเลขไทยที่อยู่คู่กัน เพื่อแสดงวิธีการเขียนตัวเลข 1-20 เป็นตัวอย่างที่ถูกต้อง ดังตัวอย่างด้านบน

Figure 11: The menu for learning Arabic and Thai numbers

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แบบเรียนอนุบาล 3 วิชาคณิตศาสตร์ การเปรียบเทียบ เครื่องหมาย การบวก การลบ

ยาว - สั้น

ไม้บรรทัด



ดินสอ

ไม้บรรทัด ยาวกว่า ดินสอ

ดินสอ สั้นกว่า ไม้บรรทัด

แบบเรียนเรื่องการเปรียบเทียบ เครื่องหมาย การบวกและการลบ หน้า การเปรียบเทียบ  
วิธีการเรียนรู้: หน้านี้ประกอบด้วย คำห้วข้อการเปรียบเทียบพื้นฐาน 6 แบบ ซึ่งมีภาพ 2 อย่างเปรียบเทียบกันและมีเสียงบรรยายประกอบการเรียนรู้ เพื่อให้เห็นความต่างและเข้าใจในความหมายของคำทั้ง 2 ได้ดีขึ้น เช่น ไม้บรรทัด ยาวกว่า ดินสอ เป็นต้น

Figure 12: The menu for learning comparison in Mathematics

**ห้องเรียนรู้อิเล็กทรอนิกส์สำหรับเตรียมความพร้อมก่อนวัยเรียน**  
(Electronic Learning Classroom for Childhood Preparation)

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Figure 13: The menu for learning relational symbols in Mathematics.

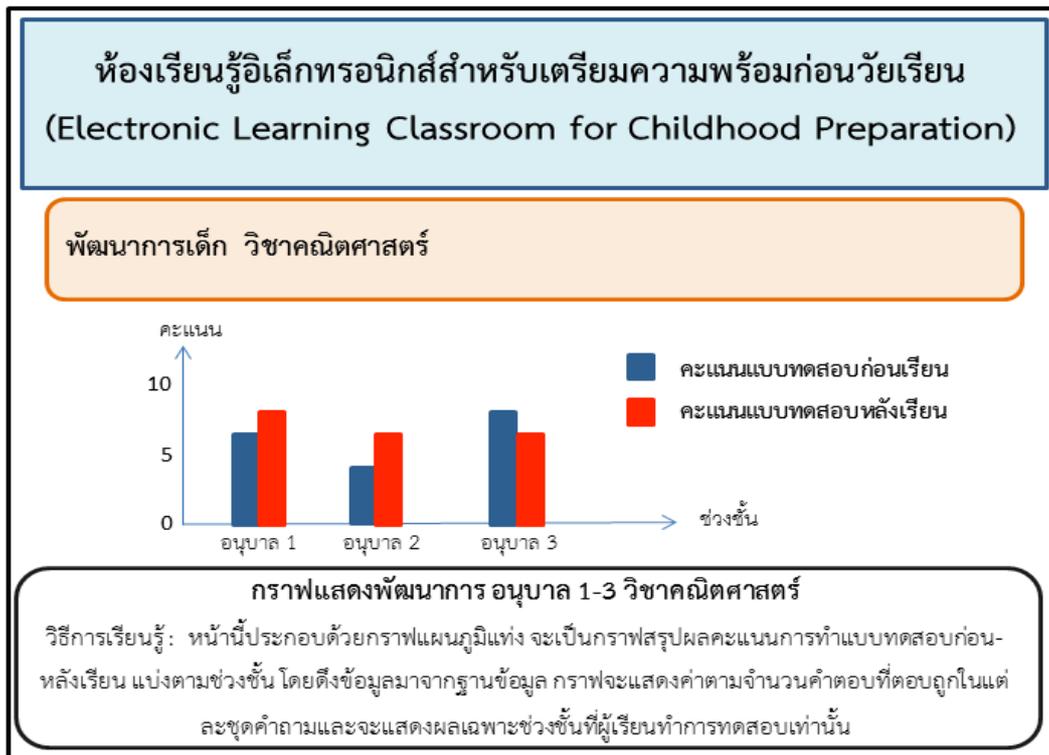


Figure 14: The menu for monitoring learning improvement.

## Conclusion

The proposed system aims to support e-learning environments in order to reduce the gap of knowledge among children who starting the first elementary level in primary schools in Thailand. The system should be adopted under parental guidance or assistance. E-learning environments for the system can be in the formal schools or child care centers or at homes. The pilot study consists of two learning areas: Thai language and Mathematics. Each learning area is divided into three levels of preschool learning: level-1 to level-3 and suitable for children of the age from 3 to 5 years. Learning materials consist of learning contents and parents' guide. The pilot study will be evaluated as the empirical evaluation and more learning areas will be added to the system in future.

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***Bomb Squad©- The Development and Evaluation of A Dual Play Online Virtual Reality Game That Incorporates Collaborative Problem-Solving Mechanism for Physics Education***

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The Asian Conference on Society, Education & Technology 2016  
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**Abstract**

Compared to the traditional lectures and practice in science education, educational games that integrate simulation and manipulation with game-based learning theories may enhance learners' understanding of abstract scientific concepts and their learning motivation. Collaborative problem-solving, CPS, is one teaching strategy that has been emphasized by many learner-centered instructions. The scientific educational games that incorporate CPS may promote learners' discussions and understandings of scientific concepts by peer online interaction in a problem-solving process.

Therefore, this study aims to adopt physics engine to develop an online game, *Bomb Squad* ©, in which two learners play as the members of a bomb disposal team in a 3D virtual reality. Clues related to physics knowledge for bomb disposal can be found in the game and the players need to solve the problems by collaboratively manipulating the objects in the game for the correct mechanics phenomenon. The learners can exchange the clues they found in the online discussion room and use classical mechanics theories for bomb disposal collaboratively. Forty-one high school students participated in this study. The results showed that the learners' learning effectiveness related to physics knowledge was enhanced and they had high degree of acceptance and involvement in the game.

Keywords: Game-based learning, simulation and manipulation, collaborative problem-solving, virtual reality game, physics education

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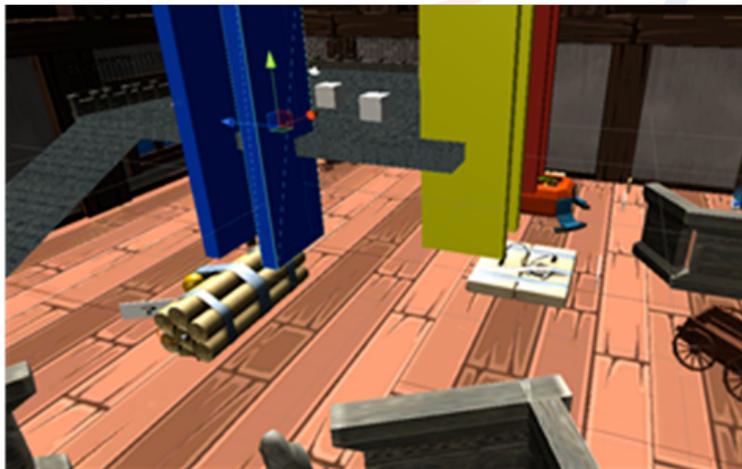
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## Introduction

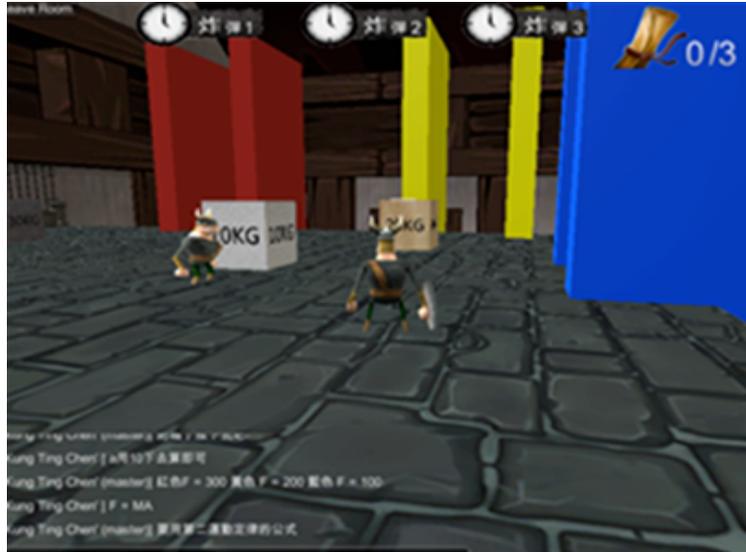
In recent years, game-based learning has been widely applied in education (Annetta, 2010), and it has become the trend in the future innovative teaching. Compared to the traditional lectures and practice in science education, educational games that integrate simulation and manipulation with game-based learning theories may enhance learners' understanding of abstract scientific concepts and their learning motivation. Collaborative problem solving, CPS, is one teaching strategy that has been emphasized by many learner-centered instructions. The scientific educational games that incorporate CPS may promote learners' discussions and understandings of scientific concepts by peer online interaction in a problem-solving process.

Therefore, this study aims to adopt physics engine to develop an online game, *Bomb Squad* ©, in which two learners play as the members of a bomb disposal team in a 3D virtual reality. Clues related to physics knowledge for bomb disposal can be found in the game and the players need to solve the problems by collaboratively manipulating the objects in the game for the correct mechanics phenomenon. The learners can exchange the clues they found in the online discussion room and use classical mechanics theories for bomb disposal collaboratively. (As shown in Figure1 and 2)

The context designed in this game encourages the learners to solve problems together and see the viewpoints from peers. The game also helps the development of collaboration ability by encouraging the learners' creativity and the possible solutions based on critical thinking (Lee, Parsons, Kwon, Kim, Petrova, Jeong & Ryu, 2016). In this game, the player needs to remove bombs by understanding and analyzing the object weights and the calculation of gravitational acceleration. The study will preliminary analyze the learners' learning effectiveness after the game.



**Figure 1. The game interface for two players to solve problems through online cooperation in Bomb Squad**



**Figure 2. The players were removing the bomb by discussing and manipulating different mechanics phenomena**

### Method

Participants in this study were 41 senior high school students in northern Taiwan (24 males, 17 females, their average age was 15.07). The learners' flow were evaluated with the questionnaire developed by Kiili (2006). The Chinese version of the questionnaire was translated and edited by Hou and Chou (2012), mainly focusing the two dimensions of flow antecedent and flow experience.

The learners' technology acceptance was evaluated with the scale by Davis (1989), including two main dimensions of perceived usefulness and perceived ease of use. Both questionnaires were Likert five-point scales, with 23 questions for the flow and six questions for technology acceptance. According to the sample collected in this study, the reliability of the technology acceptance questionnaire (Cronbach's  $\alpha=0.95$ ) and of the flow questionnaire (Cronbach's  $\alpha=0.85$ ) showed high internal consistency.

The pretest and posttest with the same content were applied for the evaluation of learning effectiveness. The testing materials were adapted from the past college entrance exam in Taiwan, including 20 questions related to the knowledge of Newton's laws of motion. The reliability of the pretest and the posttest was Cronbach's  $\alpha=0.745$ . The participants firstly had the pretest (15 minutes), and played the game (30 minutes), which was followed by the posttest (15 minutes) and the technology acceptance questionnaire and the flow questionnaire (10 minutes).

## Results and Discussions

To evaluate the learners' learning effectiveness, a paired-samples t-test was used to compare the pretest and posttest. The results (see Table 1) showed that the students' posttest scores were higher than their pretest scores, suggesting that this game improved the learners' knowledge of Newton's laws of motion. The study further divided the students into high and low achievers based on whether their posttest scores lied within the first 27% or the last 27% of all the participants for an independent t-test. The results showed no significant difference in their flow and technology acceptance, and this game thus helped raise learners' motivation despite their different levels.

As for the flow and technology acceptance (see Table 2), the mean of the overall flow scores was 3.79 (3.8 for the flow antecedent and 3.79 for the flow experience). The mean of technology acceptance was 3.56 (3.59 for the perceived usefulness and 3.51 for the perceived ease of use). All of them were higher than the median 3 in the Likert scale. These results showed that the learners could get involved in the game and have high acceptance. Furthermore, the results of the independent t-test showed no significant difference between males and females in their technology acceptance and flow. Last, a positive correlation was found between the overall technology acceptance and the overall flow ( $r=.70$ ), which suggested that the learners' technology acceptance may possibly relate to the degree of their involvement in the game.

**Table 1. Pair t-test for pre- and post test**

Variable	Posttest (n=41)		Pretest (n=41)		<i>t</i> (36)	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Posttest–Pretest	77.32	16.00	73.05	15.656	21.85	.022

**Table 2. Descriptive analysis of flow and technology acceptance**

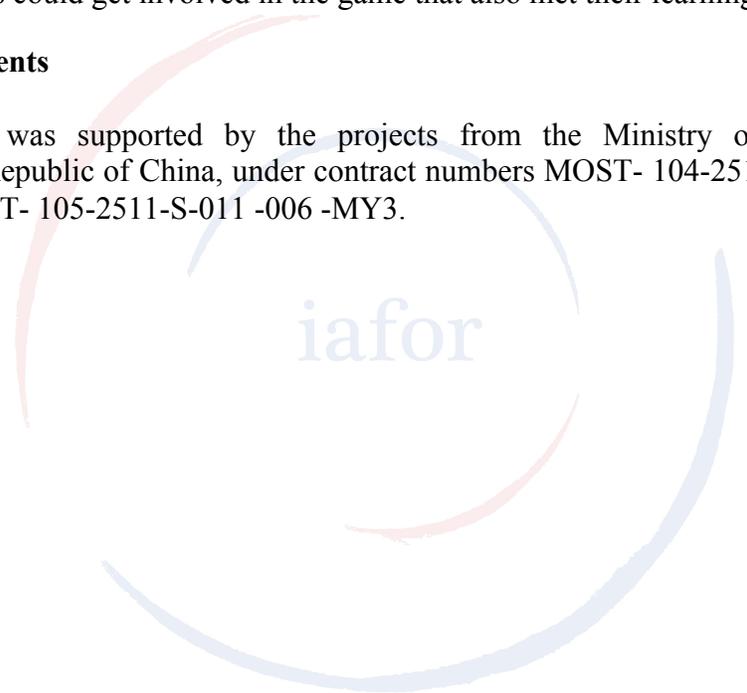
	<i>M</i>	<i>SD</i>
Usefulness	3.5976	.80986
Ease of Use	3.5122	1.01132
TAM	3.5610	.81403
Game Elements	3.6280	.81800
Flow Antecedents	3.8000	.81394
Flow Experience	3.7907	.82414
Flow	3.7949	.77267

## **Conclusion and Suggestions**

The study designed and developed a 3D educational game for physics instruction that integrated cooperation learning with the physics engine of unity, Bomb Squad ©. The study found that this collaborative learning game helped improve the learners' knowledge of Newton's laws of motion according to the learners' higher posttest scores. The game used the two-player dialogue and the mutual help modes to encourage problem solving in collaboration. The players followed the rules and find the clues in the game to remove the bombs, and they could be more familiar with the issue and had better learning performance with their received feedbacks as cognitive scaffoldings. The results showed that the average scores of the overall flow, technology acceptance, perceived usefulness, and perceived ease of use were all above the median. This suggested that the content of the game and the easiness to handle the game were highly accepted by the learners, so that the learners could get involved in the game that also met their learning needs.

## **Acknowledgments**

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The logo for 'iafor' is centered on the page. It consists of the lowercase letters 'iafor' in a light blue, sans-serif font. The text is surrounded by several overlapping, semi-transparent circular arcs in shades of red, orange, and blue, creating a dynamic, circular graphic effect.

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***The Effects of Stem Integrated into Marine Science Issues on Junior High School Students' Learning Motivation, Learning Interest, and Learning Achievement***

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The Asian Conference on Society, Education & Technology 2016  
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**Abstract**

STEM education is an integrated concept of mixing Science, Technology, Engineering, and Math fields. The purpose of this study was to explore the effects of STEM integrated into marine science issue on junior high school students' learning motivation, learning interest, and learning achievement. The experimental research method was employed. Two classes of ninth graders were selected from a public Junior High School in Keelung. One class is control group (29 students), using traditional teaching method. One class is experiment group (21 students), using STEM integrated into teaching on earth science course. Both classes had 12 lessons about marine science issue for teaching experiment during one month. Research tools consisted of questionnaires about learning motivation and learning interest and used the test to understand students' achievement, of which the data were analyzed by SPSS. Hope the study can prove that the STEM education with features such as collaborative learning, learning by doing, and connecting life experience can increase students' learning motivation, learning interest, and learning achievement of marine science.

Keywords: STEM education, Marine science, Learning motivation, Learning interest, Learning achievement

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## I. Introduction

### 1.1 General Background Information

With the rapid development of science and technology, all the countries in the world have entered the "knowledge society" system. The "knowledge workers" who can collate, analyze and innovate the knowledge and information will be important talents in the new century and new society. This critical talent affects the development of the country's economy, and the capabilities it requires are summarized as "critical capabilities in the 21st century," the so-called 4C: "critical thinking and problem solving", " Effective communication ", " collaboration and building ", " creativity and innovation ".

In response to national development, personnel training needs, the United States National Science Council (NSB) in 1986 proposed STEM teaching mode, in 2014 President Obama promoted "STEM national talent cultivation strategy", by education strategy change to enhance National competitiveness. STEM teaching model is a combination of science, technology, engineering and mathematics. With the aim of design and exploration, the STEM teaching model will solve the problem with scientific technology and scientific thinking. Knowledge and life experience link. On the other hand, students develop good communication skills, teamwork and hands-on skills, as well as independent thinking, with the ability to innovate and create.

Taiwan is an island nation surrounded by the sea, is rich in marine resources. In recent years, the government has paid more and more attention to marine education. In order to cultivate oceanic talents, it is important for the marine education and marine talents cultivation. Therefore, this research takes marine science topics such as marine litter problem which countries attach importance to in recent years as the teaching content, designs teaching flow and teaching material with STEM teaching pattern, and guides students to explore ocean science, analysis and statistical science data, and makes use of technology and technology. Engineering design brain thinking, hands-on devices to solve the problem of marine litter. It also hopes to enhance students' motivation, interest and effectiveness in marine science by discussing exploration, hands-on learning and other learning processes.

### 1.2 Research Purpose and Questions

In this study, we'll investigate STEM integrates marine science issues on Junior High School Students' learning motivation, learning interest and learning outcomes.

The purpose of the study is as follows:

1. Discuss STEM integration of marine science issues on junior high school students' learning motivation in marine science.
2. Discuss STEM integration of marine science issues on junior high school students' learning interest in marine science.
3. Discuss STEM integration of marine science issues on junior high school students' learning achievement in marine science.

The following questions are addressed in this study:

1. What is the impact of STEM integration of marine science issues on junior high school students' learning motivation in marine science?

2. What is the impact of STEM integration of marine science issues on junior high school students' learning interest in marine science?
3. What is the impact of STEM integration of marine science issues on junior high school students' learning achievement in marine science?

### 1.3 Interpretation of the Terms

#### 1. Learning Motivation

In this study, marine science learning motivation is measured by the score in the "STEM Integrated into Marine Science on Junior High School Students' Learning Motivation" Scale. The contents include Attention, Relevance, Confidence and Satisfaction. The "STEM Integrated into Marine Science on Junior High School Students' Learning Motivation" scale options are divided into five items: 1 point, 2 points, 3 points, 4 points and 5 points, which are very disagree, disagree, general, agree and agree with each other. Finally, calculated the scale score of the subjects. The higher the score, the higher the level of recognition of the subjects.

#### 2. Learning Interest

In this study, marine science learning motivation is measured by the score in the "STEM Integrated into Marine Science on Junior High School Students' Learning Interest" Scale. It includes the feelings of learning marine science, the cognition of learning marine science and the performance of learning marine science. The "STEM Integrated into Marine Science on Junior High School Students' Learning Interest" scale options are divided into five items: 1 point, 2 points, 3 points, 4 points and 5 points, which are very disagree, disagree, general, agree and agree with each other. Finally, calculated the scale score of the subjects. The higher the score, the higher the level of recognition of the subject

#### 3. Learning Achievement

This research is based on the publication of "Tidal Environment Monthly" published by National Marine Science and Technology Museum (2014,01), "Little Duckling Team Surrounded by the World" (2013), Higher Education Publication (edited by National Taiwan Ocean University) (2012), "One Ocean" (2012) Guide to environmental literacy and foreign language literature and 95 to 104 years of high school test topic content, divided into two parts, one for the choice of test Part, are single-choice questions; two for the concept of the book to write part of the list of 50 marine scientific concepts vocabulary students to check, in accordance with the content of the class and the marine vocabulary known in the table to do 5 questions proposition sentences, each proposition sentences A minimum of 2 vocabulary should be included in the questionnaire. The latter is graded according to three dimensions of Stoddart et al. (2000) openness proposition: correctness, interpretability, and propositional structure. Each dimension has a maximum of 5 points and a minimum of 0 points.

(1) correctness: according to "scientific correctness", "general knowledge", "affective", "incorrect" four options to determine the points.

(2) Explanatory: According to "high interpretation", "descriptive" two options to determine the points.

(3) proposition structure: According to the "double", "simple" two options to determine the points.

Examples of scoring are shown in Table 1.

**Table 1**

## Examples of scoring

Variables	classification	Examples	score
correctness	Scientific correctness	The deeper the water, the lower the light transmittance.	5
	General knowledge	Corals live in the sea.	3
	Affection	The lionfish is beautiful.	1
	Inaccuracy	Crocodiles are fish.	0
Explanatory	Highly explained	Sea-level rise is mainly caused by ocean warming sea warming, resulting in rising sea. In addition, the sea iceberg melting will not lead to sea-level rise. But melting glaciers on land or ice sheets will cause sea-level rise.	5
	Descriptive	Deep-sea fish have a lantern-like light body.	3
proposition structure	Duplex	Cetaceans are marine animals.	5
	Simple type	There is fish in the sea.	3
total			0~15

**1.4 Method****1. Quasi-Experimental Research**

In this study, quasi-experimental study method, including four types of variables: the independent variable, covariant, control variables and dependent variables. The experimental group was given STEM teaching and the control group was taught by narrative style. The covariant term is a variable enough to affect the experimental results, and the influence of the statistical control method of the covariant analysis is eliminated to minimize the experimental error. The covariant items in this study are learning motivation, learning interest scale and learning achievement Pre-test scores and the results of the previous semester's Earth Science Achievement Test. The control variable is to reduce the other factors interfere with the experiment, must be controlled factors, the study for the student level, teaching time, teaching materials, teaching progress and teaching. There are three dependent variables, including marine science learning motivation, marine science learning interest, marine science learning effectiveness.

**2. Questionnaire Method**

In order to understand the impact of STEM integration into marine science on learning motivation, learning interest and learning achievement, the first draft of the questionnaire was compiled according to the results of literature analysis, and the students in the ninth grade of public middle school in Keelung City were selected as subjects. Scale "and" Marine Science Learning Outcomes Questionnaire ". After the consultation by the expert opinion and pre-test results and revised to prepare a formal

questionnaire survey.

## II. Literature Review

### 2.1 STEM Education

STEM education was first originated in 1986 the United States. In the 1980s, the United States realized that the shortage of science and technology education caused the shortage of talents in the country. In 1986, the United States National Science Board (NSB) proposed the concept of STEM education integrated by science, technology, engineering and mathematics. The purpose is to train scientific and technological talents to enhance the national competitiveness (Liu Dong, Wu Junjie, Xie Zuoru, Juan, 2013). In 2001, the United States "no children lag behind" the concept of prevalence, more emphasis on the US government to promote STEM education motivation. In 2006, the US Competitiveness Program considered the development of STEM talent as the goal of today's knowledge-based economy and the key to national competitiveness (United States Domestic Policy Council, 2006). US President Barack Obama in 2014, the implementation of "STEM national talent cultivation strategy", highlights the US government emphasis on STEM education upgrade.

With the advent of the new generation, the traditional teaching mode can not meet the needs of national talent cultivation. Although the current mode of education in Taiwan is gradually changing, the majority of teachers are still teaching and learning as the main target. Teachers to teach students to test, students in order to test and learn, the knowledge can not be applied flexibly in daily life and future work, resulting in students can not successfully enter the workplace after graduation, the workplace shortage of talent after another. The main purpose of STEM education is to help students move away from fragmented and fragmented learning and memorizing processes, transforming the knowledge and mechanical processes learned by students into a process of exploring the interconnectedness of different worlds (Zhao Zhongjian, 2012: While education). STEM education is different from the previous sub-class, and inter-disciplinary approach to the integration of teaching. Division teaching easy to make students can not be all subjects of knowledge coherence, application, thinking is also more closed. Students can apply their knowledge to various fields, so that students brainstorming, to promote thinking, enhance innovation, creativity, creativity. In addition, STEM education emphasizes the link between theory and real society and life experience, which will enable students to improve learning motivation and interest, and work smoothly with the work. On the other hand, STEM education emphasizes teamwork, in order to cope with future employment trends, in the group discussion to learn the division of labor, mutual cooperation, good communication, but also implement the "No child left behind" educational philosophy. Finally, STEM education, interdisciplinary integration, and life experience, teamwork and other teaching characteristics, and then with the core of STEM education - hands-on, so that students can become key capabilities with the 21st century - critical thinking and problem-solving, effective communication, The team to create, create and innovate the future of national talent.

In this study, STEM was integrated into the marine science topic. The experimental teaching of the ninth grade students was supplemented by questionnaire and questionnaire.

## 2.2 The Meaning of Marine Science Education

In recent years, the world in science and technology continue to explore the ocean to explore their ability to enhance the understanding of marine ecology and the environment, in order to respond to the 21st century "blue revolution", Taiwan's economy towards knowledge-based economy and innovation in economic development, marine-related industries Began to transition, the traditional marine industry gradually developed into the experience of service-oriented or high-tech industries, so the needs of professionals in the industry needs and the original content is also different. The development of marine education in Taiwan, hoping to strengthen the school students at all levels of marine literacy, and then cultivate the industry needed high-quality talent (Ministry of Education, 2007).

At the primary and secondary levels, marine education is based on marine basic education knowledge, and its implications are mainly in the areas of natural and applied science (Ministry of Education, 2007). In 2008, the Ministry of Education promulgated the "Nine-Year Curriculum for National Primary and Secondary Schools" (Marine Education), which divides marine education into five thematic axes - marine recreation, marine society, marine culture, marine science and marine resources (Ministry of Education, 2008). It is hoped that students will be able to improve their marine scientific literacy through marine science education, so that students will learn to use the principles and skills of marine science and technology to solve their daily problems in the process of solving problems (Luo Lunxin, Zhang Zhengjie, Tong Yuanpin, Yang Wenzheng, 2013).

The marine science education defined in this study refers to the marine science education in the oceanic subject axis (marine recreation, maritime society, marine culture, marine science, marine resources) of the "Outline of marine education for national primary and secondary schools" proposed by the Ministry of Education in 2008. Marine Science and Ocean Resources. Its sub-categories include "Marine Geology and Chemistry", "Marine Geology and Geology", "Marine Meteorology", "Marine Applied Science", "Marine Foods", "Biological Resources", "Non-living Resources", "Environmental Protection and Conservation "(Ministry of Education, 2008).

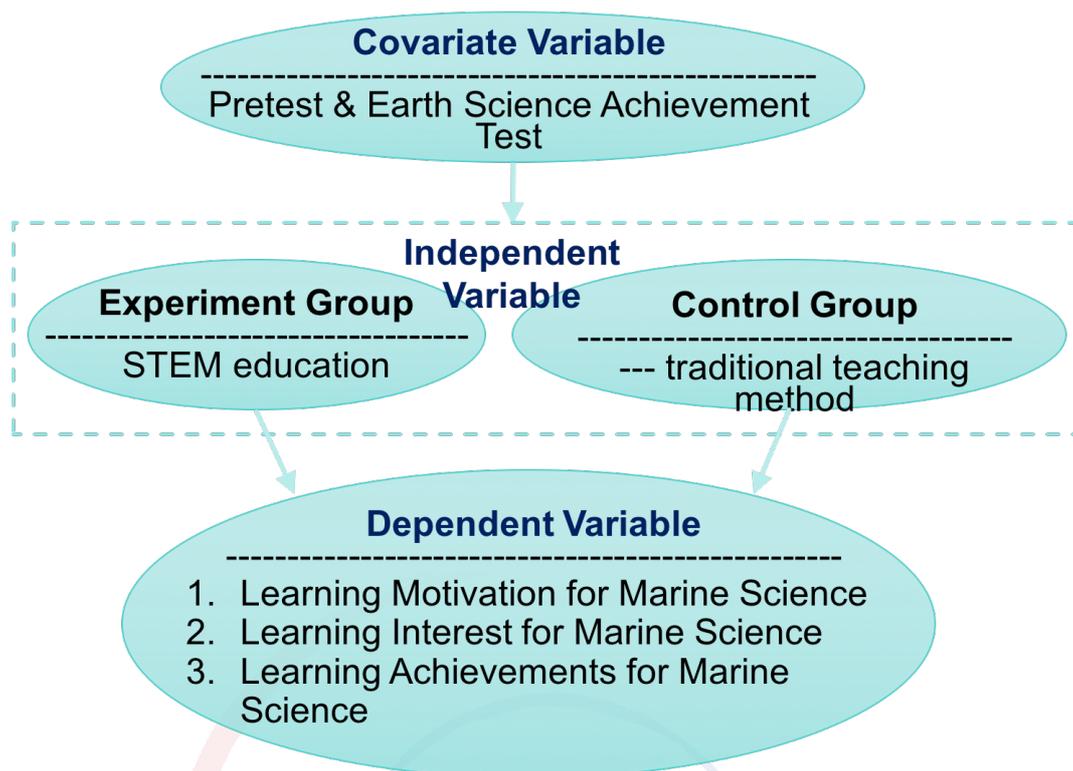
## III. Research Design

### 3.1 Research Framework

The purpose of this study is to understand the impact of integrating STEM education into marine science topics on the learning motivation, learning interest and learning outcomes of junior middle school students. The experiment group and the control group were designed. The experiment group used the STEM teaching mode, and the control group adopted the traditional general teaching method. The two groups were tested before the experiment as the basis. The structure of this study is as follows:

#### Figure 2

STEM into the marine science issues on the students learning motivation, learning interest and learning effectiveness of the impact of the structure diagram.



### 3.2 Research Subjects

In this study, a group of 9 students in a public middle school in Keelung City were enrolled in this study. There were 20 subjects in the experimental group and 27 in the control group.

### 3.3 Research Instrument

According to the purpose and problem of this study, the research tools used were "STEM Teaching Program", "Narrative Teaching Program", "Marine Science Learning Motivation Scale", "Marine Science Learning Interest Scale" And "Marine Science Learning Achievement Test Questions - Selection Question and Concept Map Assessment". The following is a description of the research tools.

#### 3.3.1 STEM Teaching Program

The STEM Teaching Program was designed by the present researchers and implemented in the Earth Science course in the ninth semester of the middle school year. The purpose of the course is to enable students to learn marine science knowledge from life experiences and apply the knowledge acquired in past biology, physics and chemistry, mathematics and life science and technology courses. In the classroom, a cooperative learning and reward system will be adopted and students will be encouraged to create a "trash bin" device in the hope of enhancing students' learning motivation, learning interest and learning through interdisciplinary integration, group discussion and publication and hands-on learning. Effectiveness.

Teaching implementation phase of six weeks, two sessions per week, a total of twelve classes. The first week is "The importance of the ocean, the relationship between the sea and the human race", the second week is "ocean currents and circulation", the third week is "exploring marine litter", the fourth week is "marine trash knowledge and influence" And the sixth week as "hands-on preparation of marine trash," to guide

students to think and discuss issues, develop students good communication, use the knowledge to solve problems and hands-on ability.

### **3.3.2 Narrative Teaching Program**

In addition to the different teaching methods, the rest of the conditions are the same, the same six-week course, but also the use of cooperative learning and incentive system. But the curriculum design does not emphasize the relevance of curriculum knowledge and life experience, but also not included in mathematical computing, biological knowledge and hands-on content.

### **3.3.3 Marine Science Learning Motivation Scale**

This research tool is based on the dimensions of a certain research scale, and then develops the marine science learning motivation scale of this research. The scale was based on the Likert Five-Point Scale, and students chose "very agree", "agree", "normal", "disagree" or "strongly disagree" according to the topic. The scale contains four dimensions, Attention, Relevance, Confidence, and Satisfaction.

(1) Expert review: After the preparation of the first draft of the research tool, in order to improve the content of the letter and effect, discussed with the instructor, compiled into an expert questionnaire. First, the expert validity questionnaires are printed to explain the purpose, structure and method of the study. Five experts and five middle school teachers are invited to the field of marine sciences education. In view of the content, title and description of the questionnaire, to provide advice, recovery expert validity questionnaire, and then in accordance with the evaluation of scholars and teachers to provide the views of the aggregation, after confirmation of the preparation is completed, then pre-test.

(2) Pre-test: In this study, the learning motivation scale pre-test selection of experimental group and control group of students outside the pre-test, issued a sample of 122, 122 were recovered, the recovery rate of 100%.

(3) Validity: In order to understand the construction validity of the learning motivation scale, the scale was analyzed by factor analysis. The Kaiser-Meyer-Olkin (KMO) sampling suitability and the Bartlett's spherical test show that the scale can be analyzed by factor analysis. According to Kaiser (1974), if the KMO value is less than 0.5, (Wu Minglong, 2009), the results of the scale of the KMO sampling suitability for the number of .938, shows that the number of samples is sufficient, and Bartlett's spherical test of significant (see Wu Minglong, 2009), Showing that the factors between the mutually exclusive exclusion, it can be factor analysis.

(4) In this study, Cronbach's  $\alpha$  coefficient was used to test the internal consistency of the scale and subscale. The Cronbach's  $\alpha$  value of the formal pre-test questionnaire was: (1) Attention 0.876 (2) Relevant 0.851 (3) Confidence 0.839 (4) Satisfied with 0.921, the total scale was 0.952, all above .83, so the scale internal consistency can be accepted.

**Table 2**  
The Reliability of Learning Motivation

<b>Dimensions</b>	<b><math>\alpha</math>Value</b>	<b>Number of questions</b>
<b>Attention</b>	.876	5
<b>Related</b>	.851	4
<b>Confidence</b>	.839	3
<b>Satisfy</b>	.921	5
<b>Total</b>	.952	17

### 3.3.4 Marine Science Learning Interest Scale

The Likert 5-point scale was used in this study. Students chose "very agree", "agree", "normal", "disagree" or "strongly disagree" according to the topic. This scale includes 11 topics, namely, "feelings of the ocean", "knowledge of the sea" and "performance of the department." This scale was reviewed together with the Marine Science Learning Motivation Scale. After the deletion of the unsuitable items, the questionnaires were compiled into a formal questionnaire and pre-tested in conjunction with the Marine Science Learning Motivation Scale. The following is the reliability and validity of this scale:

(1) Validity: The scale of the KMO sampling suitability of the amount of .916, shows the number of samples is sufficient, and Bartlett's spherical test of significant, showing the independent mutex between the various factors, it can be factor analysis.

(2) Reliability test: Cronbach's  $\alpha$  value of the formal pre-test questionnaire in the three-dimensional study of the sea of interest, respectively (1) the feelings of the ocean feelings 0.882 (2) of the marine knowledge 0.954 (3) marine scientific performance 0.875, the total scale of 0.932, are up to .88 or more, so the scale internal consistency can be accepted.

**Table 3**  
Reliability of learning interest scale

Dimensions	$\alpha$ Value	Number of questions
Feelings about the ocean	.882	3
Cognition of marine science	.954	4
Action to marine science	.875	4
<b>Total</b>	.932	11

To sum up, this study of learning motivation, learning interest scale letter appropriate degree, as shown in the table below.

**Table 4**  
The variables and their facets were studied, and the statistical tables of variance and reliability were extracted.

Study Variables	Dimensions	Extraction Variance	Combined Reliability
Marine Science Learning motivation	Attention	0.8199	0.9578
	Related	0.8227	0.9329
	Confidence	0.8040	0.9249
	Satisfy	0.8254	0.9594
Marine Science Learning interest	Feelings about the ocean	0.7762	0.9121
	Cognition of marine science	0.8284	0.9507
	Action to marine science	0.7452	0.9221

### 3.3.5 Marine Science Learning Achievement Test Questions - Selection Question and Concept Map Assessment

This research tool is based on the "Tidal Environment" (2014,01) published by the National Marine Science and Technology Museum, the "Little Duckling Team Surrounded by the World" (2013), published by Higher Education (edited by National Taiwan Ocean University Professor) (2012), National Geographic published "One Ocean" (2012) environmental literacy teaching guide foreign language literature and 95 ~ 104 years high school learning topic content development. The questionnaires are divided into two major parts. They are: (1) Marine Science Learning Outcomes Questionnaire - 15 questions, divided into three major dimensions: "Memory", 4 questions, "Understanding", 4 questions, Thinking, "including application, analysis, evaluation and creation, 7 questions. (2) Questionnaire of marine science learning performance - concept map type, divided into three major dimensions: "correctness", "explanatory", "proposition structure".

After the preparation of the first draft of the above research tools, in order to improve

the content of the letter and effect, after discussion with the instructor, compiled into an expert questionnaire. First, the expert validity questionnaires are printed to explain the purpose, structure and method of the study. Five experts and five middle school teachers in the field of marine sciences education are invited to study the content, title, and description of the questionnaire. To provide advice, recovery expert validity questionnaire, and then in accordance with the evaluation of scholars and teachers to provide the views of the aggregation, after confirmation of the preparation is completed, then pre-test. Pre-test sample to 122 ninth-grade students for the object, the project analysis to delete the inappropriate subject, compiled into a formal questionnaire.

#### IV. Results and Conclusions

##### 4.1 Students with STEM education have high learning motivation then the students with traditional teaching method.

###### 4.1.1 Descriptive statistics

According to the differences of learning motivation scale between the experimental group and the control group, the descriptive statistics obtained by collecting the related data are shown in the table.

**Table 5**

The statistical summary table of learning motivation in the experimental group and the control group.

Dimensions	Category	Number of people	Average	Number of questions	Standard deviation
Attention	Experimental group	20	18.850	5	2.8704
	Control group	27	17.519	5	4.7747
Related	Experimental group	20	15.100	4	2.1250
	Control group	27	13.963	4	3.4023
Confidence	Experimental group	20	12.050	3	1.6051
	Control group	27	10.852	3	2.9313
Satisfy	Experimental group	20	17.350	5	3.4531
	Control group	27	15.926	5	4.8984
Total	Experimental group	20	63.350	17	7.9556
	Control group	27	58.259	17	14.8650

The data in the table shows that the average score of the experimental group in each dimension is higher than that in the control group.

#### 4.1.2 Single Factor Covariant Analysis

For the experimental group and the control group of students learning motivation scale before the test results for the covariates to teaching method for the self-variable, post-test scores for the dependent variable, for single factor covariance analysis, the results are listed in the table, ( $F = 4.216$ ,  $p = .046 < .05$ ), so the hypothesis "experimental group and control group in the attention of the score was no significant difference between the two groups," the study group and the control group in the "learning motivation" Should be rejected. ( $F = 5.771$ ,  $p = .021 < .05$ ). Therefore, the null hypothesis "There was no significant difference in the score between the experimental group and the control group" should be rejected. ( $F = 3.752$ ,  $p = .059 > .05$ ), so the null hypothesis "the experimental group and the control group in the application of the score was no significant difference" should be accepted. ( $F = 5.768$ ,  $p = .021 < .05$ ), the null hypothesis "There was no significant difference in the satisfaction score between the experimental group and the control group" should be rejected. ( $F = 5.871$ ,  $p = .020 < .05$ ), the null hypothesis "There was no significant difference in the total score between the experimental group and the control group" should be rejected. Statistical test results The results of the experimental group and the control group were significantly different in the "attention", "relevant", "satisfaction" and "total score", and the experimental group's performance was better than the control group, only "confidence" did not reach significant difference , Indicating that STEM into marine science on the students in the learning motivation has good results.

**Table 6**

The covariance analysis of learning motivation between experimental and control groups.

Dimensions	Source of variation	Type III squared sum	Degree of freedom	Average sum of squares	F value	Sig
Attention	Between groups (teaching method)	82.260	1	82.260	4.216	.046*
	Group (deviation )	858.545	44	19.512		
Related	Between groups (teaching method)	55.093	1	55.093	5.771	.021*
	Group (deviation )	420.033	44	9.546		
Confidence	Between groups (teaching method)	25.015	1	25.015	3.752	.059
	Group (deviation )	293.393	44	6.668		
Satisfy	Between groups (teaching method)	128.106	1	128.106	5.768	.021*
	Group (deviation )	977.238	44	22.210		

Total	Between groups (teaching method)	1140.390	1	1140.390	5.871	.020*
	Group (deviation )	8545.901	44	194.225		

\* $p < .05$  \*\* $p < .01$  \*\*\* $p < .001$

## 4.2 Students with STEM education have high learning interest then the students with traditional teaching method.

### 4.2.1 Descriptive statistics

According to the differences of learning interest scale between the experimental group and the control group, the descriptive statistics obtained by collecting the related data are shown in the table.

**Table 7**

The statistical summary table of learning interest in the experimental group and the control group.

Dimensions	Category	Number of people	Average	Number of questions	Standard deviation
Feelings about the ocean	Experimental group	20	10.300	3	1.5252
	Control group	27	9.815	3	1.8195
Cognition of marine science	Experimental group	20	15.500	4	2.3283
	Control group	27	14.074	4	3.4633
Action to marine science	Experimental group	20	13.950	4	2.2355
	Control group	27	13.148	4	3.1096
Total	Experimental group	20	39.750	11	4.5408
	Control group	27	37.037	11	7.2985

The data in the table shows that the average score of the experimental group in each dimension is higher than that in the control group.

### 4.2.2 Single Factor Covariant Analysis

For the experimental group and control group students learning interest scale before the test results for the covariates to the teaching method for the self-variable, post-test scores for the dependent variable, for single factor covariance analysis, the results are listed in the table, that There was significant difference between the experimental group and the control group ( $P = .009 < 0.01$ ) in the " feelings about the ocean " in the "learning interest", so there was no hypothesis that the experimental group and the control group Shall not be significantly different "shall be rejected. ( $F = 4.711, p$

= .035 <.05), the null hypothesis "There is no significant difference between the experimental group and the control group in the recognition of the marine sciences" should be rejected . (F = 3.705, p = .061 > .05), the null hypothesis "There was no significant difference between the experimental group and the control group in their scores on the performance of the marine sciences" Should be accepted. (F = 6.320, p = .016 <.05), the null hypothesis "There was no significant difference in the total score between the experimental group and the control group" should be rejected. Statistical test results The results of the experimental and control groups were significantly different in terms of " feelings about the ocean ", " cognition of marine science " and "total score", and the results of the experimental group were superior to those of the control group. "action to marine science "did not reach significant differences, indicating that STEM into marine science on the interest of students in the study have good results.

**Table 8.**  
**The covariance analysis of learning interest between experimental and control groups**

Dimensions	Source of variation	Type III squared sum	Degree of freedom	Average sum of squares	F value	Sig
Feelings about the ocean	Between groups (teaching method)	31.177	1	31.177	7.434	
	Group (deviation )	184.524	44	4.194		
Cognition of marine science	Between groups (teaching method)	48.520	1	48.520	4.711	
	Group (deviation )	453.129	44	10.298		
Action to marine science	Between groups (teaching method)	34.940	1	34.940	3.705	
	Group (deviation )	414.970	44	9.431		
Total	Between groups (teaching method)	339.313	1	339.313	6.320	
	Group (deviation )	2362.461	44	53.692		

\* $p < .05$  \*\* $p < .01$  \*\*\* $p < .001$

### 4.3 Students with STEM education have high learning achievement then the students with traditional teaching method.

#### 4.3.1 Descriptive statistics

According to the differences of learning achievement scale between the experimental group and the control group, the descriptive statistics obtained by collecting the related data are shown in the table.

**Table 9**

The statistical summary table of learning achievement test (1) in the experimental group and the control group.

<b>Dimensions</b>	<b>Category</b>	<b>Number of people</b>	<b>Average</b>	<b>Number of questions</b>	<b>Standard deviation</b>
Memory	Experimental group	20	3.200	4	1.0563
	Control group	27	3.370	4	.9667
Understanding	Experimental group	20	2.900	4	.7182
	Control group	27	3.074	4	.9168
High-level applications	Experimental group	20	4.800	7	1.6416
	Control group	27	3.593	7	1.8451
Total	Experimental group	20	10.900	15	2.8266
	Control group	27	10.037	15	2.6527

From the data in the table, the experimental group in the high-level and total score of the average score, higher than the control group.

**Table 10**

The statistical summary table of learning achievement test (2) in the experimental group and the control group.

Dimensions	Category	Number of people	Average	Number of questions	Standard deviation
Correctness	Experimental group	20	43.650	15	8.5918
	Control group	27	34.815	15	12.5852
Explanatory	Experimental group	20	34.100	15	2.7891
	Control group	27	32.852	15	3.1219
Proposition structure	Experimental group	20	46.650	15	7.7614
	Control group	27	38.407	15	8.9968
Total	Experimental group	20	124.400	15	16.7061
	Control group	27	106.074	15	22.8135

The data in the table shows that the average score of the experimental group in each dimension is higher than that in the control group.

#### 4.3.2 Single Factor Covariant Analysis

For the experimental group and the control group of students learning achievement (a) before the test scores for the covariates to teaching method for the self-variable, post-test scores for the dependent variable, for single factor covariance analysis, the results are listed in the table, ( $F = 0.317$ ,  $p = .576 > .05$ ). Therefore, there is no hypothesis in experiment group and control group in the memory of "learning achievement (a)", and the difference between the experimental group and the control group is not significant. No significant difference in score "should be accepted. ( $F = 0.193$ ,  $p = .663 > .05$ ), so the null hypothesis "experimental group and control group in understanding the score was no significant difference" should be accepted. ( $F = 10.824$ ,  $p = .002 < .01$ ), the null hypothesis "There was no significant difference in the high-level score between the experimental group and the control group" should be rejected. ( $F = 4.319$ ,  $p = .044 < .05$ ). Therefore, the null hypothesis "There was no significant difference in the total score between the experimental group and the control group" should be rejected. Statistical test results The scores of the experimental group and the control group were significantly different between "high level" and "total score", and the scores of the experimental group were better than the control group, only "memory" and "understanding" did not show significant difference, Integration into the marine science on the students in the learning results have good results.

**Table 11**

The covariance analysis of learning achievement test (1) between experimental and control groups

Dimensions	Source of variation	Type III squared sum	Degree of freedom	Average sum of squares	F value	Sig
Memory	Between groups (teaching method)	.312	1	.312	.317	.576
	Group (deviation )	43.246	44	.983		
Understanding	Between groups (teaching method)	.136	1	.136	.193	.663
	Group (deviation )	31.037	44	.705		
High-level applications	Between groups (teaching method)	35.773	1	35.773	10.824	.002**
	Group (deviation )	145.412	44	3.305		
Total	Between groups (teaching method)	33.882	1	33.882	4.319	.044*
	Group (deviation )	345.218	44	7.846		

\* $p < .05$     \*\* $p < .01$     \*\*\* $p < .001$

**Table 12**

The covariance analysis of 1 learning achievement test (2) between experimental and control groups

Dimensions	Source of variation	Type III squared sum	Degree of freedom	Average sum of squares	F value	Sig
Correctness	Between groups (teaching method)	658.060	1	658.060	27.227	.000***
	Group (deviation )	1063.434	1	24.169		
Explanatory	Between groups (teaching method)	34.814	1	34.814	4.210	.046*
	Group (deviation )	363.897	44	8.270		
Proposition structure	Between groups (teaching method)	665.255	1	665.255	18.489	.000***
	Group (deviation )	1583.175	44	35.981		
Total	Between groups (teaching method)	4151.345	1	4151.345	51.291	.000***
	Group (deviation )	3561.267	44	80.938		

\* $p < .05$  \*\* $p < .01$  \*\*\* $p < .001$

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*A Basic Study on a Task-based Style Foreign Language Learning Environment  
Using RFID and a 3DCG Character*

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**Abstract**

This paper presents a method of integrating RFID tags and a 3DCG character into a foreign language learning environment, mainly focusing on the following two objectives: (1)The application of RFID tags to the use of cards or realia as learning materials in task based-style foreign language activities; (2)The use of template programs to support TVML script production for 3DCG contents. From the results of the experiment, we found that the prototype system was easy to use and the system with RFID tags shows the possibility of achieving task-based style activities. Regarding script production, most participants had no problem editing the vocabulary and expressions in the text files to increase the variation of the TVML scripts. This suggests that the prototype system is not complicated for non-professional system users, although it might be much simpler for advanced computer users to place all the data within a single CSV file for editing according to their comments. Thus, we found that the support for script production should depend on users' computer skill level. Regarding the introduction of a 3DCG character, the results suggest that a 3DCG animated character is a better conversation partner than a 2D still character. The results also suggest that practicing with a 3DCG character could help to reduce nervousness and shyness in learners, and may help them to become familiar with real conversation. However, regarding this point, there may be individual differences in opinion depending on age, gender and personality according to some comments of the participants.

Keywords: RFID, 3DCG character, language learning, support for script production, TVML, T2V

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## Introduction

According to the general policies regarding curriculum formulation introduced by MEXT (Ministry of Education, Culture, Sports, Science and Technology-Japan) (2008a, 2008b, 2009), it is important to promote foreign language communication skills. In particular, familiarizing novice learners with native pronunciation and basic target language expressions is a priority issue. Subsequent to this policy, an increasing number of elementary schools in Japan begin the curriculum by focusing on listening and speaking activities; however, many elementary school teachers are relatively unfamiliar with teaching foreign languages. Statistics from MEXT (2014) and the Hyogo Prefectural Institute for Educational Research and In-Service Training (2009) demonstrate that not a few teachers are anxious regarding how to teach English in their foreign language classes, and have, in fact, demonstrated an interest in using IT and Multimedia in their classroom activities. The general curriculum policies formulated by MEXT (2006) also mention the importance of integrating technology into classroom activities.

Constructing an environment for foreign language learning could be one of the countermeasures to support listening and speaking activities. In particular, if we apply RFID (radio frequency identification) technology, it is possible to embed a learning environment within the real world.

On the learners' side, when they use foreign languages in face-to-face communication, they may feel inhibited, shy, or nervous (Horwitz et al., 1986; Matsumiya, 2010). By using a CG character or avatar in an online virtual world such as Second Life, they feel a little safer to talk with the character, as reported by Deutschmann et al. (2009) and Wang et al. (2009).

However, it is not always easy for language teachers to write programs or scripts by themselves when they customize CG contents and combine them with realia. Support for script production is necessary for such non-professional users.

In this study, we present a method of integrating RFID tags and a 3DCG character into a foreign language learning environment, mainly focusing on the following two objectives:

- (1) The application of RFID tags to the use of cards or realia as learning materials in order to implement task based-style foreign language activities;
- (2) The use of template programs to support TVML script production for 3DCG contents.

With regard to objective (1), it is monotonous simply to demonstrate model conversations or to study pattern practices of set phrases and key sentences in foreign language activities. A variety of task-based style activities using cards or realia enables learners to learn their target languages naturally. We are developing a way of applying RFID tags to a foreign language learning system based on previous studies (Kashiwagi et al., 2006; Kashiwagi et al., 2009) as discussed below.

RFID is a method of remotely storing and retrieving data using devices called RFID tags. An RFID tag is a small object, such as a plastic card or sticker, that can be attached to or incorporated into a product. RFID tags have an antenna to receive and respond to radio-frequency queries from an RFID transceiver (an RFID tag reader) (Akiyama et al., 2004). This has the advantage of integrating realia into the educational environment.

In the previous studies mentioned (Kashiwagi et al., 2006; Kashiwagi et al., 2009), a prototype system using RFID tags was developed to support activities based on the concept of the Total Physical Response (TPR) method. In the TPR method, learners respond to commands in foreign languages using physical responses, which enables them to understand the target language directly without translating the commands into their own language.

In this paper, we also use realia as learning materials by attaching RFID tags to them so that learners can interact with the system via these objects. Learners are required to respond to the commands from a 3DCG character of the system such as “I want an apple. Please pass me the apple,” and select the appropriate tagged card or object. The 3DCG character then reacts to the learners depending on their answers. In this way, learners can experience foreign language activities in a simulative manner. Interaction between a learner and the system’s 3DCG character realizes task-based style activities that differ entirely from repetitive model conversation practice. We anticipate that learners will gradually acquire words and expressions via such experience-based activities.

With regard to objective (2), the introduction of the 3DCG character is considered to help learners to become familiar with speaking foreign languages in face-to-face communication. In order to support script production for 3DCG content, text data files and template programs, including model dialogue patterns for the activities, are prepared in the system. Users only have to edit the target words and phrases in the data file and the data are then sent to the template program to easily produce 3DCG content.

To produce 3DCG content in the system, we use TVML (TV Program Making Language, TVML Home Page) and the T2V Player (T2V Home Page). TVML, as proposed by NHK (Japan Broadcasting Corporation), is a text-based language that produces TV-program-like 3DCG animation (Hayashi, 1996, 1999). This language enables users to create 3DCG animation on a PC using a text editor. The T2V technology (Hayashi et al., 2014) is built with TVML. The T2V Player is a software that can recognize TVML script and produces 3DCG animation with voice synthesis.

In the next section, we describe the prototype system. The experiment and the results and discussion are described in the following sections. Finally, we present our conclusions and recommendations for further studies.

### **Prototype System**

In this section, we present a prototype system in which RFID tags and a 3DCG character are integrated.

### System Overview and Flow of Instructions

Figure 1 and Figure 2 illustrate the prototype system developed in this study. This system consists of a PC, RFID tags, a tag reader, and a projector for displaying 3DCG content. The system was implemented using HSP (Hot Soup Processer) and Java. As shown in Figure 1, the T2V Program Executor generates 3DCG content by sending a TVML script to the T2V Player in the following process:

- (1) The system generates a command prompt and executes a Java program. This program works as a template.
- (2) The Java program generates the dialogue sentence data, referring to the arguments received at the time of startup. The data of the arguments are prepared in the data files, as mentioned later in Figure 4.
- (3) A WAV file is produced from the dialogue sentence data generated in (2), using text-to-speech software.
- (4) The Java program produces the TVML script data based on the generated dialogue sentence data and the WAV file.
- (5) The T2V Program Executor acquires the TVML script data and sends the data to the T2V Player.
- (6) The T2V player receives the TVML script data and executes the script to produce the corresponding 3DCG contents.

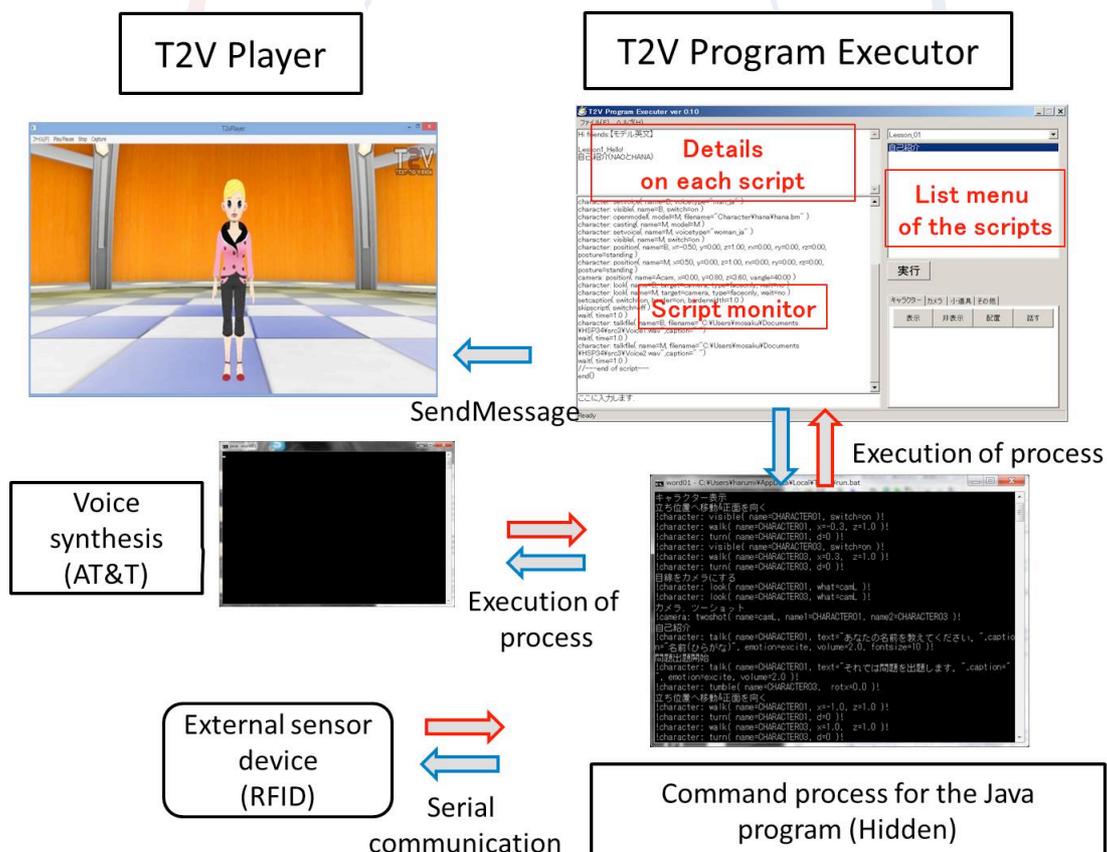


Figure 1: System overview

The interaction between a learner and the system is realized in cooperation with external sensor devices. In this study, RFID tags and a tag reader were introduced, which are described in the following section. The learner listens to the instruction given by a 3DCG character displayed on the screen, and answers the question by selecting the appropriate RFID tag. The Java program checks whether or not the selected RFID tag is correct. The system then generates the corresponding response sentence data and reads it out in a synthesized voice.

Next, the flow of instructions is described in Figure 2 with an example of 3DCG contents. When the teacher selects a script from the list menu of the PC screen, the system executes it in the process of (1) to (6) above. The projector displays a 3DCG character, and this character reads out a question in English: For example, “I want an apple. Please pass me the apple.” When the learner answers the question by selecting the appropriate RFID tag and scans it by saying “Here you are,” the system checks his/her answer. If the learner has given the correct answer by selecting an RFID tagged apple card, the system says, “Thank you.” If the learner has selected the RFID tagged banana card, however, the system detects the error and reads out an error message pointing out what he/she has actually selected: “Thank you. But I am afraid it’s not what I want. That is the banana. Please pass me the apple.” In this way, learners can experience foreign language activities in a simulative manner.

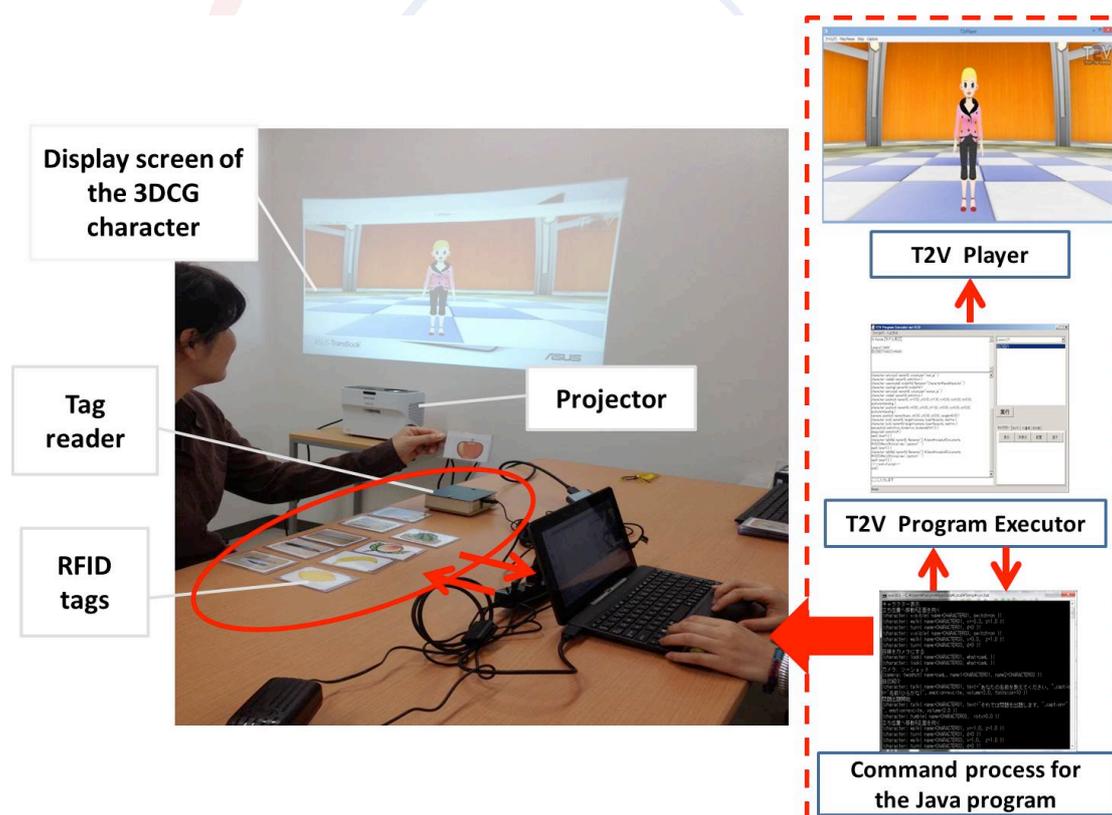


Figure 2: Example use of the prototype system

### Introduction of RFID Tags as an External Sensor Device

The Java program, in cooperation with the external sensor device RFID, is employed to realize the interaction between a learner and the system (Figure 2). All the data related to RFID tags, including individual serial numbers and corresponding word

data (i.e., apple, banana, etc.), are incorporated in a CSV file as shown in Figure 3, and the Java program acquires the data in that file at the time of program execution. When a learner scans an RFID tag, the data acquired are sent to the Java program in a serial communication. The Java program receives the tag data and checks whether or not the selected RFID tag is correct. The system then generates corresponding response sentence data and reads it out in a synthesized voice.

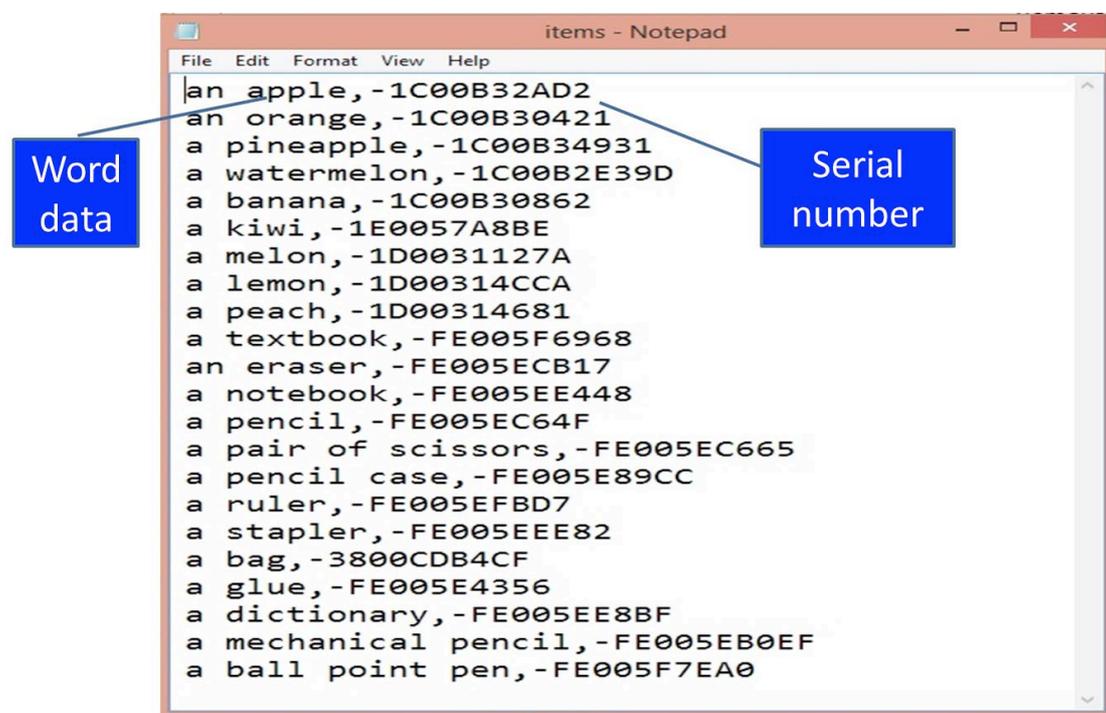


Figure 3: Example RFID tag information in a CSV file

This realizes the activity with RFID tagged realia as learning materials. Based on the RFID tag information, we will be able to further develop the prototype system to achieve various task-based style activities.

### TVML Script Production Using Template Programs

In order to support TVML script production for 3DCG contents, template programs, including model dialogue sentence patterns for the activities, are prepared in the system. The data of the arguments are also prepared in the text data files as shown in Figure 4. When we edit the data of the arguments in the data file, they are sent to the Java template program at the time of execution. Based on this method, we can increase the variations of the same pattern of the TVML scripts and easily produce 3DCG contents.

An example TVML script production is described using Figure 4. In the example data file in Figure 4, “RFID\_Sample03” represents the name of the Java Class file. “COM3” represents the RFID communication port number. “items.csv” represents the name of the RFID tag related information file. “2” represents the number of the loop time when an incorrect response occurs. “apple” represents the word data for the correct answer. Words and phrases, such as “an apple” and “the apple,” represent the sentence data necessary to generate dialogue sentences in the TVML script. For a comma separated list, the Java template program acquires the data of the arguments.

For example, to generate the example dialogue sentences shown in Figure 4, the Java template program obtains sentence data such as “an apple” and “the apple,” and substitutes them into the words and phrases enclosed in parentheses [ ] of the sentence pattern in Figure 4. Furthermore, the data of the RFID tag that the learner selects as an answer are obtained from the CSV file (items.csv in this example). In the example of Figure 4, the data “banana” is obtained from the CSV file as the learner’s selected RFID tag, and is substituted in the dialogue pattern in Figure 4.

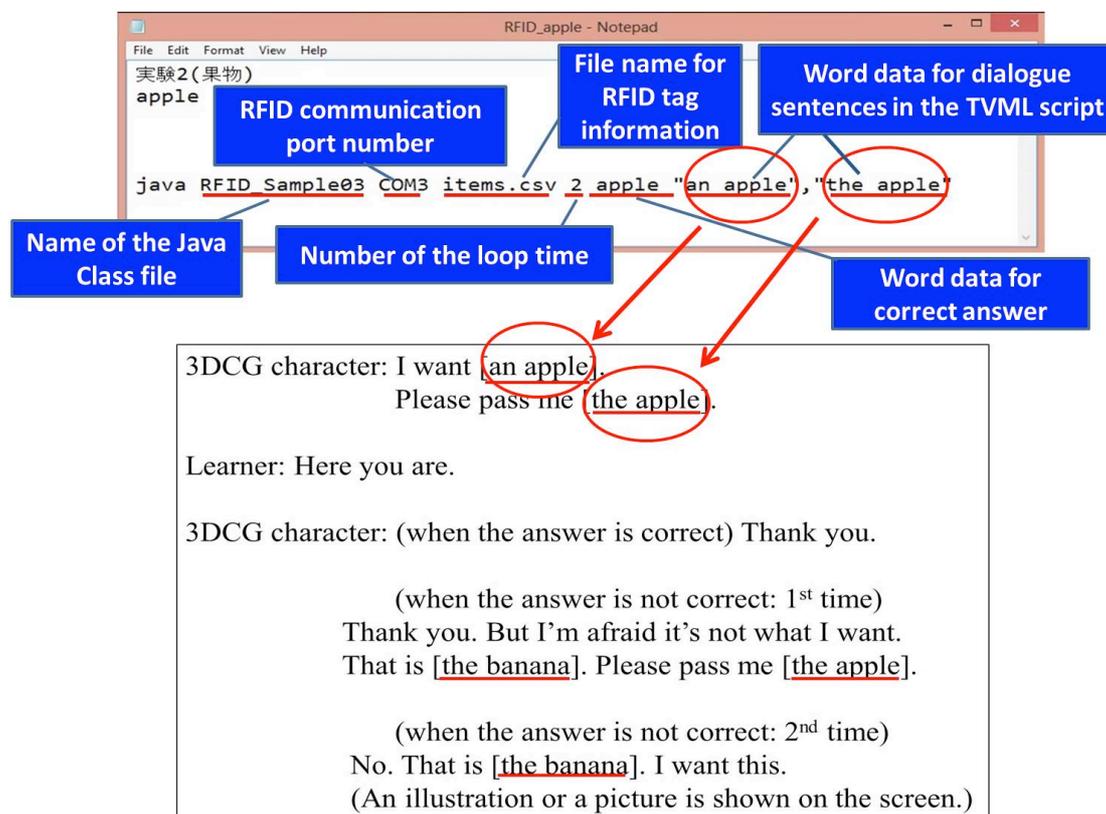


Figure 4: Example dialogue pattern

In this way, we can easily increase the variations of the same pattern of the TVML scripts for 3DCG contents merely by editing the words and phrases in the data files.

## Experiment

### Purpose

The purpose of this experiment was to investigate the following issues:

- (1) The application of RFID tags to the use of cards or realia as learning materials in order to achieve task based-style foreign language activities;
- (2) The use of template programs to support TVML script production for 3DCG contents.

### Participants

Twenty-one participants were selected to evaluate the system. Their evaluations were assimilated with the help of a questionnaire. They comprised 12 graduate and

postgraduate students, 3 foreign language educators at a university in Japan, and 6 parents whose children participated in the experiment as learners mentioned below. In addition to the above participants, 8 children (4 elementary school and 4 kindergarten) attempted to use the system as learners.

**Procedures**

Firstly, each of the participants attempted to experience the system as a learner after receiving the necessary instructions on how to use it. Secondly, they attempted to use the system by selecting the script files for 3DCG contents in the role of teacher. Lastly, they produced variations on the TVML scripts by editing the words and phrases in a text data file. Subsequently, they were asked to complete a 10-item questionnaire and interview regarding the application of RFID tags to foreign language learning environments, and on the template programs used to support TVML script production for 3DCG contents. Regarding the children as participants, after they had attempted to use the system as learners, they were asked to comment on the activity using RFID tag cards.

**Results and Discussion**

Here, we discuss the introduction of RFID tags and a 3DCG character into the prototype system.

**Introduction of RFID Tags to the Prototype System**

Twenty-one participants were asked to select the statements that best described what they had observed from the options. Q1 and Q2 in Figure 5 are regarding the introduction of RFID tags into the system. In the pie chart, red represents ‘Strongly Agree’, light red represents ‘Agree’, light blue is for ‘Disagree’, and blue is for ‘Strongly Disagree’. According to the results of Q1, all participants (67% strongly agreed and 33% agreed) showed agreement with the statement, “The system with RFID tags and a tag reader is easy to use.” The results indicate that the RFID tags are easy to use both for teachers who are unfamiliar with IT as well as for learners. This suggests that the RFID applied system would be easy to introduce into language activities at elementary schools.

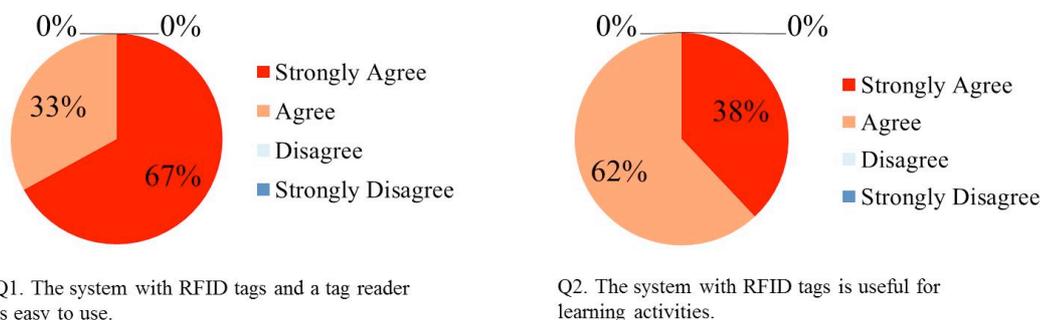


Figure 5: Results of the questionnaire on the introduction of RFID tags into the system

According to the result of Q2, all participants (38% strongly agreed and 62% agreed) showed agreement with the statement, “The system with RFID tags is useful for

learning activities.” Some participants also mentioned the following: “These activities with physical responses based on the TPR method might help elementary school children to concentrate on their activities. They seemed to enjoy playing games.” Some of the participant children also commented that the RFID tags were easy to use and the activities were fun.

The result shows that the system using RFID tags had a positive impact on the participants. This demonstrates the possibility of implementing task-based style activities with RFID tags, which would broaden the variety of language activities. In this case, we used RFID technology; however, the introduction of other sensor devices, such as infrared sensors, motion sensing input devices like Kinect, and so on, into the system might achieve more complicated task-based style activities.

### Script Production for 3DCG Contents and Introduction of a 3DCG Character

#### Support for TVML Script Production

Q3 and Q4 in Figure 6 are regarding the use of the system in the role of teacher. From the result of Q3, a total of 81% agreed (48% strongly agreed and 33% agreed) with the statement, “I could easily manage to choose the scripts for displaying a 3DCG character on the computer screen.” Positive feedback was received regarding the system interface. Most participants found it easy to use the system.

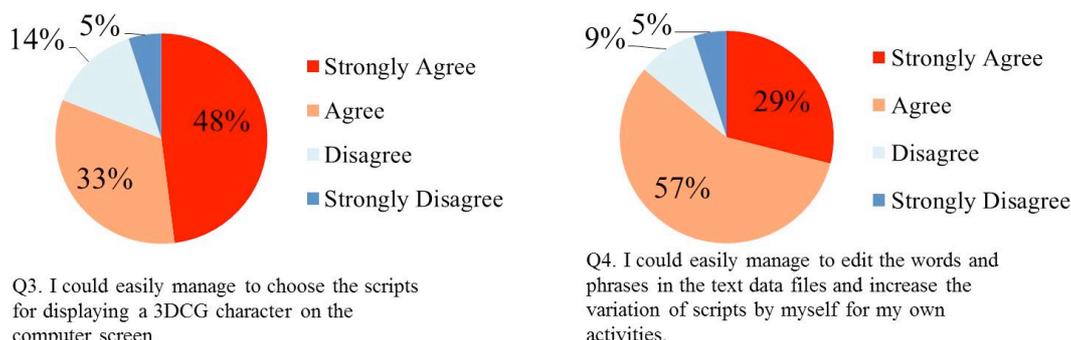


Figure 6: Results of the questionnaire on the use of the system in the role of teacher

This system also enables teachers to increase the variations of TVML scripts solely by using template programs and editing the words and phrases in the text data files in which the data of the arguments are prepared. From the result of Q4, a total of 86% agreed (29% strongly agreed and 57% agreed) with the statement, “I could easily manage to edit the words and phrases in the text data files and increase the variation of scripts by myself for my own activities.” Regarding the script production, most participants had no problem editing the vocabulary and expressions in the text files. It seemed that each text file contained an appropriate volume of data and it was easy for them to know where to edit. This suggests that the prototype system is not complicated for non-professional system users. However, 14% of participants (5% strongly disagreed and 9% disagreed) showed disagreement with the statement of Q4. They did mention that editing text files one by one to increase the variations could be confusing. These participants were advanced computer users. Thus, it might be much simpler to allow such users to place all the data within a single CSV file for editing. From these comments, we found that the support provided for script production should depend on users’ computer skill level.

### Introduction of a 3DCG Character

From Q5 to Q10 in Figure 7 are regarding the introduction of a 3DCG character. According to the result of Q5, a total of 95% agreed (52% strongly agreed and 43% agreed) with the statement, “I feel that an activity with a 3DCG animated character is better than one without such a character (voice only).” According to the result of Q6, a total of 95% agreed (67% strongly agreed and 28% agreed) with the statement, “I feel that a 3D animated character with some reactions such as nodding is better than a 2D still character as a conversation partner.” The results above suggest that it is better to use a 3DCG animated character than a 2D still character as a conversation partner.

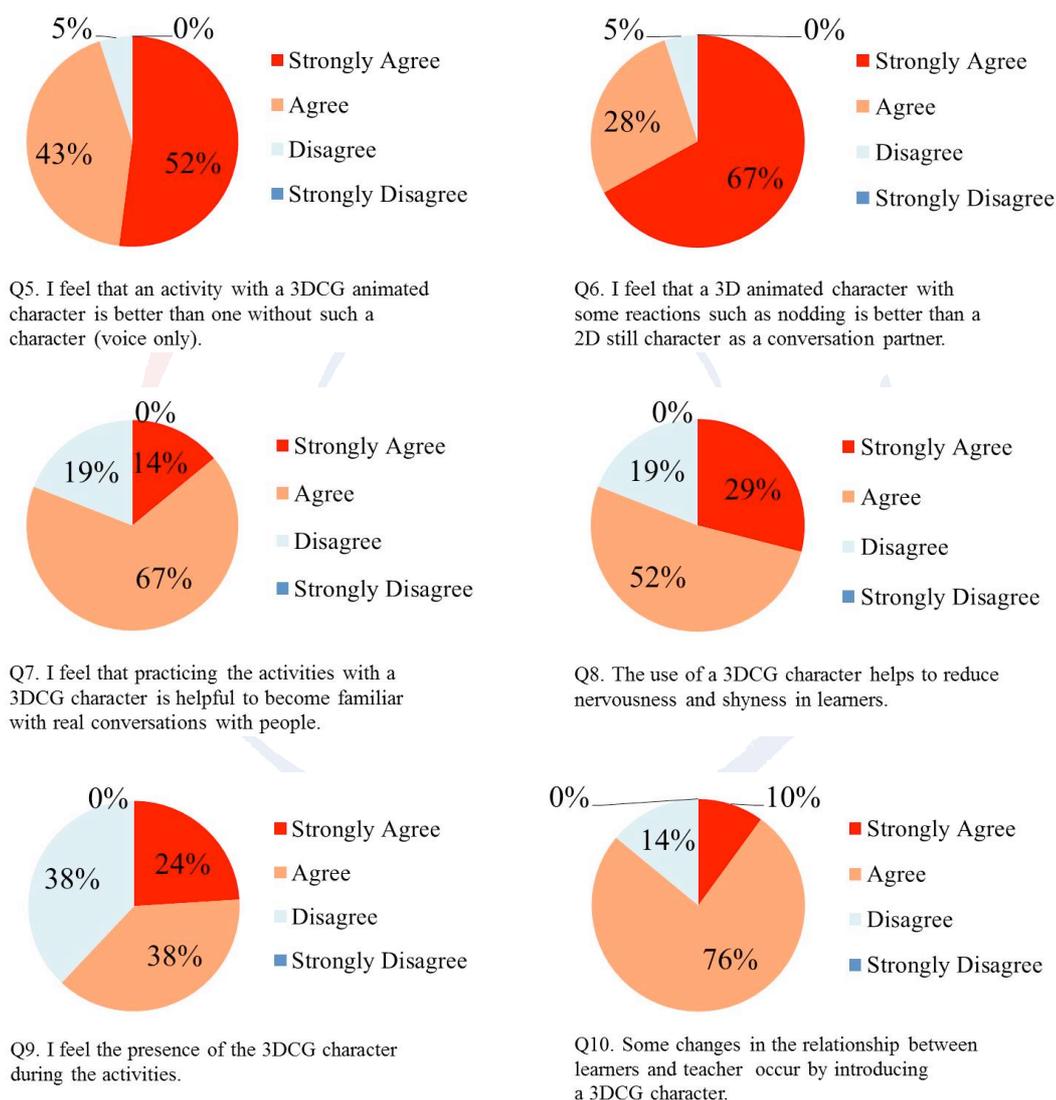


Figure 7: Results of the questionnaire on the introduction of a 3DCG character into the system

Furthermore, from the result of Q7, a total of 81% showed agreement (14% strongly agreed and 67% agreed) with the statement, “I feel that practicing the activities with a 3DCG character is helpful to become familiar with real conversations with people.” From the result of Q8, a total of 81% showed agreement (29% strongly agreed and 52% agreed) with the statement, “The use of a 3DCG character helps to reduce

nervousness and shyness in learners.” The results above suggest that practicing with a 3DCG character could help learners to reduce their nervousness and shyness, and might help them to become familiar with real conversation. However, regarding this point there may be individual differences in opinion depending on age, gender and personality according to the comments of a few participants. Given the limitations of the data, we will continue to investigate further.

Regarding the result of Q9, in total, 62% agreed (24% strongly agreed and 38% agreed) with the statement, “I feel the presence of the 3DCG character during the activities.” In the result of Q10, a total of 86% agreed (10% strongly agreed and 76% agreed) with the statement, “Some changes in relationship occur between learners and teacher by introducing a 3DCG character.” In the experiment, we observed that a few of the child participants asked for the name of the 3DCG character. It seems that they regarded the character as a partner in the activities. Two-thirds of the participants also felt the presence of a 3DCG character. Thus, they might regard the character as a participant. The results above suggest that the presence of a 3DCG character might provide an opportunity to facilitate interaction among participants, and also between learners and teacher. Regarding this point, some participants mentioned, “It seems that the activities between learners and a 3DCG character generate interaction between learners and teacher, such as giving hints or pointing out learners’ mistakes.” A similar suggestion is found in Kashiwagi et al. (2016).

However, in this study, participants focused more on the RFID tags in the activities. Therefore, it is likely that they did not pay much attention to the 3DCG character. We need to investigate further by carrying out different types of activities in which learners can communicate directly with a 3DCG character so that we can observe whether or not they feel the existence of that character, and whether any changes occur in the relationship between learners and teacher.

In addition, regarding the possibility of using 3DCG characters other than human characters, the following comments were made: “Animal characters, such as a dog, a cat, and a rabbit are familiar in our daily lives. It could be interesting to introduce them as 3DCG characters.”

## **Conclusion**

In this study, we presented a method of integrating RFID tags and a 3DCG character into a foreign language learning environment, mainly focusing on the following two objectives: (1) In order to realize task-based style foreign language activities, RFID tags were used to integrate realia as learning materials into the system. (2) Template programs were considered in order to support TVML script production for 3DCG contents.

With regard to objective (1), cards or realia were used as learning materials by attaching RFID tags to them. Learners were required to respond to the commands of a 3DCG character such as “I want an apple. Please pass me the apple,” and to select the appropriate tagged card or object. Thus, they experienced the foreign language activities in a simulative manner.

With regard to objective (2), the introduction of a 3DCG character was considered to help learners to become familiar with speaking foreign languages in face-to-face communication. In order to support script production for 3DCG contents, text data files and template programs, including model dialogue patterns for the activities, were prepared in the system. When users have only to edit the words and phrases in the data file, the data are sent to the template program and they can easily produce 3DCG contents.

In the experiment, 21 participants used the system as learners after receiving the necessary instructions on how to use it. Next, they attempted to use the system in the role of the teacher. They then produced variations on the TVML scripts by editing the words and phrases in a text file. In addition, 8 children attempted to use the system as learners. Subsequently, we conducted a 10-item questionnaire in which each question was designed to gather participants' responses on the introduction of RFID tags and a 3DCG character into the system as well as on the support provided for TVML script production.

From the results of the experiment, we found that the system with RFID tags was easy to use and had a positive impact on the participants. This suggests that the system has the potential to achieve task-based style activities with RFID tags, which would broaden the variety of language activities.

Regarding script production, most participants had no problem editing the vocabulary and expressions in the text file to increase the variation of the TVML scripts. It seemed that each text file contained an appropriate amount of data and it was easy for them to know where to edit. Thus, it is anticipated that teachers will easily be able to increase the 3DCG contents for their activities, although it might be much simpler for advanced computer users to place all the data within a single CSV file for editing according to their comments. We found that the support provided for script production should depend on users' computer skill level.

Regarding the introduction of a 3DCG character, the results suggest that it is better to use a 3DCG animated character than a 2D still character as a conversation partner. The results also suggest that practicing with a 3DCG character can help reduce the nervousness and shyness of learners, and might help them to become familiar with real conversation. However, regarding this point there may be individual differences in opinion depending on age, gender and personality according to the comments of a few participants. Given the limitations of the data, we will continue to investigate further. Additionally, we found that two-thirds of the participants felt the presence of a 3DCG character during the activities, and some of them felt that its presence could facilitate the interaction between learners and teacher. However, we need to investigate further by carrying out different types of activities in which learners can communicate directly with a 3DCG character.

As a continuous study, we need to investigate the following points by carrying out different types of activities in which learners can communicate directly with a 3DCG character: Whether or not the existence of a 3DCG character contributes to real conversation, and whether or not the introduction of a 3DCG character enhances the interaction between learners and teacher.

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## *The Application of Analytic Hierarchy Process for the Evaluation of Imaginative Teaching Strategies*

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### **Abstract**

As the advocacy for and importance of imagination is increasingly emphasized around the world, a mass fervor for imaginative education has sprung up in Taiwan. In the domain of arts and design education, imagination means the source of creative designs; a variety of teaching plans that arouse and promote imagination are required to enhance students' creativity and imagination. Therefore, the study aims at developing imaginative teaching strategies to achieve the effect of strengthening students' imagination. After developing the teaching strategies and teaching contents through field interviews, AHP questionnaires were distributed to assess the weights of teaching strategies and teaching contents. Analysis showed both consistency ratio (C.R.) and consistency ratio of the hierarchy (C.R.H.) for all items were smaller than 0.1, which conforms to the requirement of the Analytic Hierarchy Process (AHP) theory. Research results indicated the priority of teaching strategies that stimulate students' imagination were: stimulation of imagination activities, stimulation of imagination materials, stimulation of imagination pedagogy, stimulation of imagination space, stimulation of imagination personage; overall speaking, the teaching content that encourages participation in "competitive activities" had the greatest weight in stimulating students' imagination.

Keywords: Imagination, Teaching Strategy, Teaching Activity, Teaching Content.

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## Introduction

Imagination is an innate power, from which individualized accomplishments can be achieved when exerted to the highest degree (Labuske & Streb, 2008; Richard & Jim, 2005). Classical masterpieces in the area of arts and literature, painting, architecture, etc. come about from the unrestrained liberal imagination of the originators. As the results of such imagination continue to accumulate, they converge to form civilizations, and human beings continue to exert their imagination under the influence of civilizations, adding new elements to create even more innovative pieces that are passed onto later generations. In the process of stimulating imagination, observation and past experience were combined to generate great creativity and inspiration through the effects of imagination; consequently, more innovative and stylish design works are created (Chang, H. T., & Lin, T. I., 2013).

Einstein said “imagination is more important than knowledge,” because knowledge is limited but the invisible imagination can overlook everything in the world, constituting the progressive power. Guiding students to bring imagination into play for the objective of generating creative works is an essential part in the design curriculum. Education philosopher Greene (1995) proposed that arts may help release students’ imagination. In an aesthetically rich teaching experience, “imagination” plays an important role in interpreting the world and creating a brand-new world.

However, a study of imagination that discusses only imagination tends to be vague and not specific enough. Imagination will have greater practical value and maximized benefits only when it is specifically put into practice (Amabile, 1983).

Many research results of previous studies (Egan,1992; Liang 2012; Liao,2014) showed that imagination can be cultivated, and the cultivation of imagination requires a process of systematic teaching, which turns theoretical concepts and techniques into explicit knowledge to be passed on to learners. In view of this, this study intends to conclude various imaginative teaching strategies and teaching contents by identifying factors that stimulate imagination. Subsequently, the AHP is applied to find out the weights of various teaching contents, which are expected to be incorporated with relevant teaching strategies into the “computer graphics” courses in technical colleges. This is expected to achieve the objective of enhancing the graphical imagination and practicing skills of senior vocational school students, and further refine the quality of teaching. Research objectives of this study include the following:

1. Explore factors that stimulate students’ imaginations.
2. Explore teaching strategies that stimulate students’ imaginations.
3. Explore teaching contents that stimulate students’ imaginations.

## Literature Review

### 1. Factors affecting imagination

In the process of growth and learning, factors affecting students’ learning are very complicated. The factors may be roughly distinguished into three categories: 1. Personal factors: intelligent capability, self-concept, learning motivation, learning attitude and habits, and personal beliefs, etc.; 2. Family factors: socio-economic level

of family, parents' expectations, parents' educational philosophy, and parenting approach, etc.; 3. School factors: teachers' curriculum design, teaching strategies, personality traits, classroom management, and the school's equipment, etc. (Domina, 2005; Yu, M. N., 2006)

Factors that affect the functioning and development of imagination are similar. Passmore (1985) believed that teachers should bring alternative approaches to thinking and diversified life experiences for students, breaking through the conventional beliefs and increasing the probability of creating novel things. Büscher et al. (2004) sought to identify the best combination of work environment, tools to be used, and work content for designing job in different domains. Karwowski and Sosynski (2008) echoed the above study, stating that imagination education must be linked with the students' interests and habits, and on this basis, the researchers developed a training activity that features a role playing game.

From previous studies, researchers believe that apart from the school factors, family background also strongly affects students' learning accomplishments (Tsai, Gates and Chiu, 1994; Luoh, M. C., 2004), and thus some studies have focused on the influence of family background on individuals' learning results; for example, the influence of parents' educational level, occupation, and family income on students' learning results.

In the Equality Of Education Opportunity report (Coleman et al., 1990) proposed by J.S. Coleman and others in 1966, it is stated that school resources had a limited influence on students' learning results; instead, non-school factors had a greater influence; students coming from families of higher socio-economic status tend to have relatively better performances in learning results.

Moreover, Mushtaq (2012) believed that a family may pass on to their children language ability and cultural competence, and these two capabilities represent a person's cultural capital. School education mainly imparts the mainstream culture of the society. A better family background means one may acquire a more abundant cultural capital, and hence learn the mainstream culture taught in school with a higher proficiency. Therefore, people with more abundant cultural capital will achieve better learning results in school, and hence attain a higher social status; the family's social status is thus replicated. Therefore, it can be easily seen that cultivation of imagination is closely and interactively related to a person's family environment and learning environment.

In terms of recreational activities, Godbey (1988) believed participation in activities is an important part of modern life. Moderate participation may promote the generation of positive emotions, and hence affect health. One may acquire a sense of competence, sense of mastery, and sense of self-esteem, and hence develop the personality trait of self-determination through a high level of participation in recreational activities. When a person can make his/her own choice of activities, he/she will acquire a sense of freedom and satisfy his/her inherent motives. This helps maintain a sense of self-control, thereby one may cope with the stress of life and be inspired with all sorts of imagination.

## 2. Imagination teaching strategies

The term “imagination” means boundless thinking, but how can this abstract concept be measured? This difficult problem can only be solved through different levels of assessment.

Many scholars tried to enhance students’ creativity through thinking training in earlier times. This includes the Cognitive Researching Trust (CoRT) proposed by De Bono who invented lateral thinking (1976). This program comprises six parts, each with 10 sessions which cover wide-ranging topics, such as breadth, organization, interaction, creativity, information and affection, and action. The program may guide students’ thoughts, help them observe more than the surface or immediate aspects of things, and develop broader perceptions and thinking skills, and thereby more appropriate decisions can be made.

Moreover, the formerly U.S.S.R. inventor Genrich Saulovich Altshuller initiated the TRIZ in 1946. He led the TRIZ research team consisting of dozens of research institutes, universities, and enterprises, and through decades of analysis and research of top-notch inventions and patents around the world (cumulated to 2.5 million pieces), he developed the basic theory about invention issues based on dialectical materialism and system theory. The core of his theory comprises the basic theory and principle, and the particulars include: the general theory (basic rules, method of contradiction analysis, grades of inventions), technology evolutionism, 39 common engineering parameters of solutions to technological problems and 40 methods of invention, substance-field analysis and conversion principle with 76 standard solutions, problem-solving procedures of invention issues, and a physical effects database. TRIZ represents an integrated body of theories that encompasses solutions to technological problems, various approaches and algorithms of practical and innovative R&D.

Eberle (1971) made reference to Osborn’s checklist and proposed a kind of checklist technique, which may be literally translated as “SCAMPER”. In fact, it consists of seven English words, representing seven directions of improvement or change, which help the conception of new ideas. The seven directions are:

- (1) S-Substitute: Consider what things, persons or elements can be substituted.
- (2) C-Combine: Consider combining or blending with other things or services and becoming one.
- (3) A-Adapt: Consider if adaptation is necessary; for example, changing a function or using a part of another thing.
- (4) M-Modify: Adding or deleting specifications, changing shape, or modifying color tones, etc.
- (5) P-Put to another use: Consider if there is any other unconventional use.
- (6) E-Eliminate: Can the original thing be reduced in size? Extracted? May some parts of it be omitted? Can it be made more comprehensive and more refined?
- (7) R-Reverse: Re-organizing or re-arranging the original order. Or swapping the opposite position.

Karwowski developed the Test of Creative Imagination (TCI) in the early 1990s. The test content includes 16 main components – 4 straight lines, 4 semi-circles, 4 points, and 4 curve line segments. Test subjects can be scored for their fluency, originality,

and flexibility, which in turn may evaluate the subjects' creative imaginations (Karwowski & Soszynski, 2008).

In order to make imagination more assessable, Trotman (2006) listed the following ways to manifest imagination: 1. Observe students' emotions, behaviors, and responses; 2. Record conversations; 3. Observe students' interactions; 4. Collect students' writing and diaries; 5. Keep photo records; 6. Use of pictures and images; 7. Use of animations, videos, and stories; 8. Dance; 9. Compose music; 10. Extemporaneous creations and extemporaneous speaking.

In the Two-Factor Imagination Scale (TFIS) compiled by Thompson (2011), he distinguished the effect, process, and mechanism of imagination in the form of a questionnaire, so that respondents would understand their own type of imagination.

Liang (2013) listed ten indicators for evaluating imagination, which were "interdisciplinary", "effective", "figurative", "dialectical", "abundant", "innovative", "intuitive", "sensitive", "focused", "explorative", and on this basis, ten evaluative questions were developed corresponding to these ten indicators.

It can be seen from the above literature review that in the scenario of a computer graphics course, students' understanding of the course content, their personality traits, and differences in learning attitudes can be potential influencing factors, but teachers' delivery approach and responsiveness are even more critical factors that lead to success. Teachers must adjust their teaching strategies when facing students with poor design capability and inadequate creativity and imagination, so as to improve the results of teaching that do not live up to expectations. Many school teachers in the U.S. are gradually adjusting their teaching strategies and orientation now, adopting a tolerant approach and stressing high-level thinking skills to guide students' learning (Stenberg & Lubart, 1995). Despite its being an abstract concept of individuality and creativity, imagination and its performance can still be evaluated through such methods as systematic teaching, testing, and learning records.

## **Research Design**

### **1. Research framework**

To achieve the research objectives, this study's research framework is designed based on the literature review and Fuzzy Analytic Hierarchy Process (FAHP), as shown in Figure 1. Researchers tried to understand the factors that stimulate imagination first, and devised imagination-inspiring teaching strategies through field interviews. Then, the FAHP was adopted to obtain the relative weights for various teaching strategies and contents, and eventually teaching plans were developed.

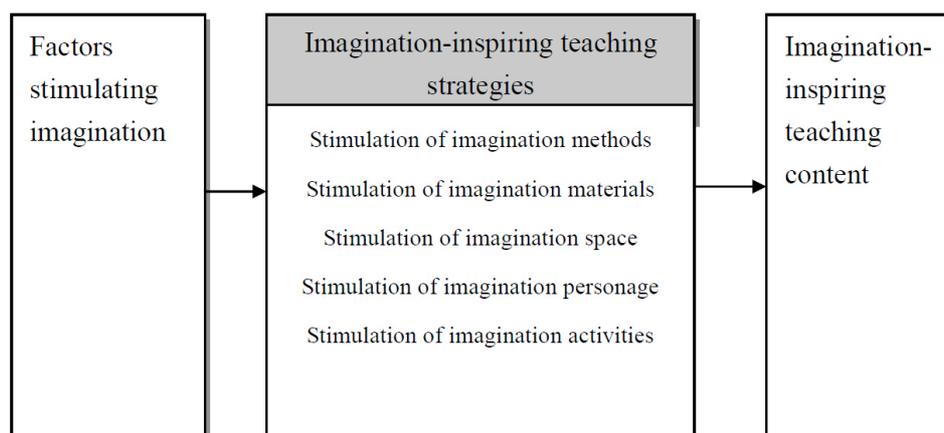


Figure 1 Illustration of the research framework

## 2. Research methods and subjects

### (1) Field interview

Field interviews with experts were employed in this study. First of all, relevant literature was reviewed and collected to serve as a reference for the interview content. Then, interviews were conducted with experienced teachers of design-related departments in technical colleges, and by recording, organizing, and analyzing the interview contents, opinions about factors stimulating students' imaginations were concluded.

Interviewees were teachers with more than ten years of teaching experience in design-related disciplines in northern, central, and southern Taiwan. A total of seven interviewees were chosen, and their background information is listed in Table 1 below:

Table 1 Basic information about the interviewees of the field interviews

No.	Sex	Serving institution	Professional title
I1	F	Department of Industrial and Commercial Design, National Taiwan University of Science and Technology	Associate Professor
I2	M	Department of Industrial Design/Graduate Institute of Innovation and Design, Taipei University of Technology	Associate Professor
I3	M	Department of Arts and Design, National Taipei University of Education	Associate Professor
I4	M	Department of Graphic Communication Arts, National Taiwan University of Arts	Associate Professor
I5	M	College of Design, Ling Tung University	Associate Professor
I6	F	Department of Product and Media Design, Fo Guang University	Associate Professor
I7	M	Department of Visual Communication Design, Southern Taiwan University of Science and Technology	Associate Professor

## (2) Questionnaire survey

This study is an assessment tool for computer graphics courses oriented towards developing imagination teaching. With the AHP questionnaire survey method, the AHP questionnaire as well as the literature review and experts' questionnaire were used as the basis for indicative perspectives and items after question adjustment, and then the "AHP Questionnaire for the Stimulation of Imagination Teaching Strategies" was developed by collecting experts' opinions to develop teaching strategies for computer graphics courses that stimulate students' imaginations.

14 teachers from technical and vocational colleges with 5 years or more of experience in teaching computer graphics-related courses were selected and the questionnaires were distributed. Information about the subjects of the questionnaire survey is listed below in Table 2.

Table 2 Basic info of AHP questionnaire survey subjects

No.	Sex	Serving institution	Professional title
Q1	F	National Taiwan University of Science and Technology	Associate Professor
Q2	M	Taipei University of Technology	Associate Professor
Q3	M	Ming Chuan University	Associate Professor
Q4	M	Taiwan University of Arts	Associate Professor
Q5	M	Ling Tung University	Associate Professor
Q6	F	Hsing Wu University	Associate Professor
Q7	M	Southern Taiwan University of Science and Technology	Associate Professor
Q8	M	Shu-Te University	Assistant Professor
Q9	M	Shu-Te University	Assistant Professor
Q10	M	China University of Technology	Professor
Q11	M	China University of Technology	Assistant Professor
Q12	M	National Taipei University of Education	Assistant Professor
Q13	M	Taibei High School	Director
Q14	M	Taibei High School	Teacher

Bozbura, F. T., Beskese, A., & Kahraman, C. (2007) believed the Fuzzy AHP may be used for research questions that are difficult to quantify, including business strategies of immature but emerging industries, the social science perspective of the resource allocation priority, etc. Currently, imagination education is at an immature stage of development in Taiwan, and therefore, the AHP questionnaire was adopted in this study to analyze the weights among various teaching strategies.

The questionnaire was designed as a comparative 9-point scale (9:1 to 1:9), where paired comparisons were conducted for same-level indicators. Data obtained were used to create a comparison matrix, from which the relative weights among the factors can be derived, and the AHP for stimulation of imagination teaching strategies can be developed.

The application of the AHP is divided into two parts, namely, the establishment of hierarchy and the evaluation of hierarchy. When using the AHP, complicated questions are assessed by experts and scholars to identify the essential factors, which are then expressed in a simple hierarchical structure. Afterwards, an assessment scale is used to conduct paired comparisons of factors and establish a matrix, and then the eigenvectors are derived. Comparisons are then made to find out the order of the hierarchical factors. Next, the consistency of the paired comparison matrix is tested to ensure it is free of errors and may be used as a reference. In the AHP, consistency is tested mainly with the Consistency Index (C.I.) and Consistency Ratio (C.R.). The value of the C.I. represents consistency of earlier and later judgments, with a C.I.>0 meaning inconsistent judgments. Saaty (1980) suggested that the C.R. should be smaller than or equal to 0.1 to indicate an acceptable level of consistency.

### 3. Research tools

#### (1) Open-end expert questionnaire for the stimulation of imagination teaching strategies

To enhance imagination of students in design-related departments, the following five teaching strategies were sorted out from the results of the literature review. Table 3 summarizes these teaching strategies that can be applied to teaching scenarios.

Table 3 Outline of expert questionnaire

Perspectives	Interview briefing
Stimulation of imagination methods	E.g.: Flipped classroom approach, cooperative learning, etc. Please provide teaching methods that you think may help stimulate imagination.
Stimulation of imagination materials	E.g.: Award-winning advertisement posters, photographs, new-media animation, etc. Please provide teaching materials that you think may help stimulate imagination.
Stimulation of imagination spaces	E.g.: Exhibitions, large parks, etc. Please suggest spaces that you think may help stimulate imagination.
Stimulation of imagination personages	E.g.: New artists, students in different disciplines, friends who are 10 years older and younger than oneself, etc. Please suggest people who you think may help stimulate imagination.
Stimulation of imagination activities	E.g.: Earning a sport certificate, learning a new thing, reading a new book, listening to never-heard before music, etc. Please provide activities that you think may help stimulate imagination.
Others	Please give supplementary comments on other teaching methods that may help stimulate imagination.

## (2) AHP questionnaire for the stimulation of imagination teaching strategies

To analyze the weights and order of the stimulation of imagination teaching strategies, relevant information was collected based on the results of the field interviews, which served as the basis of the questionnaire for establishing the self-developed structured “AHP Questionnaire for the Stimulation of Imagination Teaching Strategies”.

In the questionnaire, items were selected for specific hierarchies, and frequencies of commonly seen questions were compared. The questionnaire was designed to be answered with a 9-point scale for paired comparisons among the selected items.

Teaching strategies developed in this study were divided into two levels – “teaching content” and “teaching substance”. “Teaching content” included “teaching methods”, “teaching materials plans”, “stimulate of imagination spaces”, “stimulation of imagination personages”, and “stimulation of imagination activities”.

The levels of “teaching content” discussed included practice-oriented, inspiration-oriented, game-oriented, cooperation-oriented, temperament-oriented, individual-oriented, audio-visual animation, graphics and text, current news, nature, outdoor, indoor, arts domain, non-arts domain, virtual characters, negative figures, competition, adventure, performance, outdoor visit, and recreation, with a total of 21 items. The hierarchical structure is illustrated in Figure 2:

Stimulation of imagination teaching strategies				
Teaching methods	Teaching materials plans	Spaces	Personages	Activities
▼	▼	▼	▼	▼
Practice-oriented	Audio-visual animation	Nature	Arts domain	Competition
Inspiration-oriented	Graphics and text	Outdoor	Non-arts domain	Adventure
Game-oriented	Current news	Indoor	Virtual characters	Performance
Cooperation-oriented			Negative figures	Visit
Temperament-oriented				Recreation
Individual-oriented				

Figure 2 Hierarchical framework for the stimulation of imagination teaching strategies

## 4. Data processing

Teaching strategies	Interview results	General summary
Stimulation of imagination methods	I1: Interdisciplinary cooperative teaching, Context Mapping approach I2, I3: Brainstorming, IDEO innovative thinking, World Café approach I4: Demonstration teaching, industry-academia cooperation I5, I7: Cooperative learning, teaching with cases, team teaching, inspirational teaching I6: Game approach, scenario demonstration, critics, etc.	Practice-oriented Inspiration-oriented Game-oriented Cooperation-oriented Temperament-oriented Individual-oriented
Stimulation of imagination materials	I1: Life experience scenarios, natural structures and materials I2, I3, I4: Award-winning pieces in international design competitions, stimulating imagination by identifying inconveniences or problems in life. I5: Technological products I6, I7: Movies, music, topics from current affairs, living environment	Audio-visual animation Graphics and text Current news
Stimulation of imagination spaces	I1: Design targets and user spheres, jumping out of the daily conventional sphere I2, I3, I5, I6: Approaching nature, design-related exhibitions, museums, art galleries I4: Subjective experiential spaces, cultural and creative zones, professional bookstores, professional interest groups I7: Train stations, cinemas, crowded public spaces	Nature Outdoor Indoor
Stimulation of imagination personages	I1: Extreme users, story-tellers I2: Jimmy Liao, interdisciplinary community members mutually stimulating imagination I3: Philippe Patrick Starck, Da Vinci I4: Renowned industrial celebrities, professional senior teachers, new friends I5: Steve Jobs, Wang, Weoi-Jong, Da-Wei Sun, Xu, Yi-Ming, (Jie-Min Wu, DreamWorks, Disney, and other animation makers I6: Pop stars, animation cartoon characters I7: Positive figures (e.g., Mayday, Chu Chen, Yen, Chang-Shou, Bill Gates), negative figures (e.g., Zheng Jie, drug-addicted artists, drunk driving incidents	Arts domain Non-arts domain Virtual characters Negative figures
Stimulation of imagination activities	I1: Chats with people who have different life experiences, engaging in hands-on activities such as gardening, block building I2: Developing courage of making new attempts by traveling or appreciating artistic activities, biannual life-risking activities I3, I4: Brainstorm training activities, relaxed time, after a bath or shower I5, I6, I7: Role-playing, visiting activities, artistic activities, sharing of story inspiration, experiential activities, special projects and reports, competitive activities	Competition Adventure Performance Visit Recreation

Based on the data collected, Expert Choice 2000 was adopted for statistical analysis. With the paired comparison matrix derived from the study, a consistency test was carried out for the weights of the overall hierarchical indicators, and then the relative weight of each perspective and attribute was established. The consistency test aims to find out the Consistency Index (CI), so as to check if the paired comparison matrix derived from the respondents' answers was a consistent matrix. Apart from assessing the decision-makers' judgments, the consistency test may also be applied to the overall hierarchical structure.

As a consistency benchmark, Saaty (1980) suggested a C.R.  $\leq 0.1$  acceptable error for both assessing the decision-makers' judgments and testing the hierarchical structure, so that consistency may be guaranteed.

The Expert Choice software used in this study expressed a C.R. with the overall inconsistency test, which reached the threshold of  $\leq 0.1$  in all of the teaching methods (.00), teaching material plans (.00), spaces (.01), personages (.01), and activities (.01) questionnaires. This means the overall factor hierarchy structure is consistent, and the relative weights derived are acceptable, indicating a good reliability of this study.

## Data Analysis and Discussion

### 1. Analysis of interview results

In this study, seven teachers with more than ten years' teaching experience in design-related disciplines in northern, central, and southern Taiwan were interviewed to seek their opinions on teaching strategies that stimulate students' imaginations. Their opinions are summarized below:

#### Table 4 Analysis of interview results

### 2. Analysis of the results of the AHP weighing questionnaire

After reorganization, stimulation of imagination teaching strategies are distinguished into 5 major categories and 21 teaching contents. These were modified according to the opinions obtained from the expert questionnaire survey, and paired comparisons of various levels of indicators were conducted based on the semantic scale in order to derive the relative weights among the different levels of indicators. The consistency test and weights of the different levels of indicators are described below:

#### (1) Teaching strategies

Among the stimulation of imagination teaching strategies, the "stimulation of imagination activities" (.330) had the greatest weight, followed in sequence by the "stimulation of imagination materials" (.206), "stimulation of imagination methods" (.179), "stimulation of imagination spaces" (.168), and "stimulation of imagination personages" (.116), as shown in Table 4 below.

Table 4 Weights and order of stimulation of imagination teaching strategies

Perspectives	Weight	Order
Teaching activities	.330	1
Teaching materials	.206	2
Teaching methods	.179	3
Size of spaces	.168	4
Personages	.116	5

Overall inconsistency = .01

## (2) Teaching contents

Among the contents of various teaching strategies, in the stimulation of imagination methods, the “practice-oriented” approach (.256) had the greatest weight, followed in sequence by the inspiration-oriented approach (.200), game-oriented approach (.200), cooperation-oriented approach (.139), temperament-oriented approach (.121), and individual-oriented approach (.085).

In the stimulation of imagination materials, audio-visual animation (.596) had the greatest weight, followed in sequence by graphics and text (.207), and current news (.197).

In the stimulation of imagination spaces, nature (.407) had the greatest weight, followed in sequence by graphic outdoor (.2997), and indoor (.294).

In the stimulation of imagination personages, artistic domain (.459) had the greatest weight, followed in sequence by graphics and text (.233), virtual characters (.182), and negative figures (.126).

In the stimulation of imagination activities, competition (.285) had the greatest weight, followed in sequence by adventure (.226), performance (.223), visits (.137), and recreation (.130).

Table 5 Weights and order of stimulation of imagination teaching contents

Teaching strategies	Teaching contents	Weight	Order
	Practice-oriented	.256	1
	Inspiration-oriented	.200	2
	Game-oriented	.200	3
Teaching methods	Cooperation-oriented	.139	4
	Temperament-oriented	.121	5
	Individual-oriented	.085	6

Teaching materials	Audio-visual animation	.596	1
	Graphics and text	.207	2
	Current news	.197	3
Size of spaces	Nature	.407	1
	Outdoor	.299	2
	Indoor	.294	3
Personages	Artistic domain	.459	1
	Non-artistic domain	.233	2
	Virtual characters	.182	3
	Negative figures	.126	4
Teaching activities	Competition	.285	1
	Adventure	.226	2
	Performance	.223	3
	Visit	.137	4
	Recreation	.130	5

Overall inconsistency = .01

### 3. Series of hierarchical analysis

According to the above weighing of the different levels of factors, the calculation of the overall hierarchical weights was then conducted to prioritize the demand for various capability indicators. Among them, participating in “competition” had the greatest weight (11.5%) for stimulating students’ imaginations. The other analysis results of the overall hierarchical weighing are listed below in Table 6.

Table 6 Series of hierarchical analysis of the stimulation of imagination teaching contents

Items	Overall weighing order	Order
Competition	0.115	1
Adventure	0.091	2
Performance	0.09	3
Audio-visual animation materials	0.072	4
Practice-oriented approach	0.062	5
Nature	0.059	6
Visits	0.055	7
Recreation	0.052	8
Inspiration-oriented approach	0.049	9
Game-oriented approach	0.049	10
Outdoor spaces	0.043	11

Indoor spaces	0.042	12
People from artistic domain	0.04	13
Cooperation-oriented approach	0.034	14
Temperament-oriented approach	0.029	15
Graphics and text materials	0.025	16
Current news materials	0.024	17
Individual-oriented approach	0.021	18
People from non-artistic domain	0.021	19
Virtual characters	0.016	20
Negative figures	0.011	21

Overall inconsistency = .01

## Conclusion and Recommendations

### 1. Factors that stimulate students' imaginations

Factors that may stimulate students' imaginations in teaching include: encouraging participation in activities, using a brainstorming approach, planning suitable teaching materials, visiting different venues, observing different people, etc.

### 2. Teaching strategies that stimulate students' imagination

Five teaching strategies that may stimulate students' imaginations are developed in this study; they are listed below in order of weight: teaching activities (0.330), teaching material plan (0.206), teaching methods (0.179), spaces (0.168), and personages (0.116).

### 3. Teaching contents that stimulate students' imagination

21 teaching contents that may stimulate students' imaginations are developed in this study; they are listed below in order of weight:

- (1) Teaching activities: competition (0.285), adventure (0.226), performance (0.223), outdoor visits (0.137), recreation (0.13)
- (2) Teaching material plans: audio-visual animation (0.596), graphics and text (0.207), current news (0.197)
- (3) Teaching methods: practice-oriented (0.256), inspiration-oriented (0.2), game-oriented (0.2), cooperation-oriented (0.139), temperament-oriented (0.121), individual-oriented (0.085)
- (4) Teaching spaces: nature (0.407), outdoor (0.299), indoor (0.294)
- (5) Teaching personages: artistic domain (0.459), non-artistic domain (0.233), virtual characters (0.182), negative figures (0.126)

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***Development of an Introductory Programming Education System  
by Automatic Generation of Lecture Slides***

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**Abstract**

The learning of programming has become easy because the online learning of programming has spread globally. Such e-learning systems execute programs in which students can create and evaluate programming exercises. Coding a program has a number of steps, such as declaration variables and methods. However, e-learning systems for general programming do not evaluate programs in the middle of coding. We developed the system evaluated in the middle of creation of a student's program. Thus, on detecting an error in the program, the system will point it out. In this system, since it had pointed out by the correction videos prepared beforehand, concrete directions cannot be performed. Hence, we developed a system that can automatically generate slides containing contents of advice. This paper describes our system in detail.

Keywords: programming education, software engineering, e-learning

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## Introduction

The learning of programming has become easy with the global spread of the online learning of programming. Such e-learning systems execute programs in which students can create, as well as evaluate, programming exercises. The coding of a program involves many steps, such as declaration variables and methods. However, an e-learning system for general programming does not evaluate the program in the middle of coding. Hence, we developed a system that can evaluate a student's program in the middle of coding (Tatsuyuki, Kentaro, Takashi, & Osamu, 2015). Therefore, if the system finds an error in the program, it will point out the error. In the system, since it had pointed out by the correction videos prepared beforehand, concrete directions cannot be performed. We developed the system to generate automatically slides of the contents of advice. This paper describes the details of the system.

### The flow of learning using the system

Candidates are students of the beginner who learn Java programming. The contents exercised using the system are creating the skeleton of a program from the class diagram of UML.

A student learns the correspondence of a class diagram with a program by creating a skeleton of the program using the system. Figure 1 shows the flow of learning using the system. The main study methods are the same as those used in the previous system. A student creates a program with reference to the class diagram. Further, if a program has errors, the system will point them out and the student will correct the program according to the indication. The indicated error is shown as not only a compilation error but also a class or method name misspelling. There is no major change in the algorithm that judges errors. The differences between the previous system and this one are shown as follows:

1. The lecture video is changed into a lecture slide.
2. When there are two or more errors, the system indicates more than one.
3. When the correction of an error is finished, it is judged immediately.

First, the system can now give directions to a student by specifying a concrete class name in a lecture slide. Second, while only one screen was displayed in the previous system, multiple screens could be displayed simultaneously in this system. Furthermore, this system can point out an error precisely by using the character string of the error parts. Third, the earlier system judged when the correction of an error in a program was over and the cursor moved to the following line. However, this system judged correctly for every character.



Figure 1: Flow of learning using the system.

### The appearance of the system

Figure 2 depicts a general view of the system. It is developed as a web system, and a student uses the system using a web browser. The composition of the screen is shown in Figure 3.

The screen composition of the system is as follows:

1. Lecture slide
2. Class diagram
3. Editor

A lecture slide gives three types of information: Displays the directions of the creating program, indicates errors, and judges the completion of the program. A class diagram shows the declaration of the program to exercise. The editor is equipped with the auto-indent function and syntax highlight of Java.

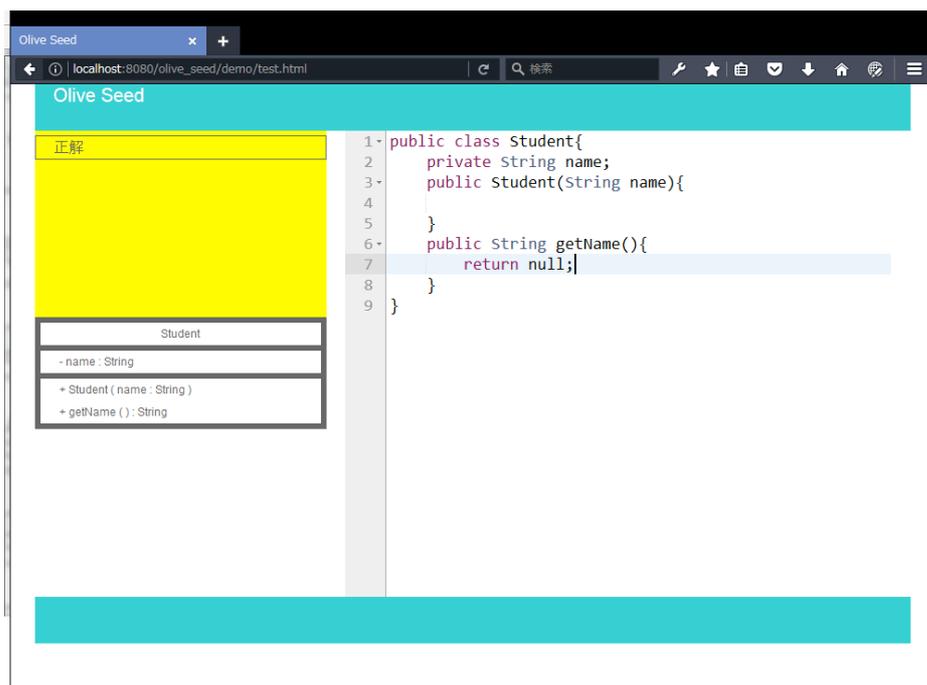


Figure 2: Appearance of the system.

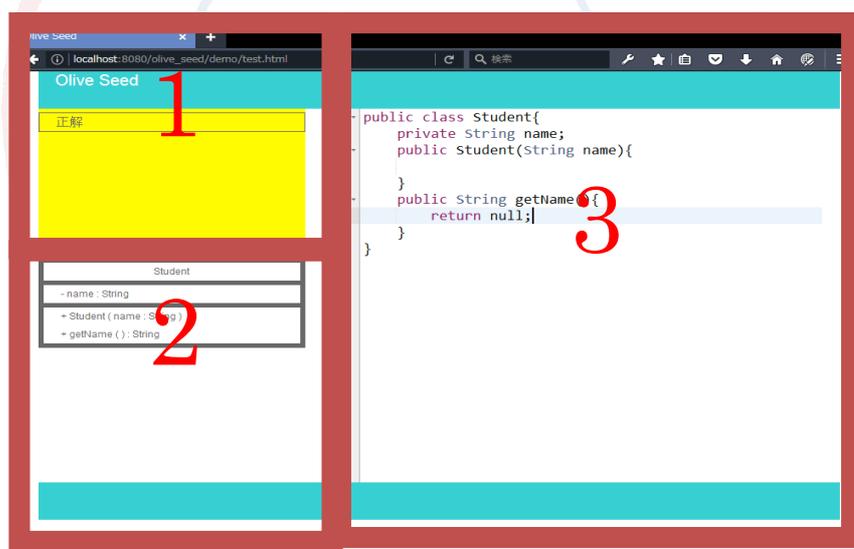


Figure 3: Composition of the screen.

### System Integration

The composition of the system is shown in Figure 4. It consists of server client forms. The server is developed using Grails, which is a web framework created by Groovy. Groovy is one of the programs operated by the Java Virtual Machine.

On the server side, the syntax analysis of a correct answer program and collection of a student's data are performed. The client side consists of mainly HTML and JavaScript. JavaScript is performing the generation of a lecture slide, lexical analysis of a student's program, and judgment of errors. An error shows the judgment result of a

spelling error, inserting words, and deleting words for a class name, a method name, or a reserved word in Java. Further, the kind of sum total is 69 patterns. The data of the syntax-analysis result of a correct answer program, and so on, are acquired using a JSON form.

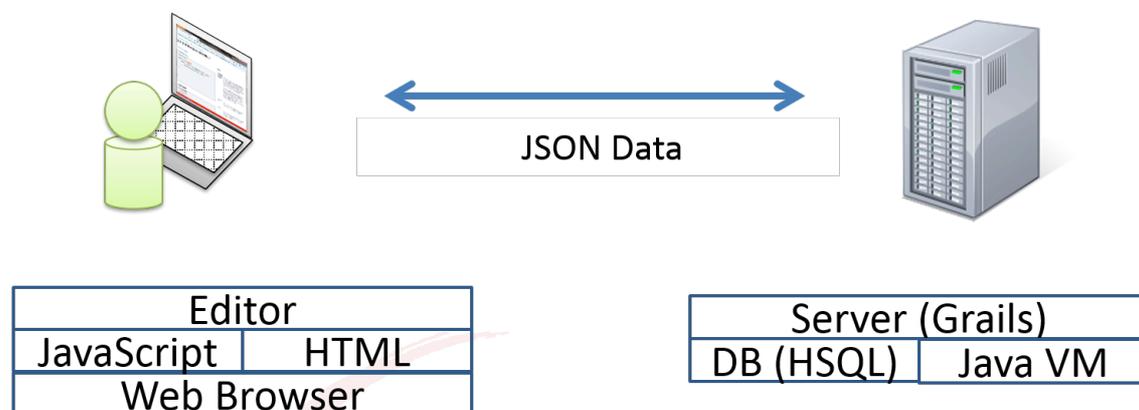


Figure 4: System integration.

**Conclusion**

In this research, when a student created a source code in accordance with a lecture video and an error was detected in the student’s code, the system switched to a slide that urged error correction. The error correction slides of this system support 69 major types of errors made by students. The developed system was able to indicate two or more errors. Moreover, the system is ready for test employment in a real-world lecture setting, to acquire student data, and to be evaluated.

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*A Reader of Gesture-Based Accessibility User Interface Design for Visually Impaired Children*

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**Abstract**

A mobile application, called READ, is developed in this paper to provide visually impaired children more friendly way of reading. This system includes accessible mobile app and book library in the cloud. In Taiwan, there is a special kind of books designed for children, which contains both braille and print characters on the same page. This kind of books is very useful for visually impaired children who start learning braille and their sighted parents or teachers can read with them. The proposed app is designed to assist visually impaired child in reading this kind of books. When visually impaired children get a book on the bookshelf, at home or in a library, they can scan the barcode on the book by the camera on the smart phone, then the proposed app READ will download the content in the cloud library and start reading the book with text-to-speech (TTS) technology to children. A non-directional barcode scanning technology is designed in the proposed app for fast recognition, and thus the barcode does not have to be focused and straight in the camera screen. Furthermore, unlike the common design concept that is based on buttons, gestures become the mainly user interface for visually impaired people. Users do not need to find the position of the buttons. Using gesture-based design the whole touch screen is the sensing area, which is more convenient and friendly for visually impaired children.

Keywords: accessibility user interface, visually-impaired children, gesture

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## Background

There are 56,000 persons with vision impairment in Taiwan, but only small parts of them, especially children, know how to use braille. Most visually impaired children are not familiar with braille and computers, and thus family members, teachers, or volunteers have to read for them. However, this way cannot be available to them around the clock. Another way to read is to listen to audio books. But recording audio books usually take a long time, and the volume of available audio books is limited. To provide visually impaired children an alternative way of reading, to enhance their skill to use braille, and to promote parent-child co-reading activities, we design and implement an APP, called READ, and a cloud library, to offer visually impaired children an alternative way of reading and promote parent co-reading activities.

Voice Over is a screen readers built in Apple's iOS system, which is classified as an accessibility feature for people with vision impairment. You can easily manipulate it with simple gestures on your iOS devices. Voice Over can use braille keyboard, which supports 6 dot and 8 dot braille, without third-party entities. Voice Over works with built-in iPhone apps, but not all commercial apps. It's a very useful function for the visually impaired people. Please refer to APPLE Website (<http://www.apple.com/accessibility/iphone/vision/>).

In Taiwan, there is a special kind of books designed for children, called dual-view book here, which contains both braille for the blind and print characters for the sighted person on the same page. This kind of books is very useful for visually impaired children who start learning braille and their sighted parents or teachers can read with them. Dual-view books can make teacher understand the reading situation of visually impaired students, and give them timely guidance. Therefore, the braille books can realize the co-reading activities.

## Research methods

The proposed app, READ, focuses on visually impaired children mainly. Even youth children can acquire how to use it. The app READ runs on iOS system, and can be downloaded from Apple Store. Eduardo Ghidini, Wagner D. L. Almeida, Isabel H. Manssour and Milene S. Silveira (2016) indications that interfaces that provide different forms of interaction, such as voice, touch and vibration, do facilitate the use of applications for the visually impaired. With friendly interface and voice guidance system, visually impaired children can use READ without parents' help. The visually impaired children can listen to the books they want with this APP. In addition, the parents can use the recording function of the app to make audio story with their own voice for their child to accomplish the purpose of parent-child reading. David McGookin, Stephen Brewster and WeiWei Jiang (2008) said touchscreen computing devices such as the iPhone are becoming more common. João Oliveira, Tiago Guerreiro, Hugo Nicolau, Joaquim Jorge and Daniel Gonçalves (2011) said good spatial ability is still required to have notion of the device and its interface, as well as the need to memorize buttons' positions on screen. These abilities decay especially for young or old people. Therefore, the operation concept of the proposed app READ is based on gestures instead of buttons. As whole touch screen is the sensing area, users don't need to focus on the position of a button anymore. Button-based user interface is not friendly for visually impaired people, especially young children who

seldom use the smart phone. It usually takes a long time to find a button on the screen, while they need to memorize the position of each button, tap on the correct location, and listen to the guidance before using it. This process is very inconvenient, and need a lot of time to adapt it. On the contrary, in the proposed gesture-based app READ, the whole touch screen is a sensing zone. The visually impaired people don't need to memorize the position of each button, which is more convenient and friendly.

### Research results

The proposed app READ run on iOS 6.0 and can be free downloading from Apple's App Store. Cooperating with Taiwan National Library of Public Information, the app links to the library's book database for the blind. This app has voice guidance assisting the visually impaired children in using the app by themselves. When the child wants to read a book, they can use this READ to scan the barcode on the book. READ will automatically connect to the library's book database, download the book's text file and play this book with text-to-speech (TTS) technology. READ also has a recording function, where parents or teachers can use this to record an audio book for their children or students. Then children can choose either TTS or audio made by parents or teachers to listen to the book. In addition, if there are volunteers who had recorded audio books stored in the database, children can also choose the audio version.

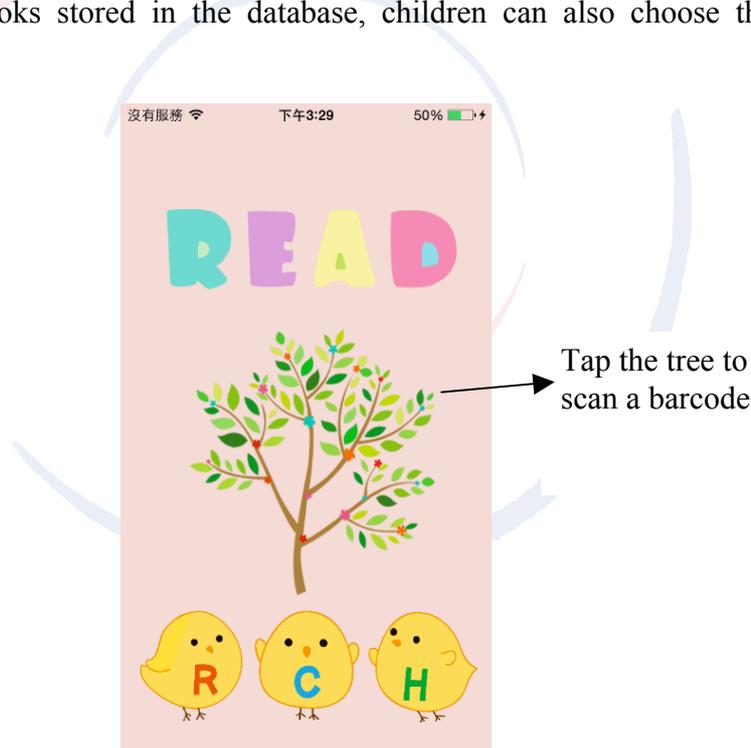


Figure 1. The main page.

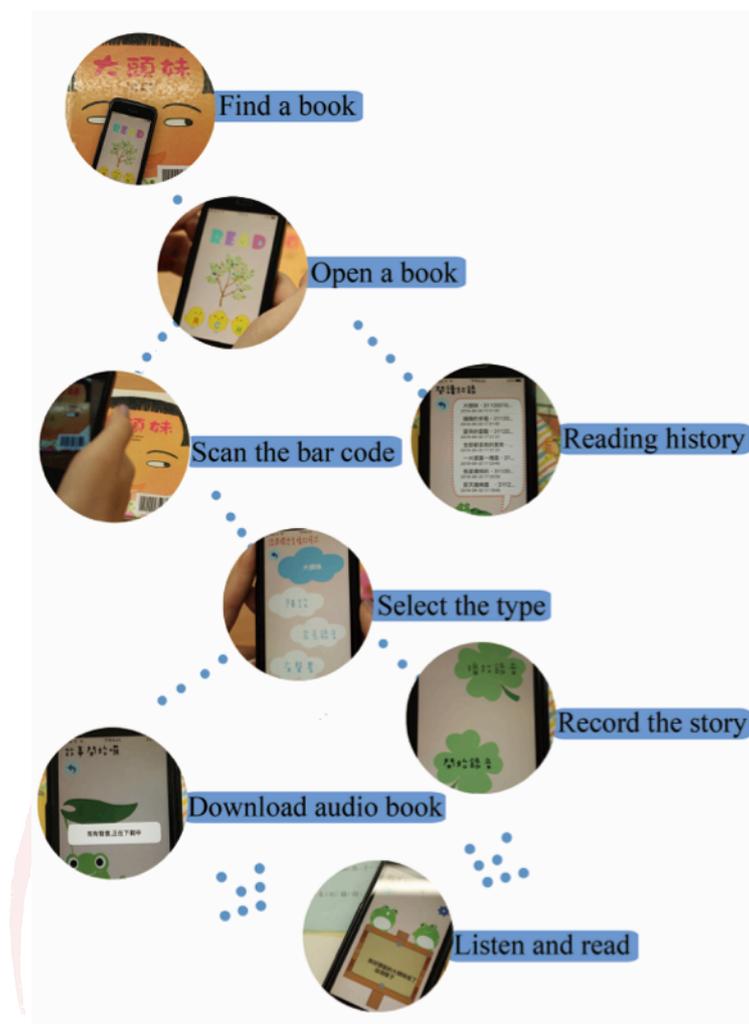


Figure 2. An example of using READ.



Figure 3. Enter the reading page

READ provides three main functions, scanning a barcode (tap the tree as shown in Figure 1), reading history (tap the 'H' as shown in Figure 1) and recording a story (tap the 'R' as shown in Figure 1). First, users need to log-in to use this app. Secondly, use READ to scan a book's barcode, and then the app will download the text file from the database, and start to play the book with text-to-speech (TTS) technology. We use a non-directional barcode scanning technology, and thus as long as the barcode is in the range of the camera, it can scan successfully. Figure 2 illustrates an example of using the proposed app READ.

Gesture		Action description
	Double tap	Open the book
	slide up	Increase pitch or Speak speed
	slide down	Decrease pitch or Speak speed
	Tap	Play or pause
	Two fingers slide to the left	Go to the previous sentence
	Two fingers slide to the right	Go to the next sentence

Figure 4. The gestures provided in READ.

In the playing page, as shown in Figure 3, the app plays a book sentence by sentence, with both words shown on screen and voice generated by TTS. When you tap on screen, the audio pauses; when you tap again, it continues. You can also go back to the previous sentence or jump to the next sentence any time by touching the screen with gestures. There are six gestures provided in this app, and different gestures indicate different actions, which are shown in Figure 4.



Figure 5. Reading history.

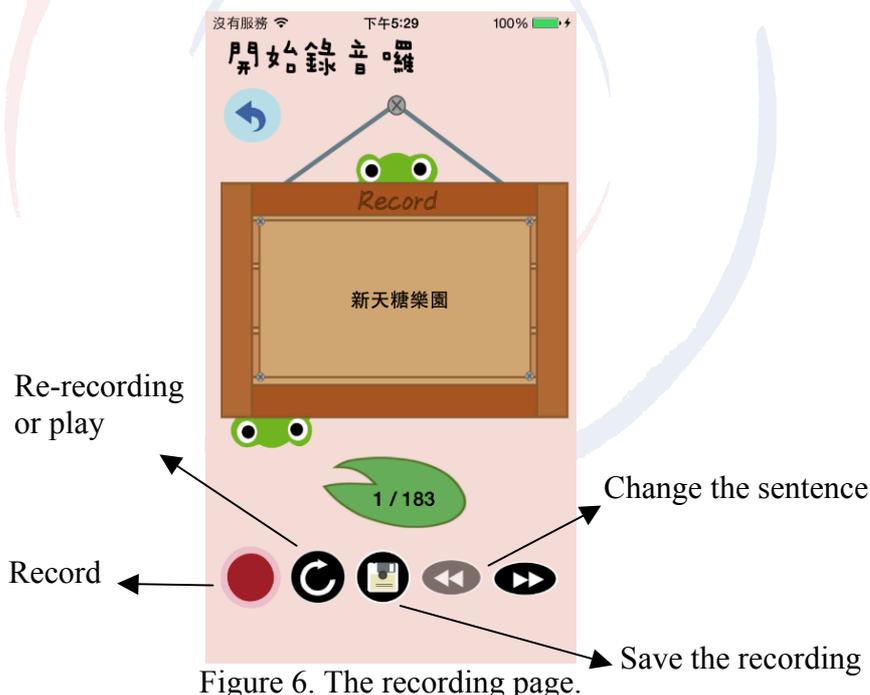


Figure 6. The recording page.

Reading history, as shown in Figure 5, allows parents to know which books the children had read, how many times they read this book, and the last time they read this book. When you double tap one entry, READ will open the book and go to the playing page automatically. Therefore, children can easily access and read the recent books again.

The recording function provides sentence by sentence recording feature, which parents can easily record an audio book. The recording page is shown in Figure 6.

## Conclusions

The traditional button-based user interface design is very inconvenient for visually impaired people. Therefore, the proposed app READ uses gesture-based interface design, where the whole touch screen is the sensing area, and the visual impaired children can control the app more easily and accessibly. Using this app, visually impaired children can scan the barcode on the book borrowed from the library and read the book easily. Additionally parents can record audio books for their child, which encourages children reading more. The app is now available at Apple's app store (<https://itunes.apple.com/tw/app/shuang-shi-shuo-shu/id989049054?l=zh&mt=8> ).



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***The Factors Affect Performance of Public Health Personnel Affiliated with  
Network Institute of Public Health and Medical Technology College  
toward ASEAN Communities***

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**Abstract**

As network institute of public health and medical technology college(NIoPH&MTC) is going to take part in ASEAN community, it is important for the public health personnel to improve their potential so that they can fit into life within ASEAN. The research was aimed at studying the factors that affect the performance of public health personnel toward Asean communities. Means of simple random sampling technique was used to collect 272 samples from public health personnel. The reliability of the overall questionnaire was 0.77. Data analysis was carried out in term of percentage, mean and multiple regression analysis. The results were found as follows: self-efficacy and expectancy on operating were identified for predicting ability on operating of public health personnel significantly ( $p < .01$ ) by 46.60 percent of accuracy. Thus, it is necessary to empower public health personnel in upgrade self-efficacy with management and public health networking and higher expectancy on operating with knowledge and essential skills required to perform medical and public health may be training or making a study trip to other agencies that are leading in the country or in ASEAN. This should contribute to health personnel for developing competency.

Keywords: factor affect, public health personnel, performance, network Institute of public health and medical technology college

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## Introduction

As Thailand is going to take part in ASEAN community, it is important for the public health personnel to improve their potential so that they can fit into life within ASEAN and play a vital role in the provision of health care globally link closely to the productivity and quality of care provision within health care organization. The Ministry of public health needs to prepare the workforce for the development of high potential and adapt quickly to the changes that will occur in the ASEAN community. Health problems such as inadequate number of personnel to support the increasing number of public health issues more. The lack of fairness in the distribution of personnel. Potential employees are also limited in dealing with more sophisticated health problems. The need to accelerate the development of human resources, quality and service models to prepare as well. Although health personnel, have a responsibility to use their knowledge and skills in professional practice to their full potential. So you can see that the development of human resources is a critical mission component of management requires both art and science of planning, manpower recruitment, selection process, place the right man on the right job and to make the most potential of the workforce, to keep them working to ultimate outcome.

Following concept that Albert Bandura 's theory of Self- Efficacy Theory that it is the process of human thought to be considered as promoting motivation in human offensive behavior to the operational aspects. The belief that we can change the behavior of the three factors is the personal factor, behavioral condition term and conditions, the environment, and found that if a person has high self- efficacy, and is expecting results from higher performance. People tend to do the exact behavior.

In accordance with Jitaram p.(2013) was found that the self-efficacy and expectancy the results of operations were positively correlated with the health practitioners in the community of healthy families were statistically significant, the level of .05. In accordance with Hanan Al-Ahmadi (2009) was found that job performance is positively correlated with organizational commitment, job satisfaction and personal and professional variables. Both job satisfaction and organizational commitment are strong predictors of nurses' performance. Job performance is positively related to some personal factors, including years of experience, nationality, gender, and marital status. Level of education is negatively related to performance. In accordance with Magdalene Hilda\Awases(2006) It was found that factors affecting the performance of nurses negatively were identified such as: lack of recognition of employees who are performing well, quality performance outcomes and an absence of a formal performance appraisal system and poor working conditions. Various factors contribute to both the positive and negative performance of professional nurses in Namibia. This study emphasis the importance of developing strategies to promote the performance of nurses; build knowledge and expertise; develop mechanisms for improving the performance of nurses; expand leadership and management capacity; and generate information and knowledge through research. However, factors affecting the performance of public health personnel affiliated with NIOPH&MTC toward ASEAN communities have not yet been examined. There is a need to seek evidence about their performance and to develop strategies to monitor and improve their performance.

**Objective**

The objective of this study was to determine the factors which positively and negatively affect performance of public health personnel affiliated with NIoPH&MTC.

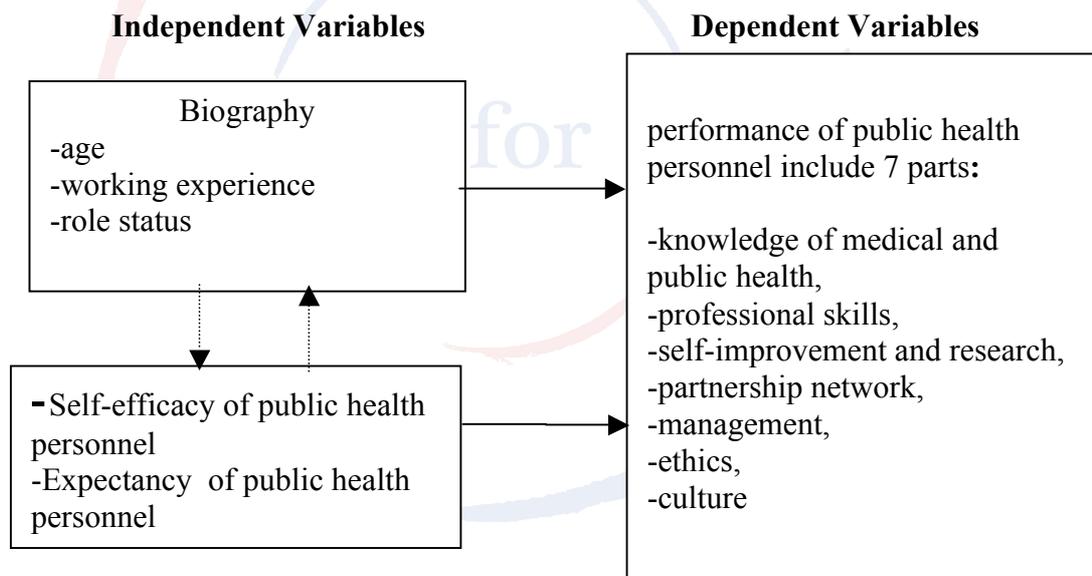
**Definition of key concepts**

Performance of Public Health Personnel: it is about working for increasing the overall productivity of an agency include 7 parts; 1) Knowledge of medicine and public health 2) professional skills 3)Self-improvement and research 4) Partnership network 5) Management 6) Ethics and 7) Cultural

Self-efficacy: the extent or strength of one's belief in one's own ability to complete tasks and reach the performance of Public Health Personnel.

Expectancy: the feeling that you have when you are expecting something especially ultimate outcomes of the performance of Public Health Personnel.

**Conceptual Framework**



Pic1. Conceptual Framework of the factors affect performance of public health personnel affiliated with NIoPH&MTC toward ASEAN communities.

## Population and sample

Population is the public health personnel affiliated with NIOPH&MTC totaling 850 persons, using Taro Yamane's formula (1973), which sample size of 272 was selected as the formula

$$n = \frac{N}{1 + Ne^2}$$

N = number of population = 850 persons

n = sample size

e = error value = 05 % (0.05)

calculation:

$$n = \frac{850}{1 + 850(.05)^2} = \frac{850}{1 + 2.125} = \frac{850}{3.125}$$

$$= 272 \text{ persons}$$

## Research tools

The researcher studied and reviewed data from various theoretical concepts and related research, guideline for creating a research tool. Survey data were collected by questionnaire, consisted 3 parts Part 1 personal characteristics, Part 2 Inputs 2 sections: self-efficacy and expectancy of public health personnel on performance It was a measure of 5 levels (strongly agree, agree, not sure, disagree and strongly disagree), to measure their opinions in relation to given statements. The basis of its interpretation was divided into 3 levels of good, fair and poor (score 3.661 to 5.000, 2.331 to 3.660 and 1.000 to 2.330), respectively. Part 3 performance of public health personnel 7 parts; 1)knowledge of medicine and public health 2) professional skills 3) self-improvement and research 4) partnership network 5) management 6) ethics and 7) cultural It was a measure of 5 levels (always, often, sometimes, seldom and never).

## Data collection method

A questionnaire was designed in line with the objective and literature review, consisting of closed-ended questions. Respondents indicated their responses on a Likert scale for agreement levels. The questionnaires, together with a return envelope, were delivered personally by the researcher to the research manager of each college. During these visits the aim, importance of the study and questionnaire return dates, were explained. Of the 300 questionnaires that were distributed, 272 were returned.

## Validity and reliability

Monitoring tool, the researcher developed a questionnaire that was validity of content by experts, reviewed the content and accuracy of language. Then updated to be trial with another group. Reliability of the instrument was determined by means of the Cronbach's Alpha, testing the internal consistency of items. The reliability of every items was adequate, recorded a reliability of 0.77, then the researcher used this tool to study a real sample.

**Data analysis**

Data analysis was carried out in term of percentage, mean, standard deviation, correlation and multiple regression analysis. The statistical analysis program SPSS was used to analyze the data.

**Ethical considerations**

This study was approved by the ethics committee of the Sirindhorn College of Public Health, Chonburi (SCPHC), Thailand. Respondents were informed about the objective of the study, their voluntary participation and their right to withdraw from the study at any time. Anonymity and confidentiality were ensured by providing self-addressed envelopes with all questionnaires, requesting respondents not to write their names on the questionnaires.



## Result

Of the respondents 34.7% were between 30–49 years of age, their average age is 40.9 years old, and most of them 65.8% were married, 75.0% were females and 52.2% had master degree (in public health/nursing/education). A third of the respondents had worked as professional nurse 32.7%, instructor, pharmacist, dentist and public health personnel 23.5%, 18.0%, 15.1% and 10.7%, correspondingly. Besides, they also had an average of about 16.2 years working experiences and 84.9% of the respondents were working as a staff / lecturer, only 15.1% were administrator. (Table 1)

**Table 1** Classified bibliography of respondents

bibliography of respondents	number	percent
Gender		
male	68	25.00
female	204	75.00
Age ( $\bar{X} = 40.91$ S.D. = 10.79 )		
21 - 30 11	72	26.47
31 - 40 11	52	19.12
41 - 50 11	82	30.15
51 - 60 11	66	24.26
Education		
Bachelor degree	99	36.40
Master degree	142	52.20
PhD degree	31	11.40
Role status		
Administrator	41	15.07
Staff / lecturer	231	84.93
Position		
Nurse	89	32.72
Health lecturer	64	23.53
Pharmacist	49	18.01
Dentist	41	15.07
Other	29	10.66
Working experience ( $\bar{X} = 16.2$ S.D = 10.9)		
10 year or less than	105	38.60
11 – 20 year	64	23.53
21 – 30 year	74	27.21
31 – 40 year	29	10.66

The level of self-efficacy of the respondents was fair (62.1%) with a mean score of  $3.9 \pm 0.6$ . The level of expectancy of the respondents was high (54.4%) with a mean score of  $4.3 \pm 0.4$ . (Table 2)

**Table 2** Classified opinion factor levels of respondents in 3 groups

factor	levels of respondents in 3 groups (%)		
	high	fair	should improve
Self-efficacy	85(31.3)	169(62.1)	18(6.6)
Expectancy	148(54.4)	114(41.9)	10(3.7)

The results revealed that there was no statistically significant relationship between demographic factors and personal attributes of participants, namely age, role status and working experience. Self-efficacy of the respondents, as a whole, were found to have a moderate and positive relationship with performance public health personnel ( $r = 0.623$ ,  $p$ -value  $< 0.001$ ). Expectancy of the respondents, as a whole, were found to have a moderate and positive relationship with working performance ( $r = 0.651$ ,  $p$ -value  $< 0.001$ ).

The Stepwise multiple regression analysis showed that two of the five factors (age, role status, working experience, self-efficacy and expectancy) were statistically significant predictors of the performance of public health personnel. These significant predictors were self-efficacy and expectancy of public health personnel. The estimated regression equation was significant at 0.01 ( $p < 0.01$ ), implying that these two variables (self-efficacy and expectancy) have an impact on performance evaluation thereby qualifying these to be the predictors for the latter. In conclusion, the two variables account for 46.60 percent of variation in the performance of public health personnel and  $R = 0.683$ . The following multivariate linear regression model shows the relationship between the predictor variables in the dependent variable. (Table 3-4)

$$\hat{Y} = 1.244 + 0.282 X_1 + 0.409 X_2$$

$\hat{Y}$  = Performance of public health personnel

$X_1$  = self-efficacy

$X_2$  = expectancy

**Table 3** ANOVA of multiple regression analysis of the two predictors.

Model	df	SS	MS	F	p
Regression	2	34.741	17.371	117.485	0.01*
Residual	269	39.773	.148		
Total	271	74.514			

**Table 4** Results of multiple regression analysis of predictors asr the criterion.

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	b	SE b	$\beta$		
Constant	1.244	.173		7.180	.000
Expectancy (X <sub>2</sub> )	.409	.046	.442	8.914	.000
Self-efficacy(X <sub>1</sub> )	.282	.039	.362	7.309	.000

## Discussion

On this line of reasoning, this study was conducted to examine the factors that affecting the performance of public health personnel affiliated with network Institute of public health and medical technology college toward ASEAN communities, Thailand. A Stepwise multiple regression analysis was used to investigate how personal attributes and two factors (self-efficacy and expectancy) predict the outcome of performance of public health personnel. This finding was similar to the one reported by HananAl-Ahmadi (2009) and was similar to Magdalene Hilda\Awases(2006). These findings have suggesting that if they want to improve their performance This finding is consistent with Bouphan (2009) who proposed that man, money, material, time and information technology were the key administrative resources for success in organization if they were combined appropriately. Besides that, all the four components of administrative resources had positive relationship with the performance evaluation. This finding was similar to the one reported by Nark-ok, J. & Bouphan, P., (2010) who revealed that administrative resources had positive relationship with the performance evaluation by primary care unit chiefs in commodity management. These findings imply that, to perform productively, sub-district health promoting hospital directors require good organizational supports, especially in terms of manpower, sufficient project budgets, tools and equipment, as well as training in staff's ability to provide effective.

Planning for the development of public health personnel should consider the efficacy of its results and its expectations for the performance. By focusing on training or workshops for groups such as personnel training focused on research and development. The partnerships and the skills needed to use information technology such as English Thus, it is necessary to empower public health personnel in upgrade self-efficacy with management and public health networking and higher expectancy on operating with knowledge and essential skills required to perform medical and public health may be training or making a study trip to other agencies that are leading in the country or in ASEAN. This should contribute to health personnel for developing competency.

## Acknowledgment

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## *Measuring the Use of Twitter in Education*

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### **Abstract**

The educational environment is affected by the transformations of new technologies, virtual communities, and social networks, and especially by the creation of social knowledge. In this frame, students show a greater tendency to use ICT tools, inside and outside academic settings, a fact that is transforming their process and the ways of learning. To cope with this situation, it is crucial to use educational strategies centred on active methodologies, the use of new technologies, the continuous participation of students, and the use of co-learning processes that focus on the characteristics of new students. However, research about the advantages of these new methodologies of teaching and learning, and especially about their performance are still scarce.

This paper concentrates and analyzes specifically on the use of Twitter as an important tool for educational purposes. Twitter, like other social media, is broadly used by students. However, and in spite of its possibilities, its use for educational purposes is reduced. In order to fill this gap, this work studies the main potentialities of Twitter to provide different applications and services for students.

In addition, and after a deep research in the literature, the paper creates a rubric or questionnaire to measure the opinion of students about the capabilities and possibilities of twitter for educational purposes. The questionnaire is tested with a sample of 105 students at the university level. Results and discussion of the results, and recommendations for future research and applications are also provided.

Keywords: Twitter, education, innovation, rubric

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## Introduction

The nowadays educational environment requires the application and transformation of new teaching and learning methods and tools (Garrigós et al., 2015). The greater tendency of students to use ICT tools inside and outside academic settings (Venkatesh, et al 2014) demand of new educational strategies centered on new active methodologies, where the participation of students and the use of co-learning processes are crucial. Moreover, the new methods have to consider the use of social networks as an essential mechanism for learning and the creation of knowledge.

There is scarce research about these new methods. In order to fill these gaps, this paper analyzes the crucial role of social media in the improvement of teaching mechanism. Moreover, the paper concentrates on the analysis of Twitter as an important tool to improve education and learning. In addition, the paper creates and evaluates a rubric about the use of twitter, and describes a methodology for using twitter for the improvement and evaluation of marketing and management assignments in courses for engineers at a university level.

## Twitter

Consider as one of the main social networks nowadays, Twitter is a micro blogging service, created in California in March 2006. Described as "the SMS of the Internet" (Garrigós et al., 2016a,b), this social network has become one of the top 10 most visited websites on the Internet (Maduewesi, 2013). Nowadays it has more than 320 million active users, which means, users that launch at least one tweet each month; it supports more than 35 languages (Twitter, 2016), several alphabets and allows automatic translation.

Due to their popularity, the use of social networks, and particularly Twitter, in education, is a reality that cannot be hidden and avoided. Following Garrigós (2016a) Twitter permits users to send short text messages, with a maximum of 140 characters, called tweets. Users can subscribe to the tweets of other users, by following them as "followers". By default, messages are public, however they can also be spread privately to certain followers. As opposed to other social networks, communication is multiple and simultaneous one-to-many. This fact, in our opinion, facilitates its suitability for teaching, as one can virtualize the connection "one-to-many" that the teacher establishes with his students in the classroom. Moreover microblogging can be used for one-way exchanges, as an official account, to keep the community informed of events, deadlines, or policy changes. However, Twitter can also provide "many to many" communication, allowing not only not the student-teacher communication or link, but also the appearance of groups with their own entity as administrators. Other interest groups can be formed, permitting communication through the use of a hashtag (string of characters that consists of one or more concatenated words preceded by the hash character (#) used to indicate a subject on which a conversation turns) or interactions between accounts.

Garrigos et al (2016a, b), analyze some of the advantages and disadvantages of twitter for learning education. Reconsidering the most important of them, we could synthesize them in the following list:

1. It is easy to use.
2. It is cross-platform multi-device. It is accessible, as it is available on almost any platform and any device that allows connection to the Internet (Garcia et al, 2015). Specially, it permits Multy-device access (eg. Smartphones), as it is always in the pocket of students
3. It is not invasive, the tool opens when you want. Moreover, it not pursues messages to the recipient.
4. It facilitates access to information, and search for hashtags. It facilitates the search of information (Miguel and Fernández, 2013), a fact that facilitates finding the most relevant information, and organize it (García et al, 2015). The use of Twitter for education has many advantages, among them we can be stress the easy of using list or hashtags (users tag the publications or events in order to group groups, themes..., allowing the possibility of spreading the opinions of people easily). Searches can be made by words, hashtags, or related tweets, which allows the localization of people or interesting, quick, instantaneous information related to the matters covered. In addition, this facilitates making debates from a hashtag.
5. It facilitates the exchange of information with colleagues or peers. It make easy the sharing of relevant information quickly (Miguel and Fernández, 2013, Carpenter, 2014), and the sharing of questions, ideas or tasks (Dunlap and Lownthal, 2009). For instance, Evans (2014) found positive correlation between the amount of Twitter usage and the sharing of information.
6. Twitter is a tool that student recognize as their own. As it is a popular, novel tool, it is usually well received among students. (Garcia et al, 2015). We cannot forget that it is a highly recognizable technology of social media (Cassidy et al., 2014), and, a tool they recognize as their own (Noguera, 2015)
7. Twitter facilitates reading, and it is agile. It produces agile reading, derived from its brevity (140 characters) (García et al, 2015)
8. It facilitates the synthesis of relevant information quickly (Miguel and Fernández, 2013). Moreover, the articles are transformed by the social network, which summarizes and make them attractive for users.
9. Twitter allows for anonymity (García et al., 2015)
10. Twitter foster sharing, conversation and relationship (Falahah & Rosmala, 2012). This platform facilitates connectedness and resource sharing (Carpenter, 2014), participation (Noguera, 2015), and communication (García et al, 2015). It promotes direct communication between users, a fact that facilitates the rapprochement between users (Miguel and Fernández, 2013). In addition, Welch and Bonnan-White (2012) state that Twitter increases student engagement in the university classroom. The benefit from engagement is especially important in the case of online courses, as its use permits sharing information (Dunlap and Lowenthal, 2009), and leads to greater cohesion within the group (Guzmán et al., 2012). Moreover, according to Guzmán et al., (2012) it helps prevent drops in attention throughout a lecture, and increases the receptivity of the students, by encouraging active participation every so often
11. Twitter enhance the ability of writing by having to condense an idea into 140 characters. The fact of expressing ideas or opinions on a subject in only 140 characters helps students in their writing skills. Hence it focuses the attention of students, and the search for objectives connected with the study plan without being tied or restricted to it (Grosseck and Holotescu, 2008), and it

- promotes learning to write for a particular audience (Dunlap and Lowenthal, 2009).
12. Twitter promotes collaboration and networking (Noguera, 2015). It facilitates interaction and collaborative work (García et al., 2015; Grosseck and Holotescu, 2008), and collaborative learning (Carpenter, 2014).
  13. Twitter improves the ability to identify with someone (empathy), or even the empathy with the subject (Sullivan, 2012)
  14. Twitter improves the practice of thinking and reflecting on learning, being a viable platform for metacognition (Grosseck and Holotescu, 2008)
  15. Twitter improves motivation and academic performance. As a tool they recognize as their own, it increases motivation, academic performance and participation (Noguera, 2015). Moreover, it promotes the motivation of the students, as it provides elements of enjoyment and social presence (Noguera, 2015)
  16. Twitter improves the working environment with peers. It improves working atmosphere (Miguel and Fernández, 2013). In addition, Evans (2014) also founded a correlation between the amount of twitter usage and student engagement in university-associated activities such as organizing their social lives.
  17. With the use of Twitter one is more open about his feelings. By using Twitter, students can be more open about their feelings and shortcomings (Junco et al., 2011). It enhances the participation in the classroom especially for those more introverted students, for whom it is difficult to express their views aloud (Guzmán et al., 2012). Hence, it means that communication between students is uninhibited and they can speak to the teacher directly (Carpenter, 2014). In general, it facilitates inclusion and equity (Noguera, 2015)
  18. Twitter facilitates peer tutoring and / or collaborative learning. It facilitates collaborative work between students (García et al., 2015; Grosseck and Holotescu, 2008). In addition, it promotes peer tutoring (Dunlap and Lowenthal, 2009), as it allows sharing images, videos, documents, presentations, etc. with others.
  19. Twitter can allow maintaining ongoing relationships after the course ends. Hence, student and faculty use of Twitter is not bound by the structure of the lesson or the timing of a semester, permitting continuous advice to students academically and professionally (Dunlap and Lowenthal, 2009; Moody, 2010)
  20. Twitter facilitates interaction and also work in collaboration between students and teachers. First of all it is interactive (Dunlap and Lowenthal, 2009; Thoms and Eryilmaz, 2015), showing other publications, which the user can intervene in, share or save by marking them as favorites (García et al., 2015). It facilitates interaction between students (García et al., 2015; Grosseck and Holotescu, 2008), as pointed before, but it also allows connection with students from other schools and countries. It also promotes collaboration between students and teacher as it also allow the dissemination of publications and teaching materials (Grosseck and Holotescu, 2008), and as it helps to enhance the sharing of resource material research and task assignment, for announcements, to negotiate rescheduling class etc. In addition, it also helps teachers (Carpenter and Krutka, 2014), through collaboration between diverse schools and countries (Grosseck and Holotescu, 2008), or even direct communication with parents, who can follow the activities of their children.

- For instance according to Carpenter and Krutka (2014), Twitter can allow educators to learn with and from each other in an apparently meaningful way.
21. Twitter allows to extend the work outside the classroom, from the questions, reminders of deadlines and others. It enables students to learn outside the classroom (Venkatesh et al., 2014), It overcomes the spatial and temporal boundaries of the classroom (García-Suarez et al., 2015), allowing work to extend outside the classroom, from questions posed, subsequent tasks with reminders of deadlines, and even raise issues of future classes or creating virtual meetings, (Noguera, 2015). Moreover, Twitter communications improve students and faculty engagement in the learning process in ways that transcended traditional classroom activities (Junco et al., 2011). The improvement on students perceptions, the ease of use, the usability and overall experience helps students to learn outside the classroom
  22. Twitter allows acquire practical skills in a more informal way (Dunlap and Lowenthal, 2009; Grosseck and Holotescu, 2008).
  23. It promotes students autonomous education. Or more broadly the self-directed, independent, and autonomous education (Noguera, 2015)
  24. It helps to reduce the number of students who leave a course. Specially, facts such as the changes in the learning environment and the higher engagement and cohesion within the group can lead to a reduction of the number of students who leave the course (Guzmán et al., 2012)
  25. Twitter contributes to the personalization of learning (Noguera, 2015), each at its own pace. This is due essentially to the attributes of the tool. In addition It also allows easy organization of time (Dunlap and Lowenthal, 2009), and organization through hashtags and publication dates (García et al., 2015).
  26. It's easy to follow influencers, and access them with or without feedback. It makes it easy to follow people who contribute on matters that are being studied. There is access to professionals, with or without feedback (Dunlap and Lowenthal, 2009; Guzman et al., 2012)
  27. The use of trending topics facilitates to find information in real time. It is characterized because of its Immediacy (Dunlap and Lowenthal, 2009; Tess, 2013). In this sense it is dynamic, as the information is in real time (Cassidy et al., 2014; Garcia, 201). It makes easy the access to the so-called "Trending topics", or the most relevant themes or spoken topics at each moment, which can be filtered by locations.
  28. Facilitates access to information within an institution (Noguera, 2015), a fact that is promoted because of the previous commented immediacy
  29. It's easy to comment and read about conferences where one cannot attend. In addition, for conference attendees, Twitter can provide a simple way to share thoughts with others at the event about specific sessions and activities, and with those who cannot attend, providing live coverage of events (Grosseck and Holotescu, 2008). It can help in brainstorming (Barreto and Jimenez, 2010) or to disseminate conference updates to non-attendees (Garrigos et al., 2016a,b). Moreover, it offers the possibility of virtual conferences through streaming (although this is an external functionality), with the possibilities of chatting.
  30. The ease of using images, videos and links and integrated tools such as surveys, improves locating information. It has a high functionality, as it allows embedding pictures, videos and links (Garcia et al., 2015), and the integrated use of tools and video presentations (Moody, 2010). Moreover, as commented previously, the so-called "Trending topics" make easy locating information.

31. Sharing things to a small community provides you with a sense of belonging to the same. As commented previously, Twitter increases student engagement, but also the sense of belonging (Guzmán et al., 2012).
32. Students can use tweets in order to send questions and observations to the group during the activities in the classroom.
33. Your behavior is viral; when re-tweeting, or spreading news, one becomes information issuer. It is viral, as contributors can re-tweet a tweet from another user, or spread photos, news etc. Students become small emitters of information (Moody, 2010), as they can share the things they can find (Dunlap and Lowenthal, 2009), for instance using Twitter as a journal club to share related papers or information (Barreto and Jimenez, 2010)
34. Apart from improving the working environment in general (Miguel and Fernández, 2013), as pointed before, specifically it has a positive impact on creating a collaborative working atmosphere (Rinaldo et al., 2011)
35. It helps to create a sense of community, and to generate confidence and security. Social media, such as Facebook and Twitter, are recognized for enabling students to build communities (Venkatesh et al., 2014). Moreover Twitter is a valued tool to create or build a sense of community and generate trust and confidence (Grosbeck and Holotescu, 2008; Moody, 2010; Thoms and Eryilmaz, 2015, Garrigos et al., 2016 a,b)
36. Twitter improves informal learning. Twitter helps the informal autonomous learning of students, who can discover resources and tools than can be applied effectively in their courses (Dunlap and Lowenthal, 2009; Grosbeck and Holotescu, 2008)
37. It increases learning in general (Thoms and Eryilmaz, 2015). It fosters student learning (García et al., 2015). In addition, and specifically, it facilitates lifelong learning and learner mobility (Noguera, 2015).
38. Twitter redefines the roles of teachers and students, opening the door to teaching student-centered methods (Noguera, 2015). In addition, Grosbeck and Holotescu (2008) highlight that the act of participation in education and the interchange of the best practices used by lecturers changes the dynamics of the classroom
39. It enhances dialogue (Moody, 2010), and promotes understanding of materials (García et al., 2015). It promotes teaching presence, or the ability of the teachers to support and enhance social and cognitive presence through instructional management, building understanding, and direct instruction, as Twitter helps lecturers to engage in interactions with students (Dunlap and Lowenthal, 2009). Moreover, it facilitates centralizing the activities and sources of information and the coordination of the work, allowing the monitoring of the main points and following activities (Miguel and Fernández, 2013).
40. Twitter facilitates changes in cognitive processes and learning patterns (Noguera, 2015). In addition, when used correctly it instigates complex cognitive processes (Venkatesh et al., 2014).

These items could be synthesized in the rubric showed in table 1

Table 1: Rubric

Number	Question
1	It is easy to use
2	It is cross-platform and multi device
3	It is not invasive, the tool opens when you want
4	Facilitates access to information, and search for hashtags
5	It facilitates the exchange of information with colleagues
6	Do you think twitter ... is a tool that you recognize as your own ?
7	Do you think twitter ... facilitates reading, it is agile?
8	Do you think twitter... allows the synthesis of relevant information quickly?
9	Do you think twitter ... allows anonymous?
10	Do you think Twitter... foster sharing, conversation and relationship?
11	Twitter enhance the ability of writing by having to condense an idea into 140 characters
12	Twitter promotes collaboration and networking
13	Twitter improves the ability to identify with someone (empathy)
14	Twitter improves the practice of thinking and reflecting on learning (metacognition)
15	Twitter improves motivation and academic performance
16	Twitter improves the working environment with your peers
17	With the use of Twitter, you are more open about your feelings
18	Twitter facilitates peer tutoring and / or collaborative learning
19	Do you think that Twitter will allow maintaining ongoing relationships after the course ends?
20	Twitter facilitates interaction and also work in collaboration between students and teachers
21	Twitter allows to extend the work outside the classroom, from the questions, reminders of deadlines and others
22	Twitter allows acquire practical skills in a more informal way
23	It promotes students autonomous education
24	It helps to reduce the number of students who leave a course
25	Twitter contributes to the personalization of learning, each at its own pace
26	It's easy to follow influencers, and access them with or without feedback
27	The use of "trending topics" facilitates to find information in real time.
28	Facilitates access to information within an institution
29	It's easy to comment and read about conferences where you cannot attend
30	The ease of using images, videos and links and integrated tools such as surveys, improves locating information.
31	Sharing things to a small community provides you with a sense of belonging to the same
32	Students can use tweets in order to send questions and observations to the group during the activities in the classroom
33	Your behavior is viral; when re-tweeting, or spreading news, you

	become information issuer
34	It has a positive impact on creating a collaborative working atmosphere
35	It helps to create a sense of community, and to generate confidence and security
36	Twitter improves informal learning
37	It increases learning in general
38	Twitter redefines the roles of teachers and students
39	It enhances dialogue, and promotes understanding of materials
40	Twitter facilitates changes in cognitive processes and learning patterns

### Empirical Study: Evaluation of Twitter

Focusing on our particular case, Twitter was employed for experimental teaching purposes in the FBO (Foundations of Business Organizations), and D&P (Deontology and Professionamism) courses, in the School of Computer Engineering at the Polytechnic University of Valencia. In order to do evaluate the advantages of the use of Twitter, we created a virtual questionnaire (following the rubric and items previously analyzed). This experiment was carried out during the 2015-2016 course, and we got a final sample of 105 valid questionnaires. We asked for the perception of students about the diverse advantages of Twitter, using a 5 points likert scale, with showing 5 the most favorable opinion.

### Results

The main results of this questionnaire are shown in table 2. Figure 1 shows the average of the opinions of the students for the 40 items of our rubric. A special feature of note is that students on the one hand were not only knowledgeable about the technology, but they were also direct users of the tool, as they had used it previously with full competence.

Table 2: Main results of the questionnaire to students, using the rubric provided

Number of question	Average (mean)	Standard deviation	1 quartile	2quartil (median)	3 quartil
1	4.08	1.07	3.5	4	5
2	4.29	0.95	4	5	5
3	3.71	1.19	3	4	5
4	3.76	1.13	3	4	5
5	3.32	1.24	2	3	4
6	3.24	1.26	2	3	4
7	3.62	1.18	3	4	4
8	3.59	1.26	3	4	4.75
9	2.51	1.3	1	2	3
10	3.40	1.18	3	3	4
11	3.51	1.20	3	4	4
12	3.32	1.06	3	3	4
13	3.29	1.13	3	3	4
14	3.18	1.15	2	3	4
15	2.87	1.25	2	3	4

16	2.96	1.16	2	3	4
17	2.92	1.22	2	3	4
18	3.10	1.15	2	3	4
19	3.03	1.25	2	3	4
20	3.39	1.14	2	4	4
21	3.43	1.18	3	4	4
22	3.40	1.18	3	3	4
23	3.39	1.22	2.25	3	4
24	2.63	1.32	1	2	3
25	3.04	1.18	2	3	4
26	3.98	1.09	3	4	5
27	3.89	1.17	3	4	4.75
28	3.56	1.09	3	4	4
29	4	1.08	3	4	4
30	4.05	1.11	3	4	5
31	3.62	1.12	3	3.5	4
32	3.36	1.27	2	3	4
33	3.76	1.21	3	4	4
34	3.33	1.14	2	3	4
35	3.39	1.10	2	3	4
36	3.68	1.23	3	3.5	4
37	3.47	1.17	2	3	4
38	3.54	1.21	2	3	4
39	3.50	1.09	3	3	4
40	3.59	1.14	3	3	4

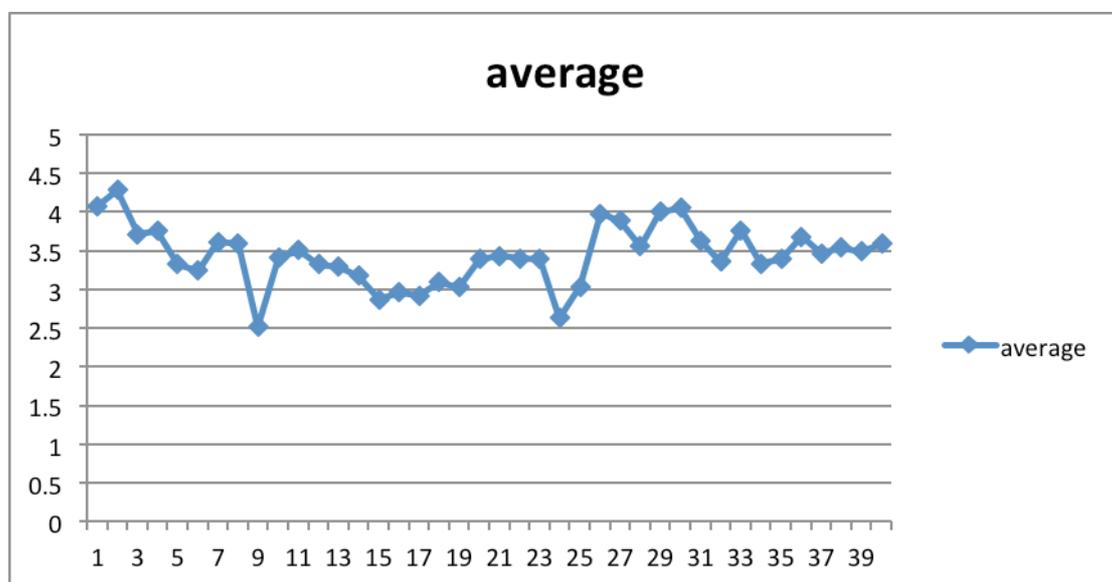


Figure 1: Average (mean) of the evaluation of items

According to the opinions of the students the question that receives more support is question 2” “It is cross-platform and multi device”. Apart from this, other questions supported, with an average near to 4 are questions 1: “It is easy to use”, question 26: “It's easy to follow influencers, and access them with or without feedback”, 27: “The use of “trending topics” facilitates to find information in real time”, 29: “It's easy to

comment and read about conferences where you cannot attend” and 30: “The ease of using images, videos and links and integrated tools such as surveys, improves locating information”.

Opposite, the ones that have lower support with an average of 2.5 are question 9: “Do you think twitter ... allows anonymous?”, and 24: “It helps to reduce the number of students who leave a course”.

However we the evaluations of students are positive in all the cases, due that most of the items get an average of more than 3 and there is no item with a punctuation lower than 2.5.

## **Discussion and Conclusion**

The literature has researched previously about Twitter usage, the context in which Twitter is used, the impact Twitter usage has on engagement of students, or even the impact of its use on the creation and maintenance of university students' cognitive social capital (Petersen and Johnston, 2015).

However, although there are some exceptions that have used it to analyze some outcomes (i.e Dunlap and Lowenthal, 2009; Guzmán et al., 2012; Clark, 2014; Pieterse and Peled, 2014; Thoms and Eryilmaz, 2015) few studies have analyzed the impact of the use of Twitter on students behavior and perceptions. In order to cope with this situation, our paper, has concentrated in developed theoretical research about the use of Twitter and the performance of students at university level. In addition, the paper has created a rubric about the benefits and consequences of the use of Twitter in the classroom. Among the theoretical advantages of Twitter analyzed, we have stress questions such as its accessibility, immediacy, interactivity, its use as a reminder about activities, asking questions, facilitating participation, discussions and provision of information.... Moreover the paper has conducted an evaluation of this rubric in the D&P and FBO courses in the School of Computer Engineering at the Polytechnic University of Valencia, with a participation of 105 final opinions by students. Specifically we analyzed the incidence of the use of Twitter in the perceptions of students about the advantages and uses of Twitter, in an experiment with optional participation by students.

The results show that the most important advantages of twitter, are related with being a cross platform and multi-device, that it is easy to use, follow and access influences, the advantages to find information in real time, the easy use of images videos and links that facilitate locating information, or the facilities to comment and read new information. However, the anonymity of the platform and its influence to reduce the number of students who leave a course are the items that have lower support. Nevertheless, all the advantages considered have a support of 3 or more up to 5 in a likert scale, and no average is lower than 2.5.

It is difficult to compare our results with the results of other similar works. This fact is because we did not find experiments that satisfy all the characteristics of our case: use of Twitter as classroom support tool. We can also add that there are few studies that have analyzed the impact of the use of Twitter on student perceptions. The fact is that Twitter is usually a "silent companion" in the classroom (Dunlap and Lowenthal,

2009; Clark,2014), just for classroom use, or to propose work outside (Guzmán et al., 2012). In some cases it has been used both in a classroom subject and in a blended learning format (Thoms and Eryilmaz, 2015), something similar but not similar enough to our case for comparison. Far from our case is the use of Twitter for professional guidance, social support, personal empowering or broadly e-mentoring novice teachers in online workshops (Pieterse and Peled, 2014).

Nevertheless, our results are similar to other previous studies, which use Twitter or similar tools for learning, due that our study support the good perceptions of the use of Twitter by students, and its positive impact in diverse questions related to the improvement of learning. Actually, the literature about the incidence of Twitter on the performance of students is still more reduced, although there are some examples of the impact of Twitter on students learning (Buettner, 2013; Dhir et al., 2013), or on college students grade points (Junco et al 2011; Junco et al. 2013). Hence, Maguth et al (2010) showed that students using technology to access and analyze information, communicate and showcase learning, were successful in their pursuits and improved the research production and presentation of results. Garrigos et al (2015) analyzed the use of Facebook for the production and evaluation of assignments and showed diverse impacts on the improvement of learning. For instance, they showed an improvement of more than 20% in the average marks and quality of these assignments, and provided other diverse impacts on the improvement of the learning process of students. More specifically, Junco et al (2011), and Junco et al (2013) in experimental settings, using ANOVA, showed that Twitter significantly improves college student grades points, apart from class participation and engagement in learning processes in ways that transcend classroom activities. However, in the second study, Junco et al (2013) did not find significant differences in the effects of using Twitter to collaborate within the class. In the same way Buettner (2013) and Dhir et al., (2013) also finds some positive relationships between Twitter usage and learning outcomes. Our study confirms these results, by showing the relevant incidence of the use of Twitter in classroom activities, for improving the learning and success of students on a course.

We are conscious that the use of Twitter has also some limitations, such as it is explained by Garrigós et al (2016a,b), and that our paper has some limitations, which could open new lines of research, as it is an exploratory study. Hence a more deep analysis about the uses, advantages and disadvantages of Twitter for educational purposes is necessary. It could be also interesting to analyze some of these uses in depth, or using bigger samples or samples in diverse geographical contexts, or a deep comparison with other platforms should be explored. For instance we detected in our conversations to students the influence of other platforms that are more based on images, such as Youtube.

These facts, apart from its practical point, obviously open new and important areas of research that are often avoided in education. Anyway, our work opens new and important areas of research that are often avoided in education, and specifically research to new empirical works. In addition, our results have some practical implications. Hence, we posit that researchers, educators and practitioners should show more interest in the use of Twitter within educational contexts. Following Garrigos et al (2016a,b,) we consider that educators should develop new approaches and strategies to help students use their networking behaviour to enhance their learning and development. Nowadays students, as digital natives, are very familiar

with the use of social networks, and this is a fact that we cannot avoid, although, as Garcia et al (2015) stresses, the final success will depend on the clear perception by students of the objective of using this tool by overcoming the simple instrumental vision of Twitter. Hence, we think that it is crucial that these kinds of initiatives be spread in the university context, starting with educators who must enhance the motivation of students (Garrigós et al., 2016a,b) and some elements of enjoyment and social presence from Twitter (Noguera, 2015). Moreover, innovation is more likely to occur in organizations that emphasize collaboration and teamwork, so enhancement of motivation and collaborative work are some of the key points of its use according to our perspective. Furthermore, previous studies show that Twitter can enhance innovation and creativity (Noguera, 2015). However as pointed out by Lin et al. (2013) and Garrigos et al (2016a,b) as a classroom tool Twitter requires careful course design.

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## ***Software Model Design for Biometric Examiner Personal Verification***

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### **Abstract**

Nowadays the Examiner Personal Verification in most universities uses comparison methodology to match a physical appearance of examiner to a student ID card. This methodology is simple by it is easily lead to an examination cheating. For instances, some students' faces have been changed during study but their student ID cards are not up to date. Some students might hire another person to impersonate them for the examination. While some students may lost their student ID cards or student ID cards get damaged. By these, it is inevitable for the proctors to face the above problems. This paper proposes the applied Biometric Technology to the Examiner Personal Verification by using fingerprint to verify an identity. This paper tends to create a software model to solve the problem not specific to any university for general. Therefore, the software model is supposed to design to be the framework for a developer to develop software to suit each university standard in the future. To develop good and acceptable software, the software model should be designed based on a software design standard to ensure that our model shall follow and meet a quality standard. This paper is designed a software model based on IEEE standard for Information Technology-System Design-Software Design Descriptions (IEEE Std 1016TM-2009).

Keywords: Examiner Personal Verification System, Software Design, Biometric Technology.

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### 1. Introduction

Software model design for personal verification examiner of an examination using a biometric is a very important and essential process to every school, university, even institute or organization where there is a process to personal assessment. The only objective of examination is to assess competency of examiners or students. There are many processes in examination, for instances a preparing basic information, room, examiner list, proctors, data and time, etc. Besides, the one important process is an examiner personal verification that emphasizes on accuracy, clarity, convenience and speed.

Some academic institutes give a priority to an examiner personal verification, of which there are some problems and challenges. Raising up two problems are intentional cheating i.e. hiring another person to impersonate for the examination or forgery and unintentional cheating i.e. lost and damaged a student ID card, unmatching of a personal to a photo on card due to no update. The challenge in examiner personal verification is in case that there are such many examiners. Thus, it is a time consuming in a verification and may cause to some errors.

An examiner personal verification system (EPVS) is to cope with these problems and challenges, there is an idea to use IT to verify examiner personal identifications. The issue of problem can be divided into four levels: The infrastructure, managing, identifying, and reliability and by two points of view: non-IT, without information technology and IT views, with information technology as illustrates in figure 1.

	Non-IT	IT
Reliability	???	???
Identifies	Human Decision	Algorithms for Verification
Managing	Before - Prepare Information During - Verify each student After - Collect Exam	IT Support - Active System IT Automatic - Passive System
Infrastructure	Basic Information : Paper	Basic Information : Database

Figure 1: EPVS Problem issues

In an infrastructure level, this level concern about the infrastructure of Examiner Personal Verification System and basic information to verify examiners, the data preparation format are cared for. By the non-IT view, information is prepared in a paper base for an instance, a signed paper for examination participation while the IT view, a database is applicable. To transform non-IT view to IT view for this issue, have to prepare Information from every paper into computer base.

In a managing level, it is concern about how to control and manage the process in an examiner personal verification. By the non-IT view, proctors would verify a student ID card and a signed paper while the IT view can be verified in two ways: an active or a passive. Regarding of an active verification, an examiner has to react some activities to the system i.e. a finger scanning, a pressing, or any other activities depending on a specific IT system while a passive one, an examiner has no interaction with the system but the system itself will automatically verify, for instances, taking CCTVs to scan examiners' faces while queuing to enter the room. To transform non-IT view to IT view for this issue, have to analysis the non-IT process and reengineering it on term of computer process. This issue is very important because if the software designer understands every process of non-IT clearly they can design new system without mistake.

In an identifying level, it is concern about a methodology to verify examiners. By the non- IT view, proctors make decision by comparing a person with a photo affixed on a student ID card while in the IT view, various algorithms are applied for a decision making to verify the real examiner, and however it depends on a methodology in managing level. For non-IT identify examiner by human decision might have human error. Sometime the real examiner have the old student card, make the proctor confuse. To transform non-IT view to IT view for this issue will reduce the human error by using machine to make decision instead. Using machine for examiner verification have many methodologies such as: apply user and password, Smart card and biometric technology. Biometric technology is the good solutions to use what people have, the most biometric that used in many applications include: retina, fingerprint, palm, face, speech, iris, motion and others to the identified the real examiner (Uddin, N., et al., 2011).

In a reliability level, the accuracy and reliability of system are focused, as both non-IT and IT have to specify what index to be used and how reliable the index is. For biometric technology uses biometric error to measure the efficiency.

Figure 1 show the issues that we could concern about in EPVS. Nowadays many University and school try to apply IT Solution into their work. IT Solution in the university have many system such as registration system, human resource system, account system, asset management system, class management system and the others. EPVS is sub-system of the University System but it more complicate than the other system.

## 2. Biometric Technology

An idea to bring Biometric Technology in verification and specifying identity is widespread used in many patterns and various organizations, for instances, security system, and people searching. BT is to use personal identity i.e. a fingerprint, a face, a hand geometry, an iris and a voice of which using BT in an examiner verifying can solve the problems such as a student ID card lost, a forgery, having an impersonate and verifying simultaneous of examiners.

Biometric technology can divide into 3 issues (Choudhary, J., 2012) include: physical biometric, behavior biometric and chemical biometric. Physical biometric is concern about physical measurement and include modalities such as face, fingerprints, iris-scans, hand geometry. Behavior biometric is concern about the way in which a user

performs such as speech, signature, gait, keystroke dynamics and other. Chemical biometric is concern about chemical cue measurement such as perspiration and smell.

An important question of a biometric technology is how the best we can use the biometric technology, regarding of a research (Prabhakar, S., Pankanti, S., & Anil J, 2003), there are a biometric technology in a comparison by five identities: a fingerprint, a face, a hand geometry, an iris and a voice as well as by seven indexes: barriers to an universality, a distinctiveness, a permanence, a collectability, a performance, an acceptability and a potential for a circumvention.

In figure 2, each biometric technology has different advantages and disadvantages. It is also stated that there is no a perfect biometric technology. The most efficiency to use a biometric technology depends on the methodology and the system characteristics, for instances, it is indicated that using a fingerprint and an iris can more identify a personal than using a voice. However, in tele-banking, the biometric technology by a voice is considered to use because a communication methodology is using a voice, for instance.

BIOMETRIC	FINGERPRINT	FACE	HAND GEOMETRY	IRIS	VOICE
					
Barriers to universality	Worn ridges; hand or finger impairment	None	Hand impairment	Visual impairment	Speech impairment
Distinctiveness	High	Low	Medium	High	Low
Permanence	High	Medium	Medium	High	Low
Collectibility	Medium	High	High	Medium	Medium
Performance	High	Low	Medium	High	Low
Acceptability	Medium	High	Medium	Low	High
Potential for circumvention	Low	High	Medium	Low	High

Figure 2: Biometric Technology Comparison

The methodology to measure the biometric efficiency is biometric system error indicators that have 2 types of errors: False Match Rate (FMR), mistaking biometric measurements from two different persons to be from the same and False Non Match Rate (FMNR), mistaking two biometric measurements from the same person to be from two different persons. Both FMR and FMNR is less is more. Using FMR or FMNR to be the indicator is depending on what kind of application. For example the criminal Identified System use FMNR to identify the criminal, the security system might use FMR to identified person who have right to access.

To develop EPVS, with high quality, we have to develop software base on the standard. Software Development has life cycle call Software Development Life Cycle (SDLC) include: requirement collect, analysis, design, coding, testing, implement and evaluate. Each step has own standard and some standard is propose on different issue. The software development has many standards such as: European Space Agency (ESA), Institute of Electrical and Electronic Engineers (IEEE), and International Organization for Standardization (ISO), Capability Maturity Model Integration

(CMMI) by Software Engineering Institute Carnegie Mellon University USA, is focus on the document in software development process. ISO/IEC JTC 1/SC 7 Software and systems engineering have many standards and projects under the direct responsibility of ISO/IEC JTC 1/SC 7 such as: ISO 3535:1977 forms design sheet and layout chart, ISO 5806:1984 Information processing. ISO Standard has focus on the standard of international operator (Al-Qutaish, R., & Al-Sarayreh ,K., 2008). Institute of Electrical and Electronics Engineers (IEEE) set the software development stand into many issue such as Standard of Software Requirement, Standard of Software Design, Standard of Software Testing, Standard of Software Quality Assurance and others. IEEE Software Standard is focus on the definition and concept of methodologies in software development. This paper is focus on software design methodology so we use Software & Systems Engineering Standards Committee to be standard.

Software design is very important, software designer have to create design model form user requirements. If the software design model have good quality it's easy to build software for the other rules in software development team. To develop the process view, the designer partitions the software into separate tasks (Kruchten, B., 1995).

Software design technique can divide into 3 techniques: process-oriented design technique, data-oriented design technique and object-oriented design technique (Yau, S., & JEFFERY, P.,1986).

The software design standard is to get an effective EPVS. It is necessary to develop a quality software. Nowadays the biggest problem in software development is what not developed to meet user's requirement. The cause of this problem is that there are various processes in software development which are information gathering, problem analysis, designing, coding, testing, installing, training including document making. It means to develop software, there need various personnel and roles whom possess different point of views in software development which sometime it is misinterpreted in communication and might cause the final results not meet users' requirement. Moreover, different roles may have their own views and might not be aware of the effect of other views which can cause to an error in software development.

Software Design by IEEE standard (Software & Systems Engineering Standards Committee, 2009) has specified view of software development as shown in figure 3 and indicated in different views in software development, a message conveying and giving an example of different charts.

Design viewpoint	Design concerns	Example design languages
Context (5.2)	Systems services and users	IDEF0, UML use case diagram, Structured Analysis context diagram
Composition (5.3) Can be refined into new viewpoints, such as: functional (logical) decomposition, and run-time (physical) decomposition.	Composition and modular assembly of systems in terms of subsystems and (pluggable) components, buy vs. build, reuse of components	Logical: UML package diagram, UML component diagram, Architecture Description Languages, IDEF0, Structure chart, HIPO Physical: UML deployment diagram
Logical (5.4)	Static structure (classes, interfaces, and their relationships) Reuse of types and implementations (classes, data types)	UML class diagram, UML object diagram
Dependency (5.5)	Interconnection, sharing, and parameterization	UML package diagram and component diagram
Information (5.6) with data distribution overlay and physical volumetric overlay	Persistent information	IDEF1X, entity-relation diagram, UML class diagram
Patterns (5.7)	Reuse of patterns and available Framework template	UML composite structure diagram
Interface (5.8)	Service definition, service access	Interface definition languages (IDL), UML component diagram
Structure (5.9)	Internal constituents and organization of design subjects, components and classes	UML structure diagram, class diagram
Interaction (5.10)	Object communication, messaging	UML sequence diagram, UML communication diagram
State dynamics (5.11)	Dynamic state transformation	UML state machine diagram, statechart (Harel's), state transition table (matrix), automata, Petri net
Algorithm (5.12)	Procedural logic	Decision table, Warnier diagram, JSP, PDL
Resources (5.13) May be refined into resource based viewpoints with possible overlays	Resource utilization	UML Real-time Profile, UML class diagram, UML Object Constraint Language (OCL)

Figure 3 : Software Design Viewpoint Standard by IEEE

From figure 3, there are many views in software development and current charts are unable to cover all views causing to the problems mentioned earlier. The research presents an idea to compile different views in software development to be closest to one chart by presenting with Information Flow Diagram (IFD). By IFD, it can present in view of Context Logical Dependency Information Interface State Dynamic Resource in one chart of which the advantages are: all roles can see an overview of software development, operation between modules or processes, and effect in changing some point in one chart. Example of IFD is indicated in figure 4.

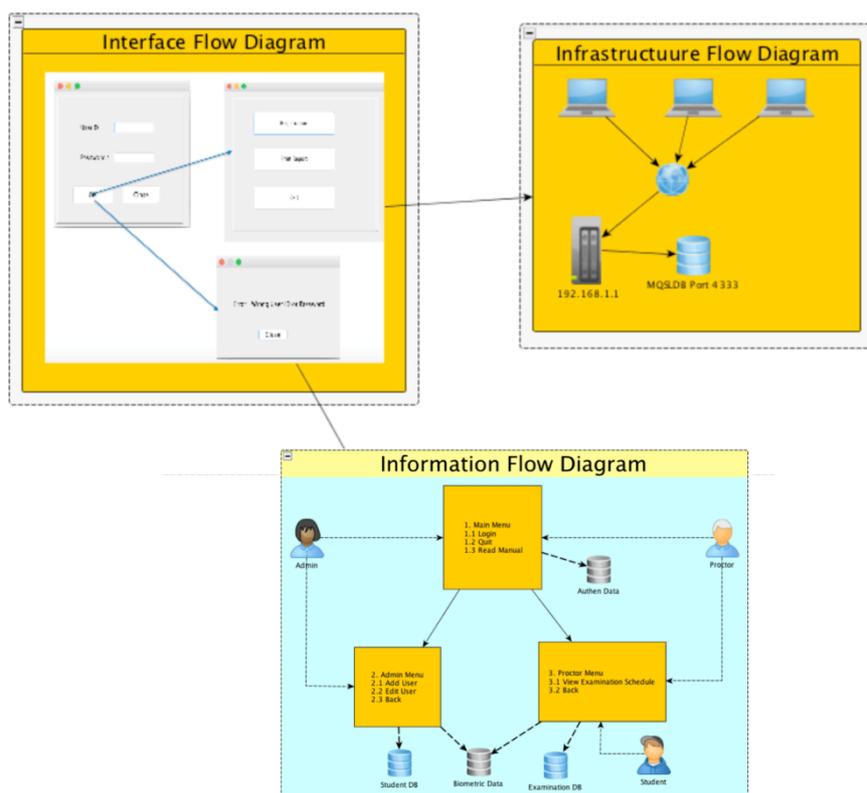


Figure 4: Example of IFD Figure

From figure 4, three diagrams include information flow diagram, interface flow diagram and infrastructure flow diagram show in one picture. The Information flow diagram show the information that use in each interface and show its flow to the next interface. It's also show the interactive between user and process. Interface flow diagram show the graphic user interface flow that can make user more understand how to use software than user manual in term of document. Interface flow diagram can reduce the gap of understand between user and software developer because user can see the final result of software development. The old school traditional software development uses the software prototype to show to the user. Software Prototype can make user see the final design of software but if user want to change something it's difficult to change in Prototype. Figure 4 also show the infrastructure flow diagram to make the implementer understand how to install the software into server and configuration the system and network. Three diagrams are the sample of multi-viewpoint in software design that can reduce the complex ability and gap of understand.

### 3.EPVS Framework

In order to develop the EPVS with the quality we not only focus on the software design but also concern on the whole picture of the examination system. Framework in developing EPVS software system is comprised of 6 main issues and shown in figure 5 as horizontal axel stands for Physical Device while vertical axel stands for Methodology.

Issue 1: Examiner Information – considers information of examiner, method and process in data collection and storage. This issue is concern about what the examiner information is and how to gather them in to the system. Sometime the huge number of the examiner spent process time too much if we have not prepared the good methodology for gathering the data.

Issue 2: Examination Information System (EIS) – considers on an examination management system of which EPVS is part of this huge system. This system has to prepare exam room, exam schedule management and management in other issues. EIS also manage the examination both the examination room assignments and the examination proctor assignments in each room (Vasupongayya, S., Noodam, W., Kongyong, P., 2013),. This issue concern about how to connect the EPVS with the legacy system in each university. Sometime the legacy system in the university is very old and closes system; sometime have non-IT system.

Issue 3: The Result/ Output – consider an outcome from EPVS system i.e. outcome format, quality and reliability. This issue concern about the output that sent out from the EPVS, Some university concentrates on the accuracy to be the first priority and processing time is the second. Some university focuses on the ease of use.

Issue 4: Biometric Technology – considers about format and algorithm. This issues concern about which algorithm applied in EVPS. It's depends on what type of biometric that EPVS use. In the same biometric technology also have many algorithm such as: Face recognition use neural network, Eigenfaces, Independent Component Analysis and the others, fingerprint use the correlation-based techniques and minutiae for alignment (Mir, A. ,H. , Rubab, S. , Jhat, Z. 2011).

Issue 5: EPVS – consider how to connect BT with EIS and how it works together in each process. This issue concern about how to connect the biometric device with the examination information system. Each type of biometric has many devices and many vendors.

Issue 6: Intelligence System – considers applying intelligence system using high technology equipment. This issue concerns about how to make the EPVS to be the intelligence system or expert system by make it more automatic and passive system. For example, apply new model of CCTV with facial recognition function while the examiner walk into the examination room CCTV will verify each examiner automatically, apply mobile with fingerprint scan function to be the device instead signing name on paper. The Intelligence System issue can applied into remote access for online testing (Rodchua, S., Yiadom-Boakye, G., Woolsey, R. ,2011) for online learning student.

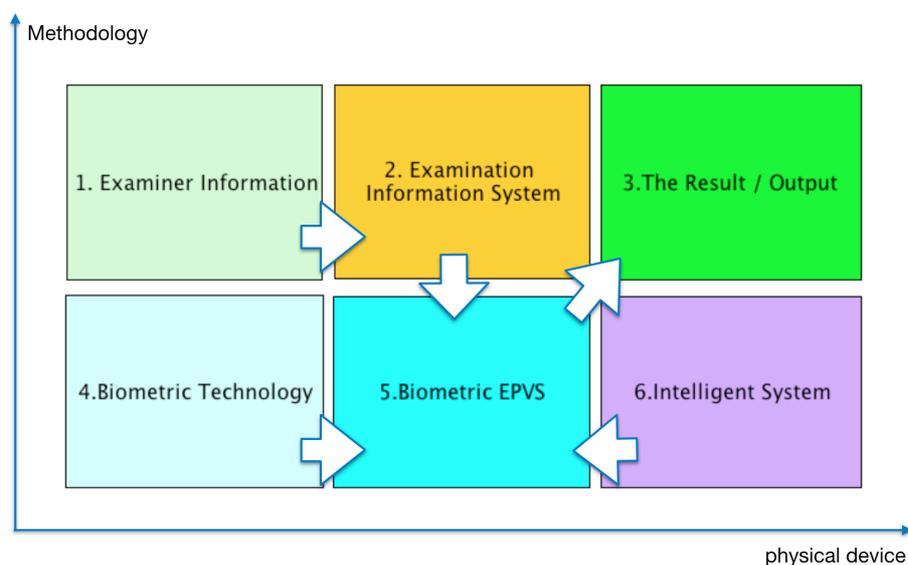


Figure 5: Framework in developing EPVS software system

## Conclusion

In conclusion, solution to solve the problem in identifying the examiner by using Biometric, need a model framework in development. To develop good software to meet users' requirement, it is necessary to meet the standard, in which here is referred to IEEE Software Design Standard that be specified many points of view in design. Efficient Software Design may lead to an efficient System Development. Therefore, to make the Design more efficient, this research presents a way in software design by using Information Flow Diagram which presenting many points of view to make the relevant personnel to see the same view in order to reduce any misunderstanding in software design.

IFD in this paper is just the example of using multi-viewpoint for software model design. It still has to complete the notations and rules in the future. The IFD has the concept of using diagrams based on the interoperate information between modules, user and anything in term of information.

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## ***Conceptual Framework: A Mobile Software Model for Web Based Learning***

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### **Abstract**

This article presents an innovative project using a mobile software applications technology for a Web Based on-line learning. Currently, mobile devices are very more widely used in our society as we have seen the large number of delivered mobile devices in each year. Therefore, we proposed the adaptive new technologies in an education, a better learning. Learners can be study anywhere on networks. With a rapid development of wireless networking technologies and an innovation in mobile devices, a mobile learning has become another learning area. In addition, applications technology for an on-line learning using the mobile software design is an Information Flow Diagram (IFD) model. It is a model of an application structural design of a prototype via the mobile learning on the web. This diagram will be the main interaction with learners and designer according to user requirements. System designers can more easily understand the system design. Other than simplify the design system this can reduce the number of symbols used in the system design. There have Interface Flow Diagram (InFD) describing the steps taken in a graphical interface in the system design. This objective of this research was to understand the design of mobile applications software based on web learning system using information flow diagram (IFD) model. The purpose is guiding principles and tools for mobile software design of the system. The current status of this research is on developing phase.

Keywords: Mobile software design, Information flow diagram, Web-Based learning

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## 1. Introduction

English language in Thailand is one the most important languages to the study. The studying of English language could help development of the countries. The instructional media for learning used in education is so important. The device is used as an instructional media of instructions to make the learners understanding the lessons more and more. The study has been developed to modern and current situation. The learners interested studying in using a social network. The instructional medias are available on the computer network system that will be the most important role. Therefore, in current situation, the study will be learning via an electronic media for instance CD-ROMs, the Internet, the Intranet, an Extranet, TVs and satellites. Electronic learning (E-learning) is the use of a communication technology as an instructional media of a learning. It can promote learning with effectiveness, especially the Internet coming into studying, and broadcast content through the network system.

E-learning is an important instructional media of instructions. It allows learners to access lessons efficiently. There is the ease of learning, because the system is connected to the device as the main component. Learners can learn without time limits, quickly for lessons and save transportation cost. In addition, learners can learn through any communication device. There don't need to go to a place of learning. The device does not require identification. These types of instructional medias have variety of forms, for instance, a Computer Assisted Instruction (CAI), a Web-Based Learning and however, with the advancement technology of evolution devices includes mobile device.

Mobiles are a portable device that can connect to the wireless data. It works like a computer. For the most part there have multiple exchange contact information with your computer. And most importantly, mobile device can add functionality by virtue software mobile. Hence, an instructional media has been developed from computer learning to mobile learning.

Many definitions exist of a mobile learning in the field. One definition of a mobile learning is the use of electronic learning materials with built-in learning strategies for delivery on mobile computing devices to allow access from anywhere and at any time (Lcarn, 2014). Mobile learning can help learners acquiring knowledges by providing them with digital information and learning materials. Hence, a mobile learning has the advantages of convenience, expediency, and immediacy. Users of mobile learning system will be also effectively promoting learning and motivation, and increase the effectiveness of an education (Xie, & Huang, 2012).

I have had the opportunity to work in a telecommunications company. The company is an Internet service provider in Thailand. For employee training, it is actually the important task of the company. There are new employees and have increase in each month. As a result, trainers and employees will be busy to work every day. In addition, in the classroom for training with a limited space and cannot train many employees at the same time. We would like to solve the problem of their training. The idea is to develop a research training, learning by an electronic equipment, because

learning will be much easier. It can save time and place. Employees can start getting into learning every time.

Hence, I have the idea of a structure designing prototype used an instructional media on a Web Based mobile learning on the design of an Information Flow Diagram (IFD) model. It is a prototype model of an application structural design for the mobile learning on web. The diagram will be the main interaction with learners and designers according to user requirement. System designers can more easily understand the system. Other than simplify the design system, this can reduce the number of symbols used. There have Interface Flow Diagram (InFD) describing the steps taken in a graphical interface in the system. This objective of this research was to understand the design mobile applications software Web Based on-line learning system by Information Flow Diagram (IFD) model. The current status of this research is on developing phase.

## 2. Related Work

Khan has defined the course Web-Based is a teaching program for hypermedia that teaching by taking advantage of the features and Internet resources to make learning meaningful, promoting, supporting to learning in every way (Khan, 1997).

Kidakan has defined that a teaching on the web in any education may be able to use a Web portal for a school in the media of multiple dimensions, or just offering some information to the teachers, as well as take advantage of the communication on the Internet, such as the written response, in the post and the live text and voice. (Marithong, 2000).

Adisak has defined e-learning (Electronic learning) is to learn its electronic means that e-learning was interpreted differently by their experience, and each one of them. An e-learning is to use technology as a tool in the development of all the time. The progress of technology for the written definition of E-learning is the technology, especially the Internet to promote learning to teach. (PhuangSombat, 2013).

E-Learning is a teaching style or any form of the broadcast content through an electronic media such as CD-ROM, the Internet, Intranets and Extranet or the TV or Satellite etc. The studies of this nature have been introduced into the market in Thailand for a while as a computer aid assistant of learning. An instructional web (Web-Based learning), an online learning (on-line learning) are distance learnings via satellite or through online learning with videos and so on (Technology-based learning, 2001).

Geddes has defined the m-learning that is to acquire knowledge and skills. There is a technology of a portable category wherever and whenever. These results in a change in behaviors that can be classified into four categories for accessing at any time. It creates an environment for learning (Context). The m-Learning helps people to learn from wherever there is a place to learn. For example, the instructors can be at any time, collaborate between students and an instructor anywhere and anytime (Geddes, 2006).

Martin, Andueza and Carro have defined The teaching of mobile phones have a different context from the education, because the educational via mobile phones on the key instruments is the phone with a small and has been limited to learn from a

mobile phone, it will be subject to the character of the school that has used mobile phones. However, it is convenience to use an equipment (Martin, Andueza, & Carro, 2006).

Monchai has believed that a teaching through a phone or a mobile learning (M-learning) is a part of an e-learning. A mobile learning is yet another avenue of an electronic media to support a distance learning that is a new way to the study to be in line with the new approach, and propose a freedom to study the lessons learned through the screen of mobile phones or portable computers (Thainthong, 2004).

Amphol has defined that software design is a design technique. The system design brings users in the form of a brush before creating the actual product. There are specific requirements of design and the ability to apply knowledge of software engineering used in the design. Creating a draft of a service delivering to a qualify as well as programs that are designed to have no errors, must match the intended use commodity and will need to make users felled more satisfied processes of the software design. The software design process will look to run repeatedly. The system needs to be analyzed in the past. Both functionality and data components of the system convert to the design requirements. The terms of design comply with the requirements and can be used to communicate with the programmers (Amphol, 2006).

A mobile is a mobile communications equipment used to carry. This will be used as the basis of the phone. Also it works like a computer because the device is portable; its features are small, lightweight, low power consumption. It currently serves in several exchange contact information with computers. Software design is the design of the system software. The software is designed to help users, and works to meet the needs of users. The software design must be designed to match the job description of various software that have worked out differently. Each software design aims to make software works better in different manners. Some structural features of the software incorporate but operates differently. It could make to determine a control of software architecture (Mobile Software Design, 2004).

From the literature reviews, we have found that many online learnings demonstrate the technology's evolution from education. An online learning has developed from an instructional media of a web-based learning on the computer system, then a web based learning on mobile devices. However, software design for an instructional media discussed above might not serve the needs of an instructional creation. Therefore, this research will be a new approach to design a mobile software that can provide a prototype model of a mobile software design to match the general objectives of the most uses.

### **3. Proposed Framework**

We propose the conceptual framework that composes of two layers: an information flow diagram (IFD) layer and an interface flow diagram (InFD) layer as illustrate in figure 1. An information flow diagram (IFD) is a diagram that show an information of receiving input data, output data, actions. Diagrams can present interfaces to describe the form of symbols.

The environment of the system describes processes that will take place on each screen, and what steps of the system perform during the execution. The diagram also shows the correlation of interaction databases. With a screen that an information is

used, users can get information of each screen in the system. Symbols uses in the diagram composed of user interface, data store, and data flow.

An information flow diagram (IFD) layer composes of symbols as the following:

- User interface uses for the user interfaces on one screen. This describes the main data input and overall results in the screen. It must include the number and name of the screen specified by the user interface. Rectangles will represent as a sign. Names and numbers and the description contained inside.
- Data store is a symbol. The database is associated with any user interface associated with each screen. The screen uses and interact the data from any database. It uses a table symbol to represent a data store, and contains the name and number of the table in the symbol specified by the number does not need any sort. However, it must be unique.
- Data flow represents the orders of sequence for interactions of users. The transmission between each user interface is used to display by the symbol of the arrows. The arrows point to the destination of the data and a sentence explains it.

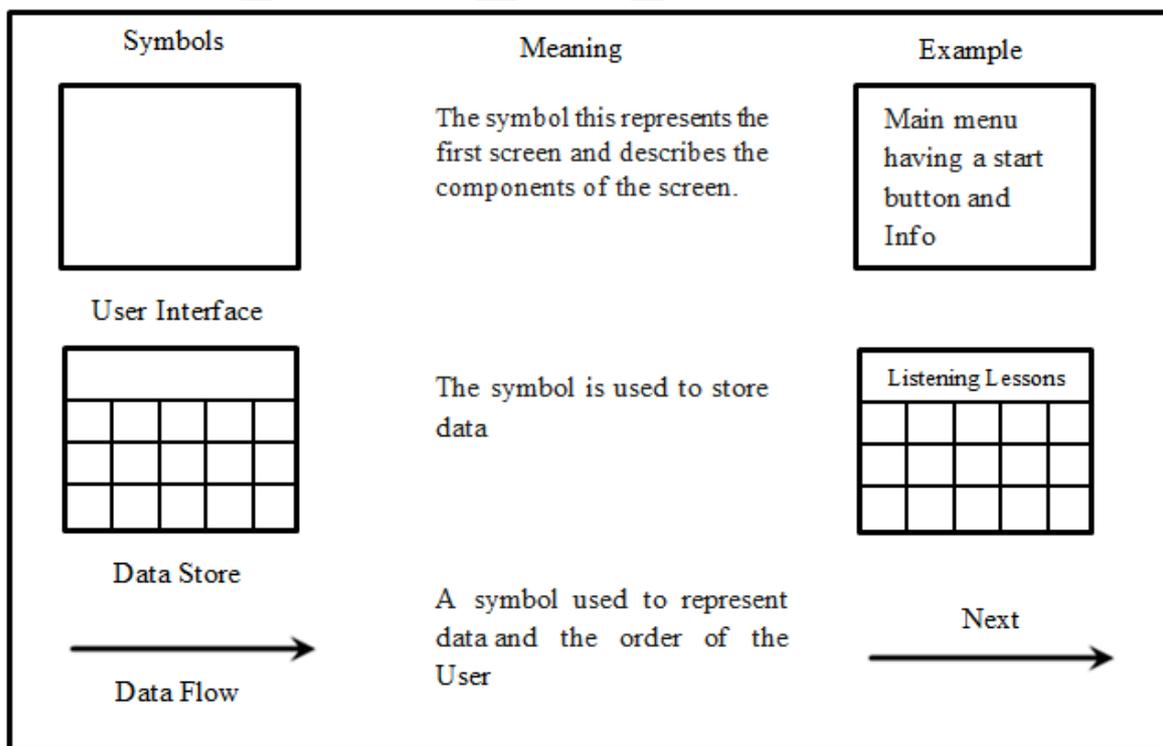


Fig.1. Proposed Conceptual Symbols used in this system.

An information flow diagram (IFD) layer composes of symbols that explains the system steps will execute on each screen and determine the validity of the processes running on the system. This information will be used in the interface flow diagram in the next step, to describe the work and the relationship of each screen in view of the graphics in interface flow diagram (InFD) layer.

As illustrates in figure 2, an interface flow diagram (InFD) layer is a diagram that shows the flow of information at a high level consisting of interfaces with the users. This gives an overall picture of the system even more. It composes of three elements that will demonstrate the relationship between user interface and the database.

- User interfaces are important to show that each screen has some elements. There are cases where some user can interact with the system and what the system interacts with users. The system should make a similar user interface in a graphical form. The shape depends on the size of the user interface is actually used.
- Data store is a symbol of the database associated with a user interface showing between each screen and the database.
- Data Flow uses to show the flow of information between the user interfaces or between user interfaces and data store, using the arrow represents the flow of information queries. The arrows point towards the end of queries of the users and have labeled statement that interact with the system.

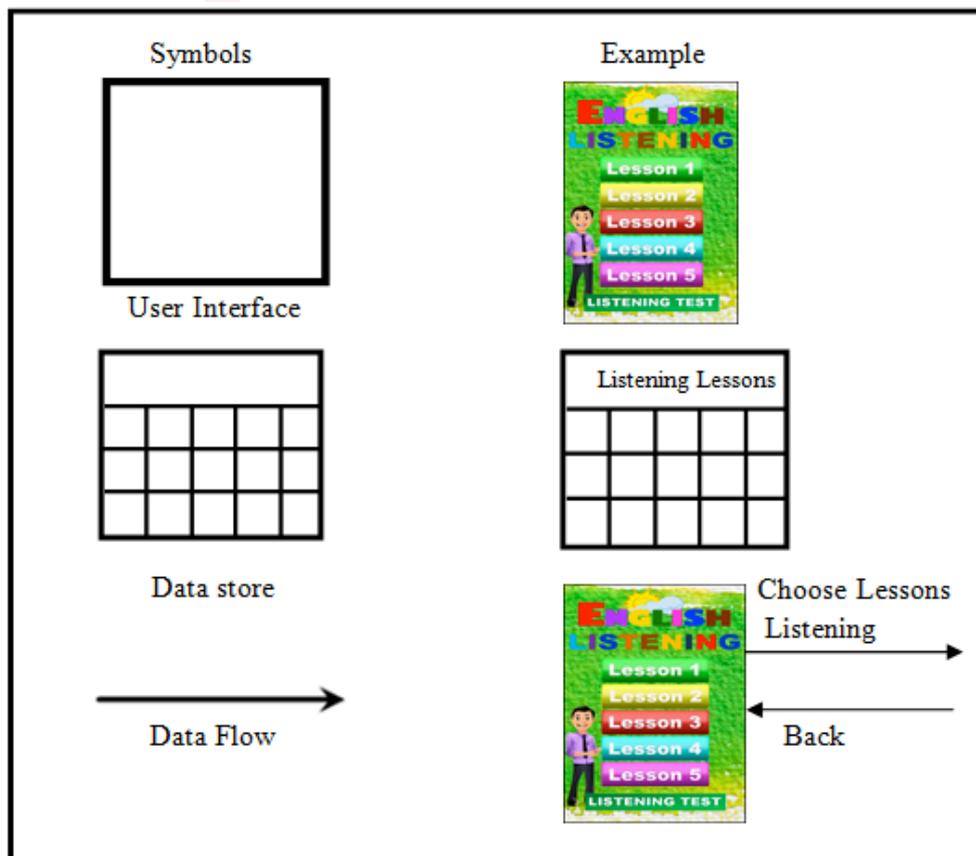


Fig.2. Proposed Conceptual Interface Flow Diagram used in this system.

From the mentioned above, this research is a conceptual framework model of application structural design of a prototype via the mobile learning on web. We have designed a prototype structures to English learning. This conceptual framework is designed of the system. There are design and explain given user to contact the system direct. There are explaining process one process of each screen how it works, as well

as information on results and action, within the screen. Users will be able to interact with the system design. The model can represent the overall process of the system including the flow information, the ordering of user's interactions within the system from screen to another screen in graphics user interface (GUI). An information flow diagram (IFD) of English learning can use to deploy and develop for any mobile learning.

However, the research has conceptual framework used to design the layout display Information Flow Diagram (IFD) will be shown as part of the infrastructure, Information and coordinate communication between the computer and the user include all processes, no separation and support for accuracy. The clarity and flexibility of the system allows the user to understand system overview screen is designed to highlight the part contacting the user as primary. It does not matter what the information will be received into the system or process. There are works with the information into the system, but are interested in just how users will interact with the system. However, there is nothing that interacts with users when users interact with one occurred on a particular screen. Information Flow Diagram (IFD) will be to encourage the reduction of the number of relationships that do not relate to each other out of the process in the system, such as a process 1 Process display command information flow between the user and the screen will display the users run only, which reduces unnecessary and the relationship of the individual processes in the system out. The symbolic relationship between a user and a screen with a database that is used to design the underlying structure of the system is clear, straightforward and no symbol, too using the data can communicate with each other in each process.

#### **4. Conclusion**

This research paper proposes a mobile software model using an information flow diagram to demonstrate how to develop a web based learning. The model has many benefits for mobile software designers and developers. It improves expressional ability in a mobile software design. The model also assists an instructional media, development, and technological advances for m-learning. There are many medias of instructions in mobile web based learning to enhance a learning efficiency. Learners can be learned easily, quickly, anywhere, and anytime. M-learning has been collecting critical content, bring the issue to determine the exact cause, and solve problems the current situation. There are the design and development of a new mobile information system. Our technique is a conceptual framework designing for a mobile prototype of learning and teaching. The underlying structure and design are simple and clear, according to the software engineering design as well.

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***The Reading Habits Among Library Users in Rural and Urban Areas of Sarawak, Malaysia***

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The Asian Conference on Society, Education & Technology 2016  
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**Abstract**

In 2014, the Sarawak State Library commissioned a research to investigate library users' reading habits and leisure time activities in the state of Sarawak. The study was conducted at seven town and fourteen village libraries, involving 843 respondents. This study found out that 81% of the library users in Sarawak were self motivated to read. 97% of the users were interested in reading and read on their own; were self-influenced (81%); loved reading materials in their own language (90%); loved to read books about their cultures (94%); enjoyed going to library (93%); and their habit was reading (73%). The library users read comparatively less outside the library; preferred reading materials in Malay and English languages; and loved to read books written in their mother tongues and about their cultures. 67% of library users were satisfied with the Internet provision and they utilized the Internet to gain knowledge (57%), pleasure (46%) and for academic work (45%). While a great majority (88%) thought that the Internet enhanced academic competence, a reasonable number (64%) indicated that they were not sure about the library electronic resources. The comparative study on rural and urban library users provided significant differences. The users of urban libraries enjoyed better access to information resources as compared to rural users. The main causes of the problem were limited number of quality academic reading materials; obsolete collections; library staff attitude; lack of community engagement; and lack of online services and flexible operating hours. Replications of high impact initiatives; enhancement of resource sharing; recontinued programmes; and rebranded programmes can rectify these issues.

Keywords: Reading habits, urban library services, rural library services, Internet provision and access, community involvement, information resources

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## **Background to the Study**

A study done in 2010 indicates that Malaysians read 8 to 12 books a year (NST, 2014). This is a huge improvement compared to 2005, when Malaysians were reported to have read only 2 books in a year. Nevertheless, this figure is way behind developed countries, whose citizens read 20 books a year. It is hoped that the reading habits among Malaysians would continue to grow and eventually match that of developed countries.

Compared to the other states in Malaysia, the administrative set up of public libraries in Sarawak is unique. It is decentralised in nature. There is the Sarawak State Library in the southern region of Sarawak with its regional centre further north in Miri, then there are the public libraries under the purview of the local authorities all over the land, and the mobile libraries operated by the Ministry of Local Government. In total there are 270 public libraries of various categories – 1 State Library, 1 regional library, 49 district libraries, 212 village libraries and 7 mobile libraries.

These public libraries operate on their own with their own funds and grants from the Sarawak State Government. The Sarawak State Library plays advisory and coordinating roles over these libraries. Quite frequently, technical assistance is also extended to these libraries.

Hence, the library development and services in Sarawak is slightly not uniform. The well-to-do local authorities prosper, while the poorer ones lag behind. Such administrative setup definitely influences the reading habits of public library users.

Occasionally, market surveys are conducted by the National Library of Malaysia to investigate the reading culture among Malaysians. However, a formal study focusing on information-seeking behaviours and reading habits in Sarawak has never been done before. It is high time that a research was conducted to uncover factors that need further enhancement; issues and concerns that require rectification or mitigation efforts; and trends that entail proper addresses pertaining to reading habits in Sarawak.

## **Literature Review**

At 93%, the Malaysian literacy rate is one of the highest in the world (Odekon, 2006). However, the reading habits among Malaysians are considerably low, judging by the number of books they in a year - twelve books. Reading has become an indispensable activity which is vital for the knowledge society comprising knowledge workers of a country. Palani (2012) has discussed the various benefits and methods of improving the reading habits. The author explains that reading shapes good personalities, brings new ideas, develops positive thinking, and inspires right attitude.

Shahriza & Hasan (2007) defines reading habit as a kind of real experience and involves many complex skills. According to Kaur & Thiyagarajah (1999), reading habits refer to regular tendencies in reading behaviours. Mohini et al. (2012) state a good reading habit is necessary for a healthy intellectual growth that would in turn inspire creative and innovative minds. Reading can increase our knowledge, at the

same time, it also builds maturity and character, sharpens our thinking, and widens our awareness in variety issues such as social, economic or political (Teh, 2013).

The education system is among the few factors that influence reading habits. Pandian (2000) argues that students in Malaysia only read for the sake of passing examinations and fulfilling the school requirements. Most of the time, students would read specifically to seek and gain information in order to get excellent academic achievements (Pandian, 1997). Education system needs people to read a lot of academic reading; this is because they need to read for knowledge on their subjects, to complete their academic task and for their academic excellence (Fairbain & Fairbain, 2001). According to Dent & Goodman (2015) there is a strong and positive correlation between reading frequency and academic achievements. Another study on reading and achievement relationship in Ghana (Owusu-acheaw & Larson, 2014) confirmed that reading habit has influence on academic performance and there is a relationship between reading habit and academic performance. In 2013 the Borneo Post reported that there was sharp decline in reading habits among young working adults who have completed their tertiary education. Among the policy makers, information professionals and educationists, this is a major concern.

The encouragement and presence of other people is another factor that affects reading habits. Pandian (1997) argues that when we are exposed to people who read regularly, we will develop a positive attitude towards reading. According to Yusof (2010), family members, peers and close friends have strong and positive influence on reading habit. In a study on rural libraries in Ghana, Dent (2008) highlighted the importance of role of families in shaping up the reading interest of family members. When interest in reading is built up in an individual, it drives that individual to read on his own, as opposed to assigned reading says Hughes-Hassell and Rodge (2007).

Noorhidawati & Forbes(2008) and Saikia (2013) stress that printed books are the most preferred library materials among library users. The presence of the digital age, however, warrants the utilization of electronic resources in the library. The major advantage of electronic resources is faster and wider access to information. Hence, these resources can be used to promote library use. Another factor that can be used to promote library is people involvement or community engagement.

According to Massachusetts Library Association, Youth Services Section (2005) involving young people in the planning and delivery of library services or in planning purchases can ensure that their interests and needs are addressed and has been found to play a crucial role in attracting their peers to the library. Lakshmi et al. (2011) argues that in any type of library, the user plays a vital role in planning, designing and introducing new information services and in assessing the quality of remaining services, facilities and their utilities. Arranging materials by genre or identifying materials of interest to young people can spur the use of the library collections says Sissons (1997).

### **Objectives of the Study**

The main objectives of the study are to

- a) to investigate the reading mindset and leisure activities of library users;

- b) to determine the extent of the reading habits based on diverse influences;
- c) to identify emerging needs of library users; and
- d) to realign and restructure reader development strategies.

### **Research Methodology**

A mixed method comprising qualitative and quantitative approaches is employed in this research. The questionnaire consisted of 96 open-ended questions and 15 close-ended questions. There are 843 respondents selected from 21 public libraries of various categories, representing the 7 selected administrative districts in Sarawak.

Data are gathered via face-to-face interviews conducted at the selected libraries. The raw data are subsequently coded and tabulated in Statistical Package for Social Sciences (SPSS) to be analysed. Data analyses include, but not limited to, frequency analysis and cross-tabulation analysis.

### **Findings and Discussion**

#### **a) Demographics**

In terms of gender, there are more females than males - 60.9% are females and 39% are males. Most of the users are teenagers. 51.2% of them are in the age range of 11-19 years. Next, the age range of 20-29 years at 20.7%, the age range of 10 years and below at 10.5% and finally, the age range of 40 years and above at below 10%.

In terms of marital status, most of the users are single - 76.9% of them are single and 21.8% are married. This is obvious since generally most of the users are teenagers. Ethnically, the biggest group are the Malays at 37.8%, followed by the Ibans at 31.6%, Chinese at 15.1% and finally, the Melanau at 7.8%.

In terms of academic achievements, a reasonable majority belongs to the primary school level (35.5%), while the upper secondary school level constitutes 23.2% and lower secondary level, 19.9%. This clearly shows a great majority of the library users are young students. Majority of the users are from the private sector at 49.7% followed by those from the public sector at 43% and finally, others at 7.3%.

#### **b) Library membership**

Surprisingly, most of the library users are not members of the library. Only 49.3% of the users are members of the library, while 50.71% are non members. There is a clear indication that the library promotion needs to be intensified. The users enjoy going to the library because of the reading materials (64.5%), the conducive environment (18.5%), the activities (13.3%), the Internet/computers (5.8%), interest (3.1%) and finally, the facilities (2%).

In terms of frequency of going the library, most of the users (22.1%) visit their libraries once a week, while 20.8% of them visit the library on alternate days. At every visit to the library, most users (43.9%) spend 1-2 hours, while 30.5% of them spend 2-3 hours and 14.5% spend only an hour.

### c) Purposes of going to the library

A great majority of the users go to their libraries to obtain information (71.3%), to increase knowledge (61.7%) and to study (51%). This indicates that users regard the library as a knowledge and information hub and storehouse. At the library, the users read books of their interest (81%); read their own books (35.2%); read newspapers (27.5%); read magazines (38.3%); have discussion with friends (45.8%); borrow and return books (37%); access the Internet (26.7%) and relax (25.9%). This suggests that the library is well used by the public.

### d) Sources of information

The sources of information that users seek in the libraries are varied. The main ones are the reference collection or section at 67.1%, followed by the magazines at 37.4%, the newspapers at 31.8%, reference librarians or officers at 30.8% and finally, the Internet at 30.1%. This clearly suggests majority of the users are independent.

### e) Motivation

It is heartening to note that most of the user (81.1%) are self-influenced and self-motivated to read. Other influences include friends or peers at 50.1%; mother at 49.0%; teachers at 42.1%; father at 41.5%; siblings at 26.1%; relatives at 16.3%; and library staff at 9.1%. This clearly indicates the users' close associates influence them to read. Unfortunately, the library staff is not part of this close association, indicating a concern that needs to be address accordingly.

### f) Preferred languages

In terms of the languages of the reading materials, most users (90.2%) prefer Bahasa Melayu or Malay, while 58% of them prefer English. The other languages are Iban (15.3%) and Chinese (14.8%). The main reasons for liking these languages are because they are good at it; they can understand better; because of academic requirement; they feel motivated; and because more reading materials are available in these languages. This suggests the majority languages are instrumental for their enhanced reading.

### g) Favourite pastimes

Contrary to common belief that the social media is topping the chart of favourite pastimes among Sarawakians, the most favourite hobbies of the library users are reading at 73.4%, listening to music at 68.9%, browsing the Internet at 64.7%, and watching television at 57.9%. All these are closely related with their reading passion and interest to seek knowledge. Some other hobbies are using email (41.8%), hanging out with friends (35.2%), shopping (34.9%), playing computer games (33.5%), cooking (31.9%), travelling (30.4%) and writing (diary, blog and poetry) (23.0%).

#### h) Duration of reading

Most of the users read for one hour (33.2%) and 2 hours (26.8%). 23.2% of the users reads for less than 1 hour and 11.2% of them reads for 3 hours. This response substantiates the above response that the majority read for pleasure.

#### i) Started reading

A majority, (33.8%) of the users started visiting the library at the age range of 7-9 years old, followed by the age range of 12 years and above at 27.0%. Some (21.9%) users started between the ages of 10-12 and some (14.3%) between the ages of 4-6. This confirmed the demographic responses on age. A substantial number of users (46.4%) started reading between the age 7-9 years old. 25.7% and 12.6% of users started reading between the age of 4-6 years old and 10-12 years old respectively. This finding indicates the users start to read when they are in primary schools, which is considered slightly late.

#### j) Reasons for liking the library

A significant majority (84.9%) of the users likes going to the library because of the books or library materials followed by 57.3% because of the conducive environment and 54.9% because of the air-conditioned environment. Other reasons for liking the library are because of the magazines at 53.3%, the newspapers at 44.8%, the Internet at 41.4% and the discussion area at 13.6%. This suggests that the public libraries are well-utilised for the acquisition of information and knowledge.

#### k) Customer service

Though a great majority (81.7%) of the users say that library staff is user-friendly, a reasonable number (18.3%) users indicate that library staff is not very welcoming. This finding clearly suggests that customer service is a reasonable concern that needs some kind of improvement or enhancement.

#### l) Library collections

Even though majority (46.6%) of the users state that there is adequate reading materials in their libraries, 30.5% of them say that the reading materials are insufficient. 22.6% of them has mixed feeling or unsure. In term of rating for library collections, 50.5% of the users rate them as good, 33.7% rates them as average, 9.9% rates them as excellent and 5.9% rates them as poor. These responses implies that some kind of improvements are needed to rectify the “insufficient” as indicated by 30.5% of the users and the “average rating” by the 33.7% of the users.

#### m) Circulation

Some of the users (20%) borrow 2 books, a few more (12.6%) borrow 1 book, while others (12.8%) borrow 3 books in a month. However, 32.8% of them do not borrow books at all. These are the non-members who read their own books; those who use the library materials in-house; and those who use the library facilities only. Books

borrowed range from fictions at 41.1%, academic at 26%, comics at 19%; scientific at 12.9%, adventure at 11.2% and cook or recipes at 8.5%.

In terms of book loan or lending period, a significant number of users (76.8%) are satisfied with the loan period, yet a few others (23.2%) are not. This suggests that the loan period needs improvement. While majority of the users (73.6%) are satisfied with the number of books issued, a reasonable number (26.4%) show concern and are not satisfied. This suggests that there is need to increase the maximum number of books that can be borrowed at one time.

#### n) Retrieval

Most users (69.6 %) can locate reading materials with ease, while a few others (16.5%) have difficulty in retrieval. 13.8% of them are unsure or have mixed feeling. This clearly suggests that there are minor issues that need to be addressed. Further probing revealed that the library materials are easily located as they are properly catalogued, labelled and arranged.

#### o) Information and communications Technology (ICT)

While majority of the users (78.7%) show satisfaction about computers in their libraries, a reasonable number (12.6%) are not satisfied. The rest have mixed feeling. Further probing revealed that the causes of this dissatisfaction are there are not computers provided; the computers are stolen or not working; and not enough computer. A significant majority of the users (69.4%) say that the Internet provision is satisfactory, but the rest (30.4%) are not satisfied. This suggests that there is plenty room for the ICT infrastructure to be improved.

Some users (56.6 %) utilize the library Internet service for gaining general knowledge; a few others (45.4 %) utilize it for pleasure; another few (45.0 %) utilize it for academic purposes; and others (18.4 %) utilize it to do job related things. This information indicates positive use of the Internet in the library.

#### q) Operating hours

A great majority of the users are satisfied with the opening hours of their libraries. However, a reasonable number (14%) show concern and are not happy with the opening hours. This clearly suggests that the library opening hour must be improved in terms of length and timing.

#### r) Community engagement

A large majority (77.0%) of the users do not participate in the library activities at local, state or national level. Further probing revealed that they do not participate as they are not interested; they lack the time; they lack information; and they are not given the opportunity. This is surprising, alarming and a major concern that needs to be addressed accordingly. A fair number of users (22.4%) however do participate in activities organised by their libraries.

## s) Users' suggestions

The top 10 suggestions from the users on how to improve the library services are:

- |   |       |
|---|-------|
| a) Provision of quality reading materials.        | 79% * |
| b) Update, expand and diversify collections       | 63% * |
| c) Improve customer service                       | 59% * |
| d) Enhance community engagement                   | 59% * |
| e) Improve library accessibility.                 | 57% * |
| f) Improve facilities - printing and photocopying | 53% * |
| h) Meet the demand of the community               | 51% * |
| g) Provision of online services                   | 49% * |
| i) Flexible service hours.                        | 45% * |
| j) Reaching out to the community                  | 43% * |

\* Multiple responses set

These suggestions reaffirm earlier discussion that the library materials need improvement in terms of diversity, depth and remit. They also reconfirm earlier findings that customer service and community involvement on the library activities need enhancement.

## s) Urban and rural comparison

The differences between the readings habit of users in the urban and rural areas of Sarawak are summarised below:

Urban	Variables / Elements	Rural
<input type="checkbox"/> More Non members	Category of Users	<input type="checkbox"/> More Members
<input type="checkbox"/> 2-3 hours	Time Spent in the Library	<input type="checkbox"/> 1-2 hours
<input type="checkbox"/> Once a week	Frequency of Visit	<input type="checkbox"/> Once a week
<input type="checkbox"/> Weekends	Preferred Library Days	<input type="checkbox"/> Weekdays
<input type="checkbox"/> Self <input type="checkbox"/> Friends	Reading Influences	<input type="checkbox"/> Self <input type="checkbox"/> Friends and mother
<input type="checkbox"/> 1-2.5 hours	Length of Reading Time	<input type="checkbox"/> 1 hour
<input type="checkbox"/> 12 years old	Started going to the Library	<input type="checkbox"/> 7-9 years old

As discussed earlier, strategies and action plans to instil reading habits among the library users at an earlier age are required to handle the late "Started going to the Library" issue face by both the urban and rural libraries. There are more non members using libraries in the urban areas and this situation needs to be addressed accordingly via appropriate action plans as well.

## Recommendations

### a) Awards

The library users' self-influenced and self-motivated reading habits need to be commended and recognised in a variety of award schemes such as praises, gifts, displays, promotion, awards and publicity. Such schemes can further propel them to enhance their positive attitude towards reading and motivate them to promote reading to their peers and family members.

### b) Nurturing

The library users' great positive reading habits and passion for reading indicate that they have an excellent baseline to be further nurtured and strengthened. This can be accomplished through the constant and consistent provision of quality and user-specific reading materials. Such nurturing is capable of creating a positive ripple effect when nurtured users start to enhance their reading interest and motivate others to have positive attitude towards reading.

### c) Competency building

The library staff needs to interact more with users to add value to the healthy reading culture. This necessary means the need to use more interpersonal skill and customer service competency. Most library staff speaks both Bahasa Melayu and English, but there is need to teach them local dialects to attract more patrons.

### d) Structured activities

Though library activities or programmes are conducted periodically, there is a need to improve these programmes by redesigning and structuring them to meet the needs of different categories of users. This definitely involves engaging the communities in determining what they require and expect of their libraries.

### e) Community engagement

In developing and implementing the library services, it is necessary to involve the communities to which the library services are targeted to. Only they know what is best for them. Many a time, library services failed to meet their objectives because the needs and expectations of the target groups are not taken into consideration in the design and development stage of the services.

### f) Enhancement of ICT

While some users are satisfied with the Internet provision, a fair number is unhappy with the Internet connectivity. In addition to that, reasonable majority of the users are not sure about the presence electronic resources. Most users believe the Internet enhances their academic competence. This clearly suggests that there is strong need to update the provision of the Internet and ICT in the library.

g) Enhancement of library resources

The library collections need to be enhanced in terms of variety, format, depth and remit of the subject areas. It was found that users expect constant replenishment of reference books and provision of books on their subjects of interest. Meeting their expectations in terms library collections will further motivate and boost up their reading interest.

### **Action Plans**

The study has highlighted areas that need to be improved further and issues that need to be alleviate to improve the service quality of public libraries in Sarawak. Various strategies and action plans have been determined to handle these areas or issues.

a) Replication of high impact initiatives

Since its establishment in 2000, the Sarawak State Library has embarked on various programmes to elevate its service quality in terms of delivery, contents and coverage. These high impact programmes are made possible via collaborations and community engagement exercises. Held annually, each of these initiatives on average can draw 1,500 to 3,000 participants or beneficiaries at one time. Already successful at the state level, the strategy now is to replicate these programmes at the town and district levels and subsequently to the rural communities.

The Children Literature Festival can attract up to 3000 participants at one time and it has been successfully organised since 2004. Both the Local Culture Competition and the Knowledge Camp attract 1,500 participants each. The most recent high impact programme was the DIY (Do-It-Yourself) Carnival or the Makers Movement which attracted 2,000 participants. This programme was co-organised with schools, the local authorities, non-government organisations and the US Embassy via its Lincoln Corner Sarawak.

b) Resources sharing

Resource sharing has been part and parcel of the Sarawak State Library. It is one of the approaches to reduce cost of operations, eradication of duplication of efforts and maximisation of resources. Enhancement of resource sharing in term of bulk loan service to the town and district libraries can to certain extent solve the problem of inadequate library resources in some of the public libraries. Bulk loan service involves lending of library resources in large quantity to eligible recipients, which in turn lend these resources to their users.

The expansion and intensification of the inter-library loan between the public libraries can also help to alleviate the problem. Consortium purchase of online resources is among the best option to rectify scarce electronic resources among the public libraries in Sarawak.

c) Enhancement of on-going programmes

There are initiatives put in place to by the Sarawak State Library to develop the human resource of public libraries in Sarawak. Staff of these libraries is given basic trainings in library management in stages. These trainings comprise of workshops, attachments and bench-marking visits inland and abroad. Obviously from findings of the study, the development of human resource in terms of customer service and service delivery needs to be improved further.

The ubiquitous library programme, commonly known as “U-Pustaka”, is a resource sharing platform involving major state libraries, a number of special libraries and the National Library of Malaysia. Through this web-based platform, library resources can be identified, requested and borrowed from almost anywhere and anytime in Malaysia. The great advantages and benefits of U-Pustaka can be extended to the town and district libraries as part of the resource sharing programmes. This entails greater collaboration effort between the Sarawak State Library and the public libraries.

d) Recontinued programmes

The research suggests the necessity to acknowledge active users and active collaborators for their efforts and participations. There is a need to nurture library users to further enhance their interest in reading and habit of going to the library. Recontinuing some of the adjourned or halted programmes to handle this situation is just about the right time. These programmes include the giving of awards and recognition to the most frequent users or frequent borrowers. The Home Library Competition and the Public Library Competition, which were held annually in the past, will be revived, intensified and fine-tuned as well.

e) Rebranded programme

The study highlights that library users in the rural areas started reading an the age of 7 - 9 years old, while those in the urban areas started reading at 12 years old. At this juncture, it is necessary to introduce a reader development early intervention programme. This programme instils reading habits at the earliest possible stage - in the womb and the first six months after birth. The Sarawak State Library has been embarking on one such programme at a small scale at the headquarters level. This programme, which has been rebranded twice from “born To Read” to “Every Book A Child” to the current one “The Reading Seeds”, will be enhanced accordingly and extended throughout Sarawak. Collaboration and community engagement are again critical success factors in the successful implementation of rebranded programme.

## Conclusion

The study has uncovered areas of concern pertaining to the reading habit of library users in Sarawak. Major areas of concern include low membership among library users and their lack of participation in activities organised by their libraries. The remit and diversity of the library collection is another area that raises concerned. The provision of ICT and Internet connectivity, especially in the rural areas of Sarawak

are also issues that need to be addressed accordingly. Based on the success of a number of initiatives and programmes of the Sarawak State Library, action plans have been identified to improve these weak spots and to alleviate areas of concerned.



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## *Using SQL in CBR for Similarity Retrieval: The Case of the TQF Advisory System*

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### **Abstract**

Case-Base Reasoning (CBR) is a methodology that stands out as one of the most useful artificial intelligence techniques. The essential idea of CBR is to answer user's queries by comparing them with problems in the case base that have been solved and determines the most similar one. Case retrieval is a procedure that a retrieval algorithm finds the most similar cases to the present problem. While conventional database management systems offer restricted query flexibility, systems that can create similarity based queries, for example, those found in case-based reasoning research, would improve the utility of data resources. This paper explains a strategy for building case-based systems utilizing a conventional relational database (RDB). The similarity computing in which database queries retrieve similar cases are presented. The implementation utilizes Structured Query Language (SQL) to find such similar cases.

Keywords: Case-Based Reasoning (CBR), SQL, Similarity Retrieval, Advisory System

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## 1. Introduction

Case-based reasoning (CBR) is a method for solving a new problem that occurs by bringing a solving method that has been used for solving similar problem in the past to be a guideline for future problem solving. Case-based reasoning has been used for solving problems in various fields such as medicine, engineering, finance, banking, education, and tourism. Case-based reasoning is a suitable problem solving method because it is similar to human's thought process which uses past experience for solving present problem and learns from what happens [1] [2]. The important thing for Case-based reasoning is how to store old cases and a method for determining the similarity between a new case and all old cases that will give a case that is the best answer or the most similar one.

For the determination of similarity of Case-based reasoning, there are many ways such as nearest neighbor, induction, statistics, neural networks, fuzzy logic, and production rules. Case-based reasoning that uses SQL to determine the similarity of cases, store the cases in relational databases. DBMS is responsible for managing the data in that database. Then SQL statements are used to determine the similarity of the new case and the old cases. When a user of the system needs to compare a new case to find a matched old case stored in the databases, there is a problem when using SQL for finding the similarity because relational database queries only give exact match answers. However, for Case-based Reasoning, the answer does not have to be a 100% match of a new case and an old case. Therefore, the use of SQL to determine the similarity of a new case and the stored old cases needs to define conditions or formats that support the use of SQL for finding the similarity of the new case and the old cases that cover all conditions.

We propose the use of SQL to find the similarity of a new case and the old cases stored in the database by presenting the cases with 100% similarity (Exact Match), with some similarity, and without similarity for the development of TQF Advisory System of the curriculum development.

## 2. Problem Statement of the research

At present, education is one of the businesses that are highly competitive because of modern technology that allows people the ability to choose various forms of education including in the education system at various institutions or to learn by themselves with various online media that provide vast and wide-open knowledge. The important thing of education, in addition to a teacher who has knowledge and the readiness and willingness to study of students, is the curriculum which can provide a framework or guideline for providing knowledge to students as well. Therefore, in the development or improvement of the curriculum, the developer can have a format for providing guidance which framework of concept should be developed in order to have graduates with knowledge exactly as specified.

The TQF Advisory System is an information system developed by using the Case-based reasoning technique in the development of the system in this work. The data of approved

curricula are stored in a database and will be used as cases for various curricula. Curriculum developers can use them as a guideline for developing the curriculum by specifying the suitable direction of framework of each curriculum. For example, if a university wants to develop its computer science curriculum within the TQF standard, the system developer can refer to cases that are approved computer science curriculum from the database for curriculum development.

Using Case-based reasoning to develop a system can provide feedback to the curriculum developer through a case of the similar curriculum from other institutions in order to evaluate the developing curriculum. To determine the similarity of a new case and all old cases, the system of this work uses SQL programs to find the similarity.

### **3. Case-based reasoning in the research**

Algorithm which are deployed in case-based reasoning (CBR) include nearest neighbor, induction, fuzzy logic and SQL retrieval.[3]

Nearest neighbor techniques are probably the most broadly utilized technology as a part of CBR since it is available in the majority of CBR tools. Nearest neighbor algorithms all work in a comparative manner. The similarity of the problem case to a case in a case-library for every case characteristic is resolved. This measure might be multiplied by a weighting component. At that point the total of the similarity of all attributes is determined to give a measure of the similarity of that case in the library to the objective case [3].

Induction techniques are generally utilized as a part of CBR since a lot of the more capable industrially accessible CBR tools give this facility. Induction algorithms, for example, ID3, fabricate decision trees from case histories. The induction algorithms recognize patterns amongst cases and separate the cases into bunches. Every bunch contains cases that are comparative. A prerequisite of induction is that one target case characteristic is defined. Basically, the induction algorithms are being utilized as classifiers to group comparable cases together. It is accepted that cases with comparative problem descriptions will allude to comparative problems and henceforth comparative solutions [3].

Fuzzy logics are a method for formalizing the typical handling of fuzzy linguistic terms, for example, excellent, good, fair, and poor, which are connected with differences in an attribute depicting a characteristic. Any number of linguistic terms can be utilized. Fuzzy logics inherently represent notions of similarity, because good is nearer (more similar) to excellent than it is to poor. For CBR, a fuzzy preference function can be utilized to compute the similarity of a single attribute of a case with the relating attribute of the target [3].

At its most straightforward form, CBR could be executed utilizing database technology. Databases are effective method for storing and recovering substantial volumes of information. In the event that problem descriptions could make well-formed questions it

is clear to retrieve cases with identical descriptions. The issue with utilizing database technology for CBR is that databases retrieval using exact matches to the queries. This is ordinarily enlarged by utilizing wild cards, for example, “WESTp” matching on “WESTMINSTER” and “WESTON” or by specifying ranges, for example, “1965”. Using wild cards, Boolean terms and other operators within queries may cause a query more general, and subsequently more inclined to retrieve a suitable case, however it is not a measure of similarity. In any case, by increasing a database with clear knowledge of the relationship between concepts in a problem domain, it is conceivable to utilize SQL queries and measure similarity [3-5].

#### 4. Similarity Retrieval

To determine the similarity of a new case at the parameter level, the procedure is as follows:

1. Specify the intended similarity range:

**Table 1.** Exact Matching and Level of Similarity Value

Exact Matching	Level of Similarity Value			Not Matching
	High	Medium	Low	
100%	100<Similarity value >=80	80<Similarity value>=60	60<Similarity value>0	Not found

Table 1 shows the specification of similarity between a new case and old cases from the answer from using SQL queries to determine the similarity including 1) if the answer for similarity between the new case and old case is 100% then the similarity value between the new case and old case is “Exact Matching”, 2) if the answer for similarity between the new case and old case is from 80% to under 100% then the similarity value between the new case and old case is “High”, 3) if the answer for similarity between the new case and old case is from 60% to under 80% then the similarity value between the new case and old case is “Medium”, 4) if the answer for similarity between the new case and old case is from over 0% to under 60% then the similarity value between the new case and old case is “Low”, and if there is no answer then the similarity value is “Not Found”.

2. Find the similarity value between the new case and old case using the following procedure:

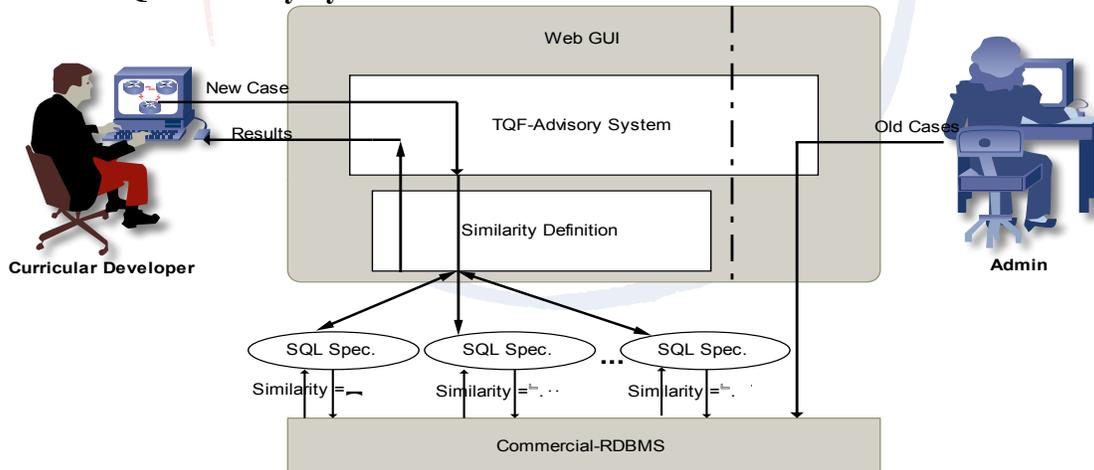
- a. Specify a new case to determine the similarity value
- b. Specify a parameter for the new case in a) that will be used as a condition to determine the similarity value
- c. Find the similarity value of the new case by using the parameter from b) for comparing between the new case and old cases whether the new case is similar to which old case and at what similarity level as defined in Table 1.
- d. Store the obtained similarity value from 3) in a similarity table in the database.

The similarity of the new case and old case of the overall parameter in each side is determined as follows:

$$\text{Similarity value} = \text{Max} \begin{bmatrix} \text{Max} \begin{bmatrix} [\text{Sum case 1}(\text{Parameter 1})] \\ [\text{Sum case 1}(\text{Parameter 2})] \\ \vdots \\ [\text{Sum case 1}(\text{Parameter } n)] \end{bmatrix} \\ \text{Max} \begin{bmatrix} [\text{Sum case 2}(\text{Parameter 1})] \\ [\text{Sum case 2}(\text{Parameter 2})] \\ \vdots \\ [\text{Sum case 2}(\text{Parameter } n)] \end{bmatrix} \\ \vdots \\ \text{Max} \begin{bmatrix} [\text{Sum case } n(\text{Parameter 1})] \\ [\text{Sum case } n(\text{Parameter 2})] \\ \vdots \\ [\text{Sum case } n(\text{Parameter } n)] \end{bmatrix} \end{bmatrix}$$

The similarity value is determined from the similarity table obtained from the determination of similarity at the parameter level. To determine the similarity value at the overall level, the sum of each parameter in each case will be determined and then the highest sum of each parameter in each case will be determined. Finally, the highest sum of each parameter in each case will be used to determine the highest value in order to determine the similarity value.

### 5. The TQF Advisory System



**Figure 1.** TQF Advisory System Architecture

The TQF Advisory System is a system that was developed as a tool for curriculum developer in higher education of Thailand to be able to see the overall picture that the curriculum prepared will eventually causes the students to possess knowledge in which direction under the 5 aspects of regulatory framework in each curriculum including 1) Ethics and Morality, 2) Knowledge Development, 3) Intellectual Development, 4) Interpersonal Relationship, and 5) Numerical Analysis, Communication, and Information

Technology Skills or the developed curriculum has the characteristic similar to the same curriculum from which institution so that it can be used as a reference or a guideline.

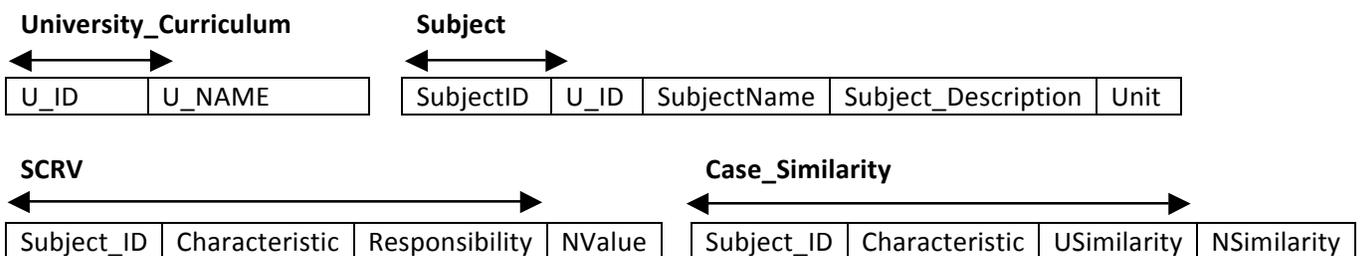
Figure1 shows TQF Advisory System architecture that illustrates the operation of the system, which includes two types of user. The first type is a user who is a curriculum developer, who is a user that use the work system to inspect or test the curriculum development that develops the characteristic of each curriculum or at the curriculum level it is similar to the same curriculum of which higher education institute in Thailand. To use it, user specifies the course information and the 5 aspects of responsibility information of the course whether it is a Primary Responsibility, Secondary Responsibility, or Not Relevant. The information that the user inputs will be compared with the information of the same course from other institutions that is stored in the database whether the course information in all five aspects of responsibility is the same as or similar to those of which institution. For the use in this part, user can update the curriculum mapping of the course according to user requirements to emphasize on any of the five characteristics, if found that the overall characteristic of the course is not consistent with the idea before storing that course into the database.

For the administrator (Admin), the admin will be responsible for storing the curriculum of each institute that has been developed and approved by the Office of the Higher Education Commission. Admin will store the details of curriculum mapping of each course of various curricula in the database.

**Table 2.** Example of Introduction to Database Curriculum Mapping [6]

Subject	Ethic and Morality							Knowledge Development							Intellectual Development				Interpersonal Relationship						Numerical Analysis					
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	1	2	3	4	1	2	3	4	5	6	1	2	3	4	
8311202 Introduction to database	•	•	○	○			•	•		○	○		•		○	•	○		○	•		○		○		•	○			•

Table 2 shows the curriculum mapping of the course Introduction to Database that shows the 5 aspects of responsibility of the course that the curriculum developer specifies for students to be responsible. The solid circle represents the Primary Responsibility, the circle represents the Secondary Responsibility, and an empty slot means Not Relevant. TQF information are stored in the database whose schemas are shown in Figure 2.



**Figure 2.** TQF Advisory System Relational Schema

The determination of the Similarity at the course level is a similarity comparison of a new course with courses stored in the database. The screenshot shown is shown in Figure 3 for the determination of the similarity. The procedure is as follows:

a) User specifies the course title in order for the system to find whether this course matches any course stored in the database. The result will show a description of the course along with the title for the user to double-check that the course is what the user needs. For example, if the user specify the name “Introduction to Database” the answer from the search system will show the course title with the words “Introduction to Database” and also show a description of all courses that are the answer in order for the user to verify that the specified title matches the course stored in the database.

b) The user specifies the parameters to be used as a condition for determining the similarity. For this research, the parameters used as condition in determining the similarity are the responsibility value of the course according to the characteristic in each aspect including Primary Responsibility (PR), Secondary Responsibility (SC), and Not Responsibility (NR).

c) The system will search the similarity of the course by using the course information from step a) and the responsibility parameters of the course from step b) to determine the similarity level of the above information with the courses stored in the database. The similarity level is classified into 4 levels including “Exact Matching”, “High”, “Medium”, “Low”, and “Not Found”.

d) The results from step c) are stored in the Case\_Similarity Table in the database which contains the subject ID (SubjectID), characteristic of the course (Characteristic), the names of the institutions with similar similarity value (USimilarity), and the similarity value of the course (nSimilarity) that the user specifies in a) the similarity value specified in b). A partial of a Similarity Table is shown in Table 3. The information obtained in this step will be later used as data for determining the similarity level of the curriculum.

**Table 3.** Similarity Table (partial)

<b>Case_Similarity</b>			
<b>SubjectID</b>	<b>Characteristic</b>	<b>USimilarity</b>	<b>NSimilarity</b>
<b>8311101</b>	<b>Ethics and Morality</b>	<b>U1</b>	<b>100</b>
<b>8311101</b>	<b>Intellectual Development</b>	<b>U1</b>	<b>86.66</b>
<b>8311101</b>	<b>Interpersonal Relationship</b>	<b>U3</b>	<b>86.66</b>
<b>8311101</b>	<b>Knowledge and Development</b>	<b>U2</b>	<b>73.33</b>
<b>8311101</b>	<b>Numerical Analysis</b>	<b>U1</b>	<b>73.33</b>
<b>8311107</b>	<b>Ethics and Morality</b>	<b>U1</b>	<b>80</b>

<b>Case_Similarity</b>			
<b>SubjectID</b>	<b>Characteristic</b>	<b>USimilarity</b>	<b>NSimilarity</b>
<b>8311107</b>	<b>Intellectual Development</b>	<b>U1</b>	<b>80</b>
<b>8311107</b>	<b>Interpersonal Relationship</b>	<b>U4</b>	<b>80</b>
<b>8311107</b>	<b>Knowledge and Development</b>	<b>U3</b>	<b>80</b>
<b>8311107</b>	<b>Numerical Analysis</b>	<b>U2</b>	<b>60</b>

**Curriculum Mapping**

Subject Name: Introduction to Database

Ethic and Morality :	Primary Responsibility	3	Secondary Responsibility	2	Not Responsibility	2
Knowledge Development :	Primary Responsibility	1	Secondary Responsibility	2	Not Responsibility	5
Intellectual Development :	Primary Responsibility	1	Secondary Responsibility	2	Not Responsibility	1
Interpersonal Relationship :	Primary Responsibility	2	Secondary Responsibility	3	Not Responsibility	1
Numerical Analysis :	Primary Responsibility	1	Secondary Responsibility	1	Not Responsibility	4

**Similarity**

U_Name	SubjectName	Characteristic	Responsibility	NValue	Similarity
<b>Ethics and Morality</b>					
U1	Introduction to Database	Ethic and Morality	Primary Responsibility	3	100 %
U1	Introduction to Database	Ethic and Morality	Secondary Responsibility	2	100 %
U1	Introduction to Database	Ethic and Morality	Not Responsibility	2	100 %
					<b>Ethics and Morality Smilarity</b>
					100 %
<b>Knowledge and Development</b>					
U2	Introduction to Database	Knowledge Development	Primary Responsibility	2	80 %
U2	Introduction to Database	Knowledge Development	Secondary Responsibility	3	80 %
U2	Introduction to Database	Knowledge Development	Not Responsibility	3	60 %
					<b>Knowledge Development Smilarity</b>
					73.33 %
<b>Intellectual Development</b>					
U1	Introduction to Database	Intellectual Development	Primary Responsibility	2	80 %
U1	Introduction to Database	Intellectual Development	Secondary Responsibility	2	100 %
U1	Introduction to Database	Intellectual Development	Not Responsibility	0	80 %
					<b>Intellectual Development Smilarity</b>
					86.66 %
<b>Interpersonal relationship</b>					
U3	Introduction to Database	Interpersonal Relationship	Primary Responsibility	1	80 %
U3	Introduction to Database	Interpersonal Relationship	Secondary Responsibility	3	100 %
U3	Introduction to Database	Interpersonal Relationship	Not Responsibility	2	80 %
					<b>Interpersonal relationship Smilarity</b>
					86.66 %
<b>Numerical Analysis</b>					
U1	Introduction to Database	Interpersonal Relationship	Primary Responsibility	2	80 %
U1	Introduction to Database	Interpersonal Relationship	Secondary Responsibility	2	80 %
U1	Introduction to Database	Interpersonal Relationship	Not Responsibility	2	60 %
					<b>Numerical Analysis Smilarity</b>
					73.33 %

**Figure 3.** TQF-Advisory System Input Screen for Curricular Developer

Figure 3 shows the input screen of TQF Advisory System for the curriculum developer showing an example of finding the similarity of the course Introduction to Database which is a new case with some details explained as follows: Ethics and Morality of new case has similarity = 100% or “Exact Matching” with the course Introduction to Database of “U1” (old case), meaning the all responsibility values including Primary Responsibility, Secondary Responsibility, and Not Responsibility of both new case and old case are the same. For Knowledge Development of new case, the similarity = 73.33%

or the similarity level of “Medium” with the course Introduction to Database with “U2” when the Primary Responsibility of new case = 1 when the Primary Responsibility of old case = 2, Secondary Responsibility of new case = 2 when Secondary Responsibility of old case = 3, and the Not Responsibility of new case = 5 when Not Relevant of old case = 3.

The responsibility values for all aspects of each course that is a new case and the obtained similarity will be stored into the database. For this system, they are stored into the Case\_Similarity table and when the system developer is satisfied with the result, the information of this new case will become an old case for use in the future.

The determination of the similarity at the curriculum level is a comparison of the new curriculum that user wants to find the similarity against curriculums stored in the database. The determination of the similarity at the curriculum level will use information on the similarity at the course level that is stored in the Similarity Table instead of taking stored data of all courses for the consideration. This is due to the fact that the information in the Similarity Table are cases which are the result from filtering out cases that are not relevant. So, accessing data for determining the similarity at this level is faster [7].

Figure 4 shows the SQL query which is used to determine the similarity at the curriculum level.

```
SELECT Max(SumOfnSimilarity) AS MaxOfSumOfnSimilarity
FROM (SELECT Case_Similarity.USimilarity,
Sum(Case_Similarity.nSimilarity) AS SumOfnSimilarity
FROM Case_Similarity
GROUP BY Case_Similarity.USimilarity);
```

**Figure 4.** SQL to find Curriculum Similarity

USimilarity	MaxOfSumOfnSimilarity
U1	419

**Figure 5.** Results from SQL in Figure 4.

Figure 5 shows the results for the determination of the similarity of the new curriculum (new case) against the existing curriculum (old case) of institution “U1” when considering the similarity of the characteristic of all courses at all aspects of characteristic and the curriculum of “U1” has the highest similarity. Therefore, it can be concluded that the new curriculum that is being developed (new case) is similar to the same curriculum of institution “U1”.

SQL statements for finding the similarity of the curriculum in the overall characteristic of each aspect of the curriculum & are shown in Figure 6.

Curriculum Characteristic	SQL for finding Curriculum Similarity for a curriculum characteristic
Ethics and Morality	SELECT USimilarity, Max(SumOfnSimilarity) As MaxOfnSimilarity

	<pre>FROM (SELECT Case_Similarity.USimilarity, Sum(Case_Similarity.nSimilarity) AS SumOfnSimilarity, Case_Similarity.Characteristic FROM Case_Similarity GROUP BY Case_Similarity.USimilarity, Case_Similarity.Characteristic HAVING (((Case_Similarity.Characteristic)="Ethics And Morality")) ORDER BY Sum(Case_Similarity.nSimilarity) DESC);</pre>
Knowledge Development	<pre>SELECT USimilarity, Max(SumOfnSimilarity) As Max<b>OfnSimilarity</b> FROM (SELECT Case_Similarity.USimilarity, Sum(Case_Similarity.nSimilarity) AS SumOfnSimilarity, Case_Similarity.Characteristic FROM Case_Similarity GROUP BY Case_Similarity.USimilarity, Case_Similarity.Characteristic HAVING (((Case_Similarity.Characteristic)="Knowledge Development")) ORDER BY Sum(Case_Similarity.nSimilarity) DESC);</pre>
Intellectual Development	<pre>SELECT USimilarity, Max(SumOfnSimilarity) As Max<b>OfnSimilarity</b> FROM (SELECT Case_Similarity.USimilarity, Sum(Case_Similarity.nSimilarity) AS SumOfnSimilarity, Case_Similarity.Characteristic FROM Case_Similarity GROUP BY Case_Similarity.USimilarity, Case_Similarity.Characteristic HAVING (((Case_Similarity.Characteristic)="Intellectual Development")) ORDER BY Sum(Case_Similarity.nSimilarity) DESC);</pre>
Interpersonal Relationship	<pre>SELECT USimilarity, Max(SumOfnSimilarity) As Max<b>OfnSimilarity</b> FROM (SELECT Case_Similarity.USimilarity, Sum(Case_Similarity.nSimilarity) AS SumOfnSimilarity, Case_Similarity.Characteristic FROM Case_Similarity GROUP BY Case_Similarity.USimilarity, Case_Similarity.Characteristic HAVING (((Case_Similarity.Characteristic)="Interpersonal Relationship")) ORDER BY Sum(Case_Similarity.nSimilarity) DESC);</pre>
Numerical Analysis	<pre>SELECT USimilarity, Max(SumOfnSimilarity) As Max<b>OfnSimilarity</b> FROM (SELECT Case_Similarity.USimilarity, Sum(Case_Similarity.nSimilarity) AS SumOfnSimilarity, Case_Similarity.Characteristic FROM Case_Similarity GROUP BY Case_Similarity.USimilarity, Case_Similarity.Characteristic HAVING (((Case_Similarity.Characteristic)="Numerical Analysis")) ORDER BY Sum(Case_Similarity.nSimilarity) DESC);</pre>

**Figure 6.** SQL statements for finding the similarity of the curriculum in the overall characteristic of each aspect of the curriculum

## 6. Conclusion

Case-Based Reasoning is a methodology widely used in many fields such as education, tourism, medicine, or other industries because it is a method that uses data from the past to support the decision making for the present situation like TQF Advisory System which is an information system developed using Case-Based Reasoning and SQL to find the similarity level between new case and old cases both at the course and curriculum levels. Users can use the data from this work as a guideline for the development of a curriculum in order to choose the direction of the development.



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***The Applications and Effectiveness of Smart Campus in Taiwan Thematic  
Research Project***

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**Abstract**

In recent years, many countries have introduced ICT-related applications in learning, energy saving, management and others on campus in attempt to alleviate the burden of teachers and administrators and to improve the effectiveness and results of learning. To help Taiwan's enterprises to provide products and services in line with the international development and to meet the needs on campus, the Industrial Development Bureau of Ministry of Economic Affairs in Taiwan launched a thematic research project, inviting 3 system integrators in Taiwan to develop comprehensive systems which cover six different aspects, including learning, social, governance, management, energy and health. So far, thirty five example schools have established. The collected information of the six aspects is integrated. The result after introducing the ICT applications is apparent, and the schools with good practices of the ICT tools has obtained solid and clear results or improvement in learning, governance, security and etc. For example, a junior high school in the remote area has seen the improvement of students' scores of the senior high school entrance exam by over 50%.

Keywords: Smart campus, education, Taiwan, Smart learning

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## Introduction

According to the statistics of the Ministry of the Interior of the Taiwan government, the population in Taiwan is 23,373,517. As for the statistics from the Ministry of Education of the Taiwan government, the number of the students and teachers in schools totals 5,381,933, sharing 23% of Taiwan's whole population. The number of schools in Taiwan is 11,426 in 2013. The teachers and most students spend at least 8 hours in schools. Therefore, from the number of schools, teachers and students, the people and the activities in schools take a very important part in the society. The services and innovative applications provided to schools have significant meanings to the whole society.

In recent years, many countries in Asia promote smart campus actively. Most applications are focused on smart learning, smart social activities and smart management. For example, the Japan projects, "Future School Promotion Project" and "Learning Innovation Project", are the launched respectively by the Ministry of Internal Affairs and Communications and the Ministry of Education, Culture, Sports, Science and Technology. According to Japan Ministry of Internal Affairs and Communication (MIC)'s report (2013), Ministry of Education, Culture, Sports, Science and Technology has collaborated with MIC to work on "Future School Promotion Project", a 4 years project started with 10 primary schools in the fiscal year 2010. Then, 8 junior high schools and 2 special support schools participate. Meanwhile, "Learning Innovation Project" of MEXT was implemented in the same 20 schools (10 primary schools, 8 junior high schools and 2 special support schools). Interactive whiteboards and tablets in some elementary schools, junior high schools and supportive schools have been used as examples to locate problems or issues. [a]

Also, the Chinese government also provided national guidelines or launched various plans to promote smart learning, like "National Outline for Medium and Long-term Education Reform and Development (2010-2020)" [b], "Ten-Year Development Plan of the Informatization of Education (2011-2020)" [c] and the "China Action Plan for Digital Education 2020" [d]. The mentioned guideline and plans were intended to improve various aspects of digital and information education so as to strengthen education and foster talents.

## Literature Review

As for the study of the smart campus, Estisilat-BT Innovation Center [EBTIC] (2010) [6] provided its definition and scope about smart campus which covers 6 aspects, including "iLearning", "iSocial", "iGovernance", "iManagement", "iGreen" and "iHealth". These aspects can work independently and inter-dependently to integrate campus with interactivity. The following is the brief introduction of each aspect:

1. iLearning: The eLearning or any other resources of learning to form an holistic learning environment.
2. iGovernance: The governance inside and outside campus.
3. iGreen: Energy saving or harvesting for sustainability with ICT tools.
4. iHealth: Prevention and epidemic alert healthcare system and various tools.
5. iSocial: Networking and communication.

6. iManagement: Various management, maintenance, surveillance and others in a centralized fashion.

Figure 1: The 6 aspects of iCampus



### Methodology and Method

From 2002 to 2011, Taiwan has implemented “Taiwan e-Learning and Digital Archives Program” and has laid the foundation of Chinese digital contents and fostered the talents in this field. Thanks the development in these 9 years, the Chinese contents and materials had been digitized successfully. According to the e-Learning Industry Output Value Report 2013 (Industrial Development Bureau of Ministry of Economic Affairs, 2013) [7], the e-Learning industry was categorized into 4 groups, including digital materials, platforms, learning services and hardware. The percentage of the output value of each group is 37.85% for hardware, 37.18% for learning services, 19.13% for digital materials and 5.85% for platforms.

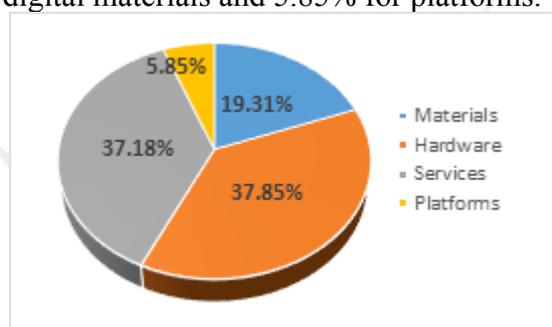


Figure 2: The percentage of the output value of the 4 groups in the e-Learning Industry in Taiwan (Industrial Development Bureau of Ministry of Economic Affairs, 2013)

The maturity of the talents and the industry helps the promotion of the smart campus. In order to promote the smart campus industry, the government introduced the thematic research project with the participation of the enterprises. 4 strategies go with this thematic research project. First of all, the government promotes the standard in line with that in the international community. Secondly, the government promote innovative smart services and solutions of the integrated cloud services so as to form the industrial value chain of the smart campus industry. Thirdly, example schools in the rural and urban areas are established for field verification and to narrow the gap between the country and the cities. Also, the experiences are very helpful for the potential customers or clients in the international market. Finally, the government

endeavors to assist the enterprises in Taiwan to succeed in the market overseas and establishing the image of international brands.

The promotion encourages the enterprises in Taiwan to integrate the technology or applications of the green industry, wearable devices, learning devices, cloud platforms, information services and others so as to form a comprehensive value chain to be competitive in the market.

The international standards are introduced to integrate the software, software and services in order to solve the compatible problems of different systems or equipment. In order to achieve this goal, there are two parts in the process. Firstly, enterprises are invited to form the special interest groups and starts the system interface integration of cross-disciplinary applications in order to promote the integrated standards among the 6 aspects of smart campus. In addition, the “Education Cloud” services are also integrated, including the database of the learning records, learning portfolio, school rolls, health, school affairs and others.

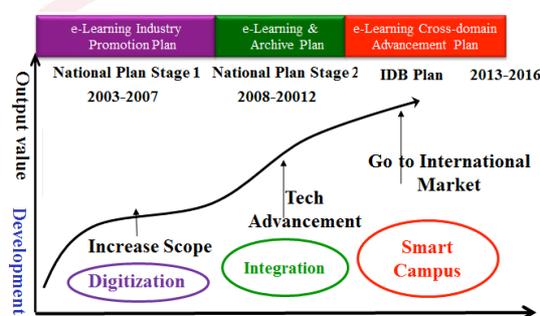


Figure 3: The stages to develop the e-Learning Industry (Industrial Development Bureau of Ministry of Economic Affairs, 2013)

## Conclusion

The purposes of the smart campus thematic research project are to integrate hardware and software for the supervising department’s convenience of management among schools, to provide a future-oriented learning environment and to narrow the gap between the rural and urban areas. So far, the following things have been achieved.

(1) 35 example schools in Taiwan and 9 example schools overseas: The thematic plan has the participation of 3 major system integrators in Taiwan, including Wistron Corporation, Delta Electronics and MiTAC Information Technology Corp. By bringing the resources of the big enterprises, these 3 companies are able to link the small-and-medium enterprises to develop the innovative services or applications in the 6 aspects of smart campus. 35 example schools are dispersed in 9 counties in Taiwan, and 9 example schools are established respectively in China, Thailand and Vietnam.

(2) Collaboration with overseas partners: In order to have close co-operation with the overseas market, the enterprises in Taiwan work with their overseas partners. For example, one of the partners in Vietnam has helped Taiwan enterprises enter the Vietnamese market by providing the products or services of smart classrooms, digital textbooks and training. Based on the long-term partnership, 4 example schools are

established there for the schools and the government in Vietnam to know the benefits of smart campus.

(3) Participation in innovative services or applications: The thematic research project also collaborate with other education related organizations, like Institute for Information Industry [III] to implement the innovative models of services or applications. “The Small School Alliance” is one of the successful works. III has been commissioned by the Industrial Development Bureau of Economic Affairs to implement the national plan called “e-learning Industry Cross-Domain Advancement Plan” [9]. The enterprises joining the thematic research project of smart campus also participate in the activities of Small School Alliance.

Small School Alliance is intended for the small-sized schools in Taiwan to obtain good education resources in an economic way. When these schools enjoy the resources provided to them, they can also share their special lessons with others. For example, the schools in the mountains can share their special ecosystem in their environment.

The resources are not just in Taiwan. The activities of exchanges are also held with those in Singapore, Vietnam and Malaysia. The English teachers from the Philippines are connected with the students in Taiwan to bring special learning experiences to students and to improve students English. This kind of real-time interactive online lessons also brings apparent improvement in different subjects. For example, the level-Based, real-time adaptive English lessons result in distinguishing outcome: 25.74% progress in metropolitan school, while 38.18% progress in remote schools. After completing the full English, long-distance, level-based English courses taught by foreign teachers, the research results showed that the average score of progress for the whole class at schools in metropolitan areas is 17.73, with a rate of 25.74%; the average score for schools in remote villages is 21.2, with a rate of 38.18% (The result of performance belong to the plan sponsored by the Industrial Development Bureau of Ministry of Economic Affairs and will be posted for the reference of the general public in Taiwan according to its schedule. The detailed implementation will be presented in this December in IEEE TALE2016 in Bangkok, Thailand.) The Table 1 shows the results of 2 schools joining the real-time interactive English lessons.

Table 1. Comparison of Level-based English learning progress between urban and rural schools

Groupings based on level	Degree of progress in urban schools	Degree of progress in rural schools
High achievement	19.59%	15.98%
Middle achievement	25.67%	33.91%
Low achievement	101.04%	76.37%
Average of the whole class	25.74%	38.18%

Also, Baolai Junior High School, a junior high school less than 100 students in the remote area, has seen the improvement among the students of the middle level in their senior-high-school-entrance-exam scores by over 50%.

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*A Study of the Online Learning Environment in the B.A. (English) Program of  
Sukhothai Thammathirat Open University, Thailand*

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**Abstract**

This study aims to study the interactivity patterns of online learners, as well as the factors influencing interactivity patterns based on the principles of constructivism theory. It makes use of a survey, which stresses that the learners play the role of learning constructors by themselves in a socially constructed environment. According to social constructivism, learners express their opinions to construct knowledge based on personal experience, including their collaboration with other learners and/or instructors.

The findings from the Constructivist On-Line Learning Environment Survey (COLLES) questionnaire showed that the item 'Tutor support,' which is the component of the theory of social constructivism, was at the highest degree of agreement, while the least agreement is on the item of 'Peer support'. The questionnaire results were confirmed in student group interviews and in focus group discussions which learners volunteered for. The factors influencing this may likely be that most learners value tutor support much more than peer support for learning in the university online environment. Also, they are all distance learners who are part-time learners, and may prefer learning in traditional ways to collaborative learning or constructivism, and there are also variations in terms of age, learning experience, background, career, etc.

Moreover, they mostly agree on the correlation of the online learning curriculum with the 5 learning domains of the Thai Qualification Framework (TQF) comprising ethical and moral development, knowledge, cognitive skills, interpersonal skills and responsibilities and analytical and communication skills.

Keywords: Social Constructivism, Tutor Support, Peer Support

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## **Introduction**

Since its foundation in 1978, Sukhothai Thammathirat Open University (STOU) has cultivated a distance learning system that makes quality higher education accessible to all who wish to further their studies. STOU is committed to offering equal opportunities in education for all people and promoting education which people can access without limitations of time or place. This affordable and convenient system enables students to study by themselves without having to attend conventional classes, and it provides students in different locations with the freedom to study according to their individual circumstances and interests. Besides, in accordance with the university policy of the “open” university, there are no selective measures to screen applicants. Students are able to continue their careers, study simultaneously in other institutions, and take control of their own intellectual development by choosing from a variety of instructional activities. Self-guided instruction is mailed to students at the beginning of the semester through integrated media comprising textbooks, workbooks, audio and visual materials, supplementary reading materials, radio and television programs, computer-assisted instruction and e-Learning. In addition, students are able to access face-to-face instruction and guidance at regional and provincial study centers.

In terms of internal academic organization, the university is divided into 12 schools. Each school is responsible for the planning of the curricula and the provision of instruction in the group of subjects it supervises. The programs offered by these schools range from certificate programs up to doctoral programs. The School of Liberal Arts, one of the schools in STOU, is responsible for developing curricula, providing foundation courses in the bachelor’s degree programs for every school, and offering certificate, bachelor’s, master’s and doctoral programs in liberal arts subjects. Under this school, the English department is responsible for offering foundation courses and programs for practicing English skills for STOU students.

### **Online English Language Learning in the B.A. (English) Program**

After three decades of distance education in the certificate program in English for specific purposes via printed-based teaching materials, a new challenge appeared. With the integration of the Internet into a large number of fields including language learning, the English department of STOU saw an opportunity for launching an online B.A. program in English. First, we produced a number of new online courses in English language learning in order to prepare for the start of the online program. Subsequently, in 2011 the program was launched online using two Learning Management Systems (LMS): D4L+P and Moodle, and our first group of 99 students graduated in 2013.

This first group of 99 students graduated from the B.A. program in English which is the first online distance language learning program of Sukhothai Thammathirat Open University (STOU). Several follow-up studies on the students’ satisfaction with the program have been carried out. For example; graduate and employer satisfaction with the program has been studied and a survey has been carried out on the correlation between the program curriculum and the Thai qualifications framework (TQF) for higher education. In general, these studies confirmed the success of online distance language education, focusing on student/peer and student/teacher interaction as the

main focus of language learning. The study specifically monitors learner interactivity in the online English program by focusing on learner construction of knowledge according to the social constructivism principle. However, up to now there has not been any study assessing the efficacy of online teaching using a constructivist online learning environment survey.

### **The Theory of Social Constructivism and the Online Learning**

One key concept of Vygotsky's social constructivism theory is that knowledge construction is both a social and cognitive processes. Knowledge and meanings are actively and collaboratively constructed in a social context mediated by frequent social discourse. In a social constructivist learning environment, effective learning happens only through interactive processes of discussion, negotiation and sharing. Guidelines from social constructivism has been widely accepted in investigating learner knowledge construction in various fields, such as mathematics, science, technology, pharmacy, and others. For the field of language learning, several research projects have been conducted to investigate the students' perception on each of the scales based on social constructivism theory, comprising Professional Relevance, Reflective Thinking, Interactivity, Tutor Support, Peer Support and Interpretation of Meaning. The research findings by Galvin (2012) confirmed that there were some students who are reluctant to interact with others in the online learning community. However, Peer Support is a voluntary activity which supports students' online learning experience. Giving or being given advice from peers is beneficial to students in an enhancement of their learning from teachers. In addition, the study by Ware (2008) underlined online language learners may be satisfied with the peer feedback but they prefer direct advice given by their teachers. For this study, it has been used to examine the learning collaboration among online distance learners in the B.A. English program. In light of the social constructivist theory, the quality of the learning management system D4L+P is studied. Regarding the other LMS, Moodle, while it has been used as the platform for doing assignment and course content delivery, it is currently not used as a place for online group work activities for learners.

### **The University Online Learning Management System: D4L+P**

**D4L+P** stands for Design for Learning plus Portfolio. It is the online learning management system that supports collaborative learning developed from T5 Model learning design (T5 refers to task, tool, tutorial, team and instructor interaction). This means "learning is about the learner making an effort to engage in their own learning". Distance learners must devote their time to constructing knowledge within a limited time frame. There should also be support for learners to work and construct their knowledge. In this LMS, learners are first assigned collaborative work, then give feedback to peers. They must also consider peer feedback on their own work. At the end, learners cooperate with their team members to finish the final piece of work that will be posted on the system. Overall, the learning design under this model focuses on the learning process rather than the product. The overall scheme of online assignments in this LMS are as follows (Sataporn, 2014):

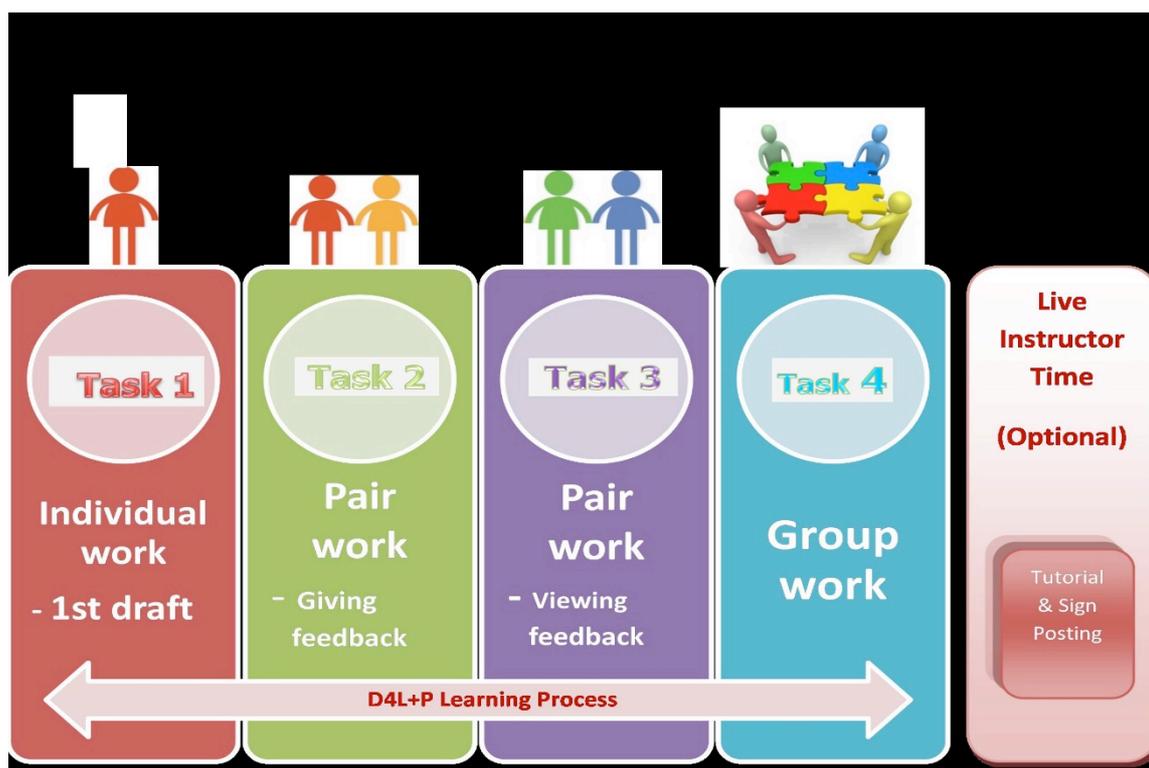


Figure 1: The overall scheme of online assignments in D4I+P

### Task 1: Learning by Doing and Problem Solving

In the first step, or Task 1, students are assigned to do individual work where they have to study the information in their resources. These resources can be certain pages in their textbooks or study guide, video/audio clips, or links to online learning objects prepared by the instructors. The first attempt students make to submit their first assignment is not the end of their chance to learn from doing that task. In doing this step, they create their meaning of the topic covered by the task and solve the problem challenged by the task. Their study with the resources has to be more active, focused and meaningful as well, as they do not just read or listen passively but try to get the full meaning out of what they study.

### Task 2: Learning from examples and comparing work

After the first step, they move on to Task 2, to view their peer's work for Task 1. They then give feedback on each piece of work. By doing this, they have another chance to think about the task. By comparing their work with their peers, they can also learn from the examples their peers set. They have a chance to give suggestions of how to do the task to other learners as well, if they find that their work does not yet meet the requirements set by the instructors. Learners can also defend their work at this stage when they see that their peer's interpretation of the task is different from how they see it. Students are motivated to do this task as well because they know that their feedback will be given marks from the peers who receive it.

### **Task 3: Learning from Feedback and Improving One's Work**

The next step is Task 3, where students are able to view the feedback given by their peers in Task 2. In this step, they have to judge how useful each piece of feedback is for them and assess it accordingly. During these two steps, students learn more about the content covered by the task.

### **Task 4: Learning from Sharing One's Work in the Community**

In the last step, or Task 4, students work in teams to share their ideas and work together to do the assignment, which is an extension of Task 1. After the team leader submits this assignment, every team member gets into the system to assess their teammates' contribution. The marks each member gets from this teamwork are factored into his/her total marks. The system is so strictly set that if students fail to do any of tasks 2-4, they will not be awarded the marks for that piece of module assignment given to them by their peers.

### **Live Instructor Time: Learning from Instructor and Signposting**

Live Instructor Time, is when the instructor gives feedback on student work and answers students' questions at an appointed time. Actually, throughout this process, the chat room is open 24/7 for them to communicate with their team, classmates, and instructor. This learning process keeps them active and engaged with each weekly assignment, so that some students get into the habit of working online nearly every day over the course of the semester (almost 4 months or 15 weeks).

Briefly, the D4L+P learning employs both pedagogy and digital learning technologies. The pedagogy includes a constructivism belief about how one learns (Task-based, and Problem-based Learning Concepts). Each task submission is locked after the due date is over. As each task submission due date is set as the time frame throughout the course, students also get to practice managing their time, since they are responsible for task submission. They are also responsible to their peers, as their feedback has to reach them before the deadline in order for it to be responded to. In all, this study mainly involves an investigation of learner interactivity in constructing knowledge by interacting with other learners and/or teachers in the D4L+P learning environment, which is set up in accordance with the principle of social constructivism theory.

### **Objectives**

1. To study the online learners' interactivity patterns in accordance with social constructivism theory
2. To study factors affecting online learners' interactivity patterns in the online learning environment in the program

### **Methods**

There were both quantitative data collected from the online questionnaire and interview data obtained from the interview and the focus group in this study. The

quantitative data was collected from the groups of samples who enrolled in the course of 14423 Professional Experience in English in the first semester of the 2014 academic year, as well as the first group of graduates in the program who volunteered for filling in the online questionnaire. More interview data were collected from the samples who volunteered for participating in the interview and focus group sessions.

### **The online questionnaire respondents**

The first group of 148 graduates and another group of 61 current students (the 2014 academic year) in the B.A. English program were asked to fill out the online questionnaires giving their opinions on each questionnaire items. The main part of the Constructivist On-line Learning Environment Survey (COLLES) questionnaires used in this study reflect the scales developed by Taylor and Maor (2000) based on the theory of social constructivism. The scales are concerned with student perceptions of a virtual classroom environment that helps reconstruct themselves as both reflective and collaborative learners. The online questionnaire of this study is mainly designed to measure student perception of:

- Professional Relevance – the extent to which engagement in the on-line classroom environment is relevant to students' professional worldviews and related practices.
- Reflective Thinking – the extent to which critical reflective thinking is occurring in association with online peer discussion.
- Interactivity – the extent to which communicative interactivity is occurring on-line between students and between students and tutors.
- Interpretation of meaning (Making sense) – the extent to which students and tutor co-construct meaning in a congruent and connected manner.
- Tutor support (Cognitive demand) – the extent to which challenging and communicative role modelling is provided by tutors.
- Peer support (Affective support) – the extent to which sensitive and encouraging support is provided by peers.

In addition to the constructs of the theory of social constructivism above, the researcher has added more questionnaire constructs into the online questionnaire. The following constructs are also used to examine more details or components of D4L+P, which is the Learning Management System used in the program.

- Overview of online learning environment – the extent to which the online learning environment provided in the course assists practicing language learning skills.
- Learning contents – the extent to which the learning contents provided in the online learning course are useful, appropriate and beneficial to student language learning.
- Components in learning environment – the extent to which all other components provided in the online course (resource links, live chat, and web boards are beneficial to student language learning.
- Online activities – the extent to which the online activities provided assist in constructing the language learning community.
- Peer evaluation – the extent to which feedback from peers as well as feedback to peers is helpful.

In order to collect the information from learners concerning their perceptions on the online English curriculum program, another construct on TQF below has been added to the questionnaire. According to the Thai Ministry of Education, The Qualifications Framework for Thailand's higher education system (TQF) is designed to support implementation of the educational guidelines set out in the National Education Act, to ensure consistency in both standards and award titles for higher education qualifications, and to make clear the equivalence of academic awards with those granted by higher education institutions in other parts of the world. The Framework is meant to provide appropriate points of comparison in academic standards for institutions in their planning and internal quality assurance processes, for evaluators involved in external reviews, and for employers, in understanding the skills and capabilities of graduates they may employ.

- Correlation with the Thai Qualifications Framework for higher education (TQF) – the extent to which the online language learning in the course is relevant to the 5 learning domains of the Thai Qualifications Framework for higher education: ethical and moral development, knowledge, cognitive skills, interpersonal skills and responsibility, and analytical and communication skills.

### **The interview and focus group respondents**

There were 15 students who volunteered to be interview respondents and 29 students who volunteered to participate in the focus group interview.

### **Results**

The following graph displays the results from the analysis of the online questionnaire which comprises two main items: the group of questions applied from the Constructivist On-line Learning Environment Survey (COLLES) and another group of questions concerning the overall perspectives of the learning environment of the B.A. program. The graph display the mean scores for twelve questions of the online questionnaire which its web link was sent to the group of students who volunteered for this study after their end of the 4-year program.

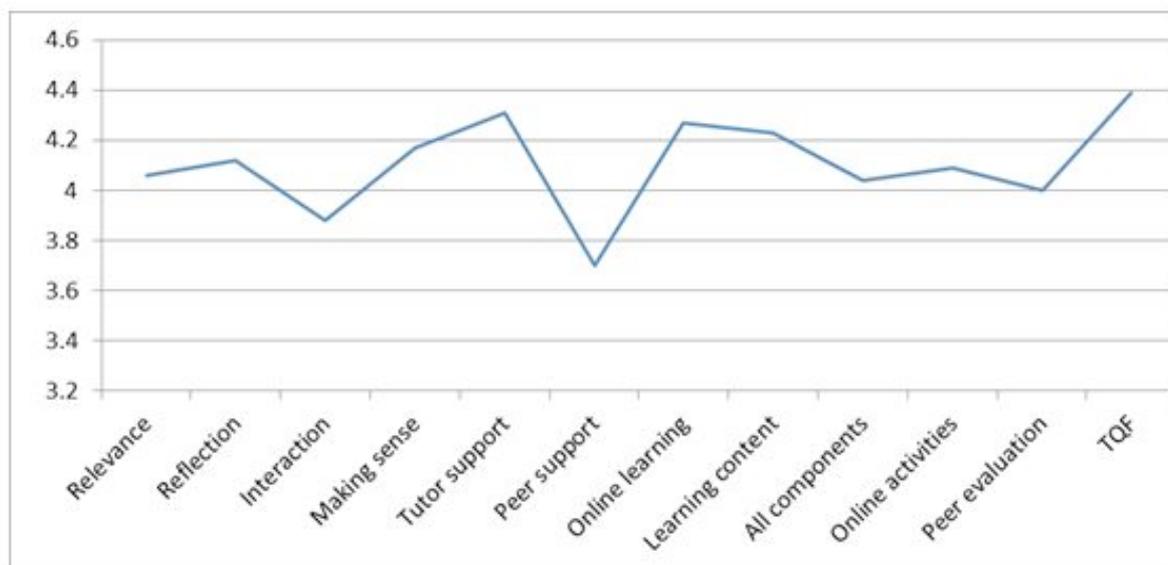


Figure 2: Overall perceptions of students’ online learning environment (N = 47)  
 Note: The numbers on the left signify the mean scores of each online questionnaire items

From the analysis of the online questionnaire, the results can be divided into two parts: the mean score of response to the question items from the social constructivist theory (COLLES) and the mean score of response to the additional question concerning the overall perspectives of online learning environment as in the following table.

COLLES question items	Mean scores	Overall perspectives on online learning environment items	Mean scores
Tutor support	4.31	Correlation with TQF	4.39
Interpretation	4.17	Overview of online learning	4.27
Reflection	4.12	Learning content	4.23
Relevance	4.06	Online activities	4.09
Interactivity	3.88	Component in online environment	4.04
Peer Support	3.70	Peer evaluation	4.00

Table 1: Overall perceptions of students’ online learning environment  
 In the following tables, the mean of each component of the 12 groups of questionnaire items is displayed in each table.

<b>Relevance</b> I have found that.....	<b>Mean</b>	<b>S.D.</b>
Online learning increases my professional skill.	4.20	0.22
What I have learned is related to my profession.	3.97	0.14
What I have learned is important for my profession.	4.00	0.16
I have learned how to improve my work.	4.06	0.15
Average mean	4.06	0.17

Table 2: Respondents' perception on the relevance of the online learning and their professions

For the item "Relevance" which is drawn from the theory of social constructivism, the overall respondents' perception is at the high degree of agreement (mean = 4.06). Concerning 'Online learning increases my professional skill' is at the high degree of agreement (mean = 4.20). It is followed by the perception concerning 'I have learned how to improve my work' (mean = 4.06), 'What I have learned is important for my profession' (mean = 4.00) and 'What I have learned is related to my profession' (mean = 3.97).

<b>Reflection</b> I have found that.....	<b>Mean</b>	<b>S.D.</b>
I have revised my learning method.	4.23	0.09
I have revised my opinions.	4.17	0.13
I have revised my colleagues' ideas.	3.93	0.22
I have revised the learning contents which I have read and learnt.	4.17	0.12
Average mean	4.12	0.14

Table 3: Respondents' perception on the Reflection on the online learning environment

For the item "Reflection" which is drawn from the theory of social constructivism, the overall respondents' perception is at the high degree of agreement (mean = 4.12). Concerning 'I have revised my learning method' is at the high degree of agreement (mean = 4.23). It is followed by the perception concerning 'I have revised my opinions' which has the same mean value as the item 'I have revised the learning contents which I have read and learnt' (mean = 4.17). The least agreement is on the item 'I have revised my colleagues' (mean = 3.93).

<b>Interaction</b> I have found that.....	<b>Mean</b>	<b>S.D.</b>
I explain my idea to other students.	4.36	0.11
I ask other students to explain their ideas.	3.70	0.16
Other students ask me to explain my ideas.	3.57	0.17
Other students respond to my ideas.	3.89	0.15
Average mean	3.88	0.5

Table 4: Respondents' perception on the Interaction in the online learning environment

For the item “Interaction” which is drawn from the theory of social constructivism, the overall respondents’ perception is at the high degree of agreement (mean= 3.88). Concerning ‘I explain my idea to other students’ is at the high degree of agreement (mean = 4.36). It is followed by the perception concerning ‘Other students respond to my ideas’ (mean = 3.89), ‘I ask other students to explain their ideas’ (mean = 3.70) and ‘Other students ask me to explain my ideas’ (mean = 3.57).

<b>Making Sense</b> I have found that.....	<b>Mean</b>	<b>S.D.</b>
I understand my friends’ opinion.	4.21	0.10
My friends show that they understand my opinions.	3.93	0.14
I have a good understanding of what the teacher explains.	4.29	0.08
The teacher shows that he/she understands my opinion well.	4.27	0.11
<b>Average mean</b>	<b>4.17</b>	<b>0.11</b>

Table 5: Respondents’ perception on the Making Sense from the online learning environment

For the item “Making sense” which is drawn from the theory of social constructivism, the overall respondents’ perception is at the high degree of agreement (mean = 4.17). Concerning ‘I have a good understanding of what the teacher explains’ is at the high degree of agreement (mean = 4.29). It is followed by the perception concerning ‘The teacher shows that he/she understands my opinion well’ (mean = 4.27), ‘I understand my friends’ opinion’ (mean = 4.21) and ‘My friends show that they understand my opinions’ (mean = 3.93).

<b>Tutor Support</b> I have found that.....	<b>Mean</b>	<b>S.D.</b>
My teachers encourage me to learn.	4.34	0.14
My teachers support my online activities and help me when I need it.	4.30	0.15
My teachers are good guides communicating information	4.30	0.16
My teachers are good models in evaluating peers creatively.	4.32	0.16
<b>Average mean</b>	<b>4.31</b>	<b>0.15</b>

Table 6: Respondents’ perception on the Tutor Support from the online learning environment

For the item “Tutor Support” which is drawn from the theory of social constructivism, the overall respondents’ perception is at the high degree of agreement (mean = 4.31). Concerning ‘My teachers encourage me to learn’ is at the high degree of agreement (mean = 4.34). It is followed by the perception concerning ‘My teachers are good models in evaluating peers creatively’ (mean = 4.32) and the item ‘My teachers support my online activities and help me when I need it’ has the same degree of agreement as the item ‘My teachers are good guides communicating information’ (mean = 4.30).

<b>Peer Support</b> I have found that.....	<b>Mean</b>	<b>S.D.</b>
My friends encourage or support me to join them in online learning.	3.61	0.14
My friends value my online work.	3.83	0.14
My friends are aware of my participation.	3.57	0.02
My friends gave me valuable feedback on my work.	3.78	0.15
Average mean	3.70	0.14

Table 7: Respondents' perception on the Peer Support from the online learning environment

For the item "Peer Support" which is drawn from the theory of social constructivism, the overall respondents' perception is at the high degree of agreement (mean = 3.70). Concerning 'My friends value my online work' is at the high degree of agreement (mean = 3.83). It is followed by the perception concerning 'My friends gave me valuable feedback on my work' (mean = 3.78), 'My friends encourage or support me to join them in online learning' (mean = 3.61) and 'My friends are aware of my participation' (mean = 3.57).

To conclude from the analysis of the COLLES questionnaire, the item 'Tutor Support' is at the highest degree of agreement and 'Peer Support' is at the lowest. It could be seen that most samples in this study are still in need of support from their teachers order to interact with others in the environment. This could also be in contradiction with the focus of the social constructivist principle in that learners should collaboratively learn to construct their own knowledge and teachers are just the facilitators.

The following tables illustrate the result from the analysis of the questionnaire constructs focusing on the components of the D4L+P online learning system.

<b>Overview of Online Learning</b> I have found that.....	<b>Mean</b>	<b>S.D.</b>
Learning management of online learning in the curriculum assists me to easily understand the learning content.	4.15	0.11
Learning management of online learning in the curriculum assists me in remembering the subject matter for a long time.	4.15	0.13
Learning management of online learning in the curriculum assists me in constructing and understanding by myself.	4.36	0.10
Learning management of online learning in the curriculum assists me in applying my learning to other fields.	4.40	0.10
Learning management of online learning in the curriculum assists me in developing any language learning and thinking skills at higher levels.	4.36	0.09
Learning management of online learning in the curriculum assists me in making reasonable decisions.	4.31	0.11
Learning management of online learning in the curriculum assists me in making friends and in understanding them.	4.15	0.15
Online activities help me to work with others.	4.27	0.13
Average mean	4.27	0.11

Table 8: Respondents' perception on the Overview of the Online Learning Environment

For the item ‘Overview of Online Learning’ which is the additional items apart from the constructivist items in the questionnaire, the respondents’ perception concerning ‘Learning management of online learning in the curriculum assists me in applying my learning to other fields.’ is the highest degree of agreement (mean = 4.40).

<b>Learning Contents</b> I have found that.....	<b>Mean</b>	<b>S.D.</b>
Learning contents are clear and can be easily understood.	4.20	0.15
There is systematic organization of learning contents and activities in all courses.	4.23	0.14
The amount of content in all courses is appropriate.	4.14	0.12
The learning contents and activities in all courses are beneficial and assist me in learning English.	4.34	0.10
Average mean	4.23	0.13

Table 9: Respondents’ perception on the Learning Contents in the Online Learning Environment

For the item “Learning Content”, the respondents’ perception concerning ‘The learning contents and activities in all courses are beneficial and assist me in learning English.’ is the highest degree of agreement (mean = 4.34).

<b>All Components in the Learning Environment</b> I have found that.....	<b>Mean</b>	<b>S.D.</b>
The data under the Resources button are beneficial for doing activities.	4.25	0.13
The live chat is beneficial to me.	3.72	0.16
The course web boards are beneficial to me.	4.13	0.16
The group web boards are beneficial for my work.	4.06	0.17
Average mean	4.04	0.15

Table 10: Respondents’ perception on All Components in the Learning Environment  
For the item ‘All Components in the Learning Environment’, the respondents’ perception concerning ‘The data under the Resources button are beneficial for doing activities.’ is the highest degree of agreement (mean = 4.25).

<b>Online Activities</b> I have found that.....	<b>Mean</b>	<b>S.D.</b>
I have found that my participation in online activities with friends stimulates learning and was a valuable learning experience.	4.08	0.13
The participation in Assignments 1-3 in D4L+P helps prepare for team activities (Assignment 4).	4.25	0.13
This online learning helps develop teamwork and communication skills.	4.15	0.13
This kind of learning is more beneficial than classroom learning.	3.66	0.15
I have found that I belonged to a learning community.	4.00	0.14
I have found that my English is much better.	4.17	0.10
I will continue practicing English by myself.	4.31	0.17
Average mean	4.09	0.13

Table 11: Respondents' perception on Online Activities

For the item 'Online Activities', the respondents' perception concerning 'I will continue practicing English by myself.' is the highest degree of agreement (mean = 4.31).

<b>Peer Evaluation</b> I have found that.....	<b>Mean</b>	<b>S.D.</b>
Reading and giving comments to others helps me understand work problems as well as stimulating my thoughts in my work development.	3.87	0.13
Knowing there will be peer evaluation helps motivate me to finish the assignments.	4.06	0.14
I have evaluated my friends' online work without any problems.	4.06	0.16
Average mean	4.00	0.14

Table 12: Respondents' perception on Peer Evaluation

For the item "Peer Evaluation", the respondents' perception concerning 'Knowing there will be peer evaluation helps motivate me to finish the assignments.' and 'I have evaluated my friends' online work without any problems.' are the same highest degree of agreement (mean = 4.06).

<b>The Relationship with the TQF according to the 5 Learning Domains</b>	<b>Percentage</b>	<b>Mean</b>
have found that .....		
The learning management in online learning makes me aware of ethical and moral issues.	48.9	4.23
The learning management in online learning helps me gain knowledge from the courses.	59.6	4.51
The learning management in online learning motivate me to know all courses' contents in the curriculum.	55.3	4.45
The learning management in online learning motivates me to cooperate with others and be responsible.	53.2	4.42
The learning management in online learning helps me practice numerical analysis, communication and technology use.	48.9	4.36
Average mean		4.39

Table 13: Respondents' perception on The Relationship with the TQF according to the 5 Learning Domains

For the item 'The Relationship with the TQF according to the 5 Learning Domains', the respondents' perception concerning 'The learning management in online learning helps me gain knowledge from the courses.' is the highest degree of agreement (mean = 4.51).

To conclude, from analysis of questionnaire constructs focusing on the components of the D4L+P online learning system, it is shown that there is the highest degree of agreement on the item 'Correlation with TQF' and 'Overview of online learning' respectively. It could be stated that most learners agreed that the online learning program in the study is beneficial for them in assisting their study as well as the program in correlating with the TQF's 5 learning domains. Meanwhile, the lowest agreement is on the item 'Peer Evaluation', which seems to show that learners do not much rely on their peers in evaluating their work.

#### **Discussion of the results of the study**

The questionnaire results can be reviewed and analyzed as follows.

#### **Teacher-led learning environment?**

There is a general perception among the questionnaire respondents that there is an optimum correlation for TQF and Tutor support. Students consider that the online course is correlated with the 5 learning domains of TQF (mean = 4.39) which is the highest degree of agreement on the questionnaire. Meanwhile, for the group of items applied from the theory of social constructivist, the respondents' perception concerning 'Tutor Support' is the highest degree of agreement. It seems students in this study prefer to have tutor support that they expect their tutors almost always (mean = 4.31) to encourage, praise, and value their online participation and to be empathic and responsive to them.

These results might prompt us to reflect that students prefer to rely on the teachers and regard teachers as their authority. How can we persuade them to reconsider their expectations for tutor support? Might the current high expectation result from

uncertainty with the new learning environment, with the English learning or even with both of those issues?

### **High satisfaction close to the maximum degree**

Students generally have indicated very high satisfaction in the items concerning online learning environment in this B.A. program. They consider that the online learning environment used in all courses of the program assists them in understanding the learning content, constructing their own knowledge and practicing language learning skills (mean = 4.27). They also perceive that the learning content of the online learning courses is clear, appropriate and beneficial for learning and practicing English (mean = 4.23).

### **High degree of agreement for the question items from the social constructivist theory (COLLES)**

Many questionnaire items applied from components of the theory of social constructivist obtain high degree of students' agreements. Students in this study agree that they themselves and their fellow students as well as tutors very often (mean 4.17) are able to understand the messages posted on the electronic forums or course web board. Likewise, students prefer to be engaged often (mean = 4.12) in thinking critically about their own ideas and other students' ideas, and about how they are learning. In addition, students find that their participation in online activities is beneficial for practicing English and teamwork skills and it enhances their sense of learning community as well as their English skills (mean 4.09). Also, students consider their online learning to be almost always (mean = 4.06) interesting and directly related to their professional practice. In fact, some students intend to become English teachers after completing the program. Similarly, students have indicated that they are highly satisfied with all components of the learning environment comprising information provided under the resource link, the live chat, course web board and group web board (mean = 4.04).

### **Lesser agreements on peer support and interactivity constructs**

Overall, students' opinions about peer support show (mean = 3.70) that students do not place much value on encouragement, admiration, feedback or awareness of participation from peers. Similarly, agreement on the interactivity construct (mean 3.88) seem to show that most students in this study agree that their involvement through online communication with peers and teacher in the online learning environment is on the lower level compared with other items of the social constructivist theory.

These results are interesting in that although we provide the student centered learning environment (D4I+P and Moodle) for our program, students seem not to value the peer support and interactivity. This might be a result of several causes. First, most Thai students are familiar with the 'spoon-fed' learning system both in the typical and virtual classroom. Mostly, they have been taught by the classroom teacher without training to

learn by collaborative learning especially in language learning. Teachers are their authority and take control in all cases in the classroom. Learning by working in teams

with their peers, brainstorming and sharing knowledge among their peers seem to be a new approach for the Thai learning system. Second, it is one of our university policies that we are an open university and we must accept all variable background of students in terms of their age, learning background, language proficiency and etc. Last, most Thai students may have never been trained to express their ideas in class because they may be afraid of losing face. They always just passively listen to the teacher and keep quiet. However, there are some students who are confident to do so.

### **The difference of peer support**

Given the above finding, the results from the peer support construct are seemingly different (mean = 3.70). As the constructs underpinning the peer support scale lie at the pedagogical heart of our online environment, we might expect that students would value highly the opportunity to interact often with fellow students, they would value and appreciate peer support. It is not surprising that the sample group of students who are our questionnaire respondents do not agree much with an importance of the peer support item. This might be because almost all of the students in the program are part time, and their backgrounds are diverse in terms of profession, work experience, level of English, age and gender. Also, most students have been using English in their work for a period of time, some are senior or high-ranking officers with long work experience, so they do not seem to rely much on peer support. Results from this study contradict one of the constructivist principles that collaborative learning or interactivity among learners can promote active learning. Teachers should also be trained to apply the concept of constructivism to create a learning environment that promotes active learning in order to acquire knowledge, as in Holzer (1994). For Thailand, there is a study by Nomnian (2012) which investigates an application of the constructivism principles to language teaching. It is found from this study that constructivism cannot be achieved if students do not focus on doing their class activities and teachers do not motivate them to participate, but they rather focus on the university entrance exam. This research also strengthens the importance of constructivism that a real learning environment should be created to facilitate and promote the learning skills focused on in constructivist theory.

Since quantitative data alone cannot shed further light on these results, we must turn to other data sources in order to make sense of this apparent anomaly. From the interviews with volunteer students in this study, we can draw the following conclusions:

#### **1. Learners' diversity**

Online distance learners are different in terms of their background knowledge especially in English. Some can give advice to their peers as long as they have the confidence to do so but others are not able to.

#### **2. Team work**

There are both advantages and disadvantages to doing the team work. It is good to exchange knowledge and ideas in order to help in clarifications but some friends do not assist, some always say that they just agree with others, some do not listen to others but just believe in their idea and etc. Some students should attempt to do their work themselves before asking to others for help. It was common to encounter the kind of person who always asks for help without doing the work for themselves. On the other hand, there are many good team members who always help others and show kindness in all matters such as registering, preparing for the exam etc.

### 3. Online activities

There are several online students' behaviors, some are very active in posting on the forum. For example a student mentioned on the interview that "I always go to post on the course web board at the very beginning in order to know friends, then I will stay in contact on the phone in order to help each other." Some said about their team member that "I know some friends who give much or less help, it depends on each individual." While another student claimed that "I was not given much help from others because some do not know about the course either."

### Conclusions and recommendations

This study has made evident several points of perception among the online learners in the program, which uses a learning management system set up based on a constructivist theory.

1. Most online learners in this study agreed that the online learning in this program is correlated with the five learning domains of the Thai Qualification Framework for higher education (TQF), comprised of ethical and moral issues, knowledge, cognitive skills, interpersonal skills and responsibility, and analytical and communication skills. The highest percentage of their perception score is that they believed they gained knowledge from the program.

2. The online learners in this study reported that they valued teacher support in participating in the online activities. They also believed in teacher guidance and expected teachers to be available most of the time. This is similar to the findings in a study by McLoughlin and Marshall (2000) that assistance given to online learners can increase cognitive growth and understanding and it is much better to create learner collaboration than to have them work independently. However, McLoughlin and Marshall (2000) also found that more capable teacher support and peer support are valuable to online learners. This finding differs in part from this study's because most students in this study did not place great value on peer support.

3. The online learners in this study did not attach great value to either their peer support or interactivity. This might be that because they are experienced learners who have been working for some years. The results from this study may be on the contrary to some previous studies for example Galvin (2012), which showed that the participants benefited from peer support when they gave and/or received academic, practical and emotional support. In addition, there is a study by Ware and O'Dowd (2008) that indicates that the feedback provided by peers is often limited in scope and accuracy.

#### Recommendations from this study are as follows:

1. Teachers should monitor, guide and also give regular feedback to each individual online assignment.
2. The university should provide for sufficient staff in order to give feedback to each student's work. This can lead to an improvement in quality of the online learning system of the program.
3. There should be more training for students in terms of their responsibility in participating in online activities, which should be supportive of their peers.

**The limitations of this study are as follows:**

1. The conclusions from this study are limited to the particular context of the first two groups of graduates of the B.A. (English) program at the Sukhothai Thammathirat Open University. There were two groups of volunteers: the first was a group who agreed to complete the online questionnaire and the other group was those who were interviewed for the study.
2. The online learners participating in the context of this study are all distance learners, and most are part-time learners and come from many parts of the country. Therefore, they are diverse in terms of their background, learning experience, profession and expectations for study in the program. That might have affected student perceptions and opinions shown in responding to the online questionnaire as well as the interview.
3. When this study was carried out, there were two learning management systems used as the university online system: D4L+P and Moodle. However, D4L+P is the only system for most courses that is as a platform for online group activities. The Moodle is currently used only as a platform for course content and online assignments for a few courses.

**Recommendation for further study**

Further studies could address several issues. For example, an analysis of the benefit of online activities in order to compare the results of students who participate in the online activities with those who do not. Besides, there could be a comparison of the efficiency of the two learning management systems currently in use (D4L+P and Moodle).

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### *An Interactively Application of Fairy Tales for Preschool Children*

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#### **Abstract**

There are many classics fairy tales, the Grimm's Fairy Tales, Hans Christian Andersen fairy tale, Arabian Nights, etc. which are well known by every child across the world. These stories not only are interesting, but also have educational value.

The rapid development of mobile devices and the increase in their use by preschool children, revealing how technology plays an important role in this generation. Technology makes content more engaging through interaction, particularly e-book. Instead of being bounded by limitations of traditional paper books, multimedia applications open up a new world in reading. In view of this, the main purpose of this research is to develop a set of interactive learning applications, based on the fairy tales as learning background for preschool children. To achieve this purpose, the methodology adopted multiplatform game development in C# with Unity, in Windows 10. The Android 5.0.2 version of the smart phone system was used as the implementation platform.

This Interactive Application includes the interactive learning prospect that allows the incorporation of animation, moving pictures and sounds which extend the ability to present materials that encourage children's interaction with the subject matter. In addition, this system adds interaction features with readers and discussion questions, including puzzles, multiple-choice, true-false questions, sums, etc. This application provides a thinking platform for the children. It helps in the child to develop the reasoning, logic, imaginative skills and capacity for independent thinking.

Keywords: Fairy tale; Preschool; E-book; Smartphone

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## Introduction

There are many classical fairy tales, for example, Grimm's fairy tales, Hans Christian Andersen fairy tales, and Arabian Nights, which are known by every child across the world, and these stories are still very famous nowadays. These fairy tales are not only interesting but also full of educational value. Therefore, more and more parents and kindergarten teachers choose fairy tales as materials for children to discuss. There is a research showed that early literacy education is important for children as it establishes the foundation of reading and writing skills which is essential for future education, furthermore, it can help in the development of children's emotion, thinking, and language (Chew & Ishak, 2010).

The mobile devices develop rapidly nowadays. One of the biggest mobile company, Ericsson, expected that in 2015, seventy percent of people across the world have at least one smartphone in 2020, and the age of using mobile devices is decreased. There are more and more parents will use smartphone as the bridges between them and their children. However, most fairy tales are still paper books, it is rare to see the application of fairy tales in the app store. Instead of being bounded by limitations of traditional paper books, multimedia applications provide more convenient choice of reading. Therefore, this study transforms traditional paper fairy tales into e-books. E-books are easier to collect and carry. We use sounds and animation to demonstrate fairy tales. Based on plot, the study will design relative games to increase interest.

There is a recent review said that iPads for learning corroborates are easy to use, have a positive impact on student engagement, increasing motivation, enthusiasm, interest, independence and self-regulation, creativity and improved productivity (Clark & Luckin, 2013; Pegrum, Oakley, & Faulkner, 2013). Our application uses smartphone and tablets as platform because their operation method is similar to iPads and most of the people know how to use them now.

Pictures and sound play important roles in children's learning. There is a research showed that pictures play a great role in children's lives and reinforce children's knowledge about the environment, creating a sense of confidence (Gonen & Guler, 2011). In addition, the research indicated that sound could make children absorb new knowledge more effectively while the children are reading. Therefore, this study adds pictures and sound in the application to let children understand the knowledge which we want to express to them easily.

The most important idea of this application is that interactive function with users will be added. There is a research shows that an interactive learning environment turns passive students into active learners that fully engaged (Moore, Fowler, & Watson, 2007; Dufresne, Gerace, Leonard, Mestre, & Wenk, 1996). Another research also shows that with the use of e-book can grab the users' attention and the users can be more motivated (Zhou, Cheok, Tedjokusumo, & Omer, 2008), and it helps children understand word's meaning and storyline better, thereby contributing to the development of their vocabulary (Fathi, 2014). There are many kinds of games will be put into each fairy tales including puzzles, connect to dots, choice, count, true or false etc. Children could train different ability by playing these games, for examples, a child could increase their logic ability by playing puzzle games. After each fairy tale, the application will add several questions, parents could discuss them with their child.

During the discussion between parents and child, parents could understand their kid's thought deeper. The generation gap can definitely and effectively reduce between the children and the parents by communicating, the atmosphere of the family will increase, and parents could convey correct concept and behavior to children.

## **Method**

The main development software of this study is Unity and the methodology of it is C# in Windows 10. The Android 5.0.2 version of the smart phone system was used as the implementation platform.

The 3D characters and animals in the stories will be created by AutoCAD and the background of stories will be made by Photoshop. After this, we will import them into Unity.

The reasons for that we use Unity as our development software are:

It is friendly for users to develop 3D-games with Unity.

Unity provides two programming languages- C# and JavaScript, and the developer could choose one of them which is familiar to him.

Unity could release on multiple platforms and it is easier and more convenience than others software.

## **Hypothesis**

The study is specifically designed for preschool children. Compared to the same age children, they could think independent and expressed better on communication skills after using this system. Parents are not only understand the thought of their children better but also enhance home's atmosphere and decrease the generation gap between them during the discussion. There are a few steps to develop the system. First, the designed stories of the system. Second, objects, sounds, animation, the interaction added to the system. After integrating the basic functions, the system inputted feedback to us from users. Finally, developers will solve these problems instantly.

## **Conclusions and Future Work**

The multimedia applications open up a new world in reading, instead of being bounded by limitations of traditional paper books. Therefore, this study makes paper fairy tales transform into e-books after adapting and designing stories content and adds interactive function. Utilizing these methods is not only making children concentrate on learning fairy tales but also comprehend the implication clearly in stories. The rate of participation in learning will also be increased. In addition, children could express their thought and point of view with parents through final discussion questions. Besides learning the skills on communicating, it provides a bridge of communication between parents and children to make parents understand their children's thoughts better.

The study has completed adapting the content of fairy tales. Take Snow White for example, the castle will be designed to puzzles. By playing puzzles, children's ability of logic could also be increased. Another example is that we will add a true or false

question on whether Snow White takes the apple which bad queen give her. After each fairy tale, there are some questions for children. For example, if there is a stranger knocks the door, what should they do? If the stranger claims that he is relative, should they open the door or not?

This study is mainly developed on Android system currently. After developing on Android system, we will expand our application on iOS system. The study will also add English version in the future; therefore, children could not only have fun on reading fairy tales but also learn English in the same time. Finally, we will add feedback function to get users advice directly and rapidly. It also plays an important role for us to improve our application.



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***Development of Japan's e-Government:  
My Government as a Step Towards a Ubiquitous G2C Networked Society***

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**Abstract**

Since the early 2000s, the Japanese government has strived to escape various socio-economic problems, and also tried to use information technology (IT) to solve these problems. The major implementation of IT strategies designed to transform the country from a bureaucracy into an open e-government is scheduled to occur between 2016 and 2017. These were supposedly designed to build infrastructure to promote legislative and administrative efficiency. However, the most revolutionary aspect is the development of a citizen-centered system. E-government service is an international trend and symbolizes, to some extent, how democratic and open a country is. Japan's joining the trend signifies its intention to achieve true democracy—not merely a political slogan, and to invite the citizens to participate. This paper takes a critical social and policy approach to examine the last decade of Japan's IT strategies and also examine its newly launched e-government system. The paper argues that the government in creating the system has viewed citizens as passive recipients of e-government services. In order to truly transform the nation into an IT society, people need to become active participants to shape e-government. Some educational opportunities will be suggested to help move towards that goal.

Keywords: e-government, open government, Abenomics, Japan, IT strategies, IT society, efficacy, government services

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## Introduction

In the early 1980s, Japan was a rising economic superpower. Its economic miracle was inspiring or threatening to other developed economies. However, a decade later the Japanese miracle peaked and crashed, triggering twenty years of spiraling deflation. Japan went from being the No. 2 economy in the world to No. 3 and the nation lost hope and vision. Prime Minister Shinzo Abe was re-elected in 2012 and again two years later on the strength of promises to rebuild Japan's economy. This paper focuses on his most recent term and in particular how information technology played a central role in his political agenda to remake Japan under his Abenomics vision and how it is tied with the creation of e-government.

Following his September 2015 re-election, Abe announced the "Three Arrows of Abenomics 2.0" as his game plan. The goal of this economic strategy was to accelerate his first three arrows of Abenomics, but from different angles to help the nation escape years of economic deflation. He also claimed this would address the problems of Japan's low fertility rate and aging population. It aimed to increase Japan's GDP by about 20 percent to 600 trillion yen by 2021. He argued that in such a society, "each and every one of Japan's 100 million citizens can take on active roles" [1]. Some officials viewed this as a real challenge when the workforce is diminishing due to the graying of society [2]. Abenomics 2.0 envisions women and senior citizens as vital yet underutilized human resources, and demanded that various policies should be established to ease their way into the workplace. Those policies were designed to reduce the number of women leaving work to nurse children or provide eldercare by improving social security and other support. Japanese society previously expected that women would leave the productive labor force after marriage in order to raise their children and/or take care of parents and in-laws since Japan has fewer nursery schools or senior care homes per-capita than other developed countries. Abe believed that continuing women and seniors in the workforce would boost productivity and spending, which would jumpstart the economy. The Ministry of Health, Labour and Welfare reported that between 2011 and 2012, about 95,000 men and women left the workforce in order to take care of elderly relatives [3].

In 2013, the Abe Cabinet pronounced its *Declaration to be the World's Most Advanced IT Nation* as one means to carry out the growth strategy. It envisioned a Japan along the following lines:

- 1) A society that encourages the creation of new and innovative industries and services and the growth of all industries
- 2) The world's safest and most disaster-resilient society where people can live safely, with peace of mind, and comfort
- 3) One-stop public services that anyone can access and use at any time

To some extent, this was not new. Ever since 2001, earlier administrations had promoted their own IT vision. For example, the 2006 New IT Reform Strategy's slogan was "realizing ubiquitous and universal network society where everyone can enjoy the benefits of IT" [4]. These IT visions overall produced more failures than success. The most incisive criticism was that "many citizens have yet to experience the outcomes of that development" [5].

This paper will examine to what extent Japan has made progress to become the society depicted in the vision described in the 2013 IT Strategy; especially, focusing on the aspect of government public services. It argues that although the IT infrastructure and system itself have been moved closer towards a citizen-centered IT environment, the current scheme still sees citizens as passive recipients of e-services and does not incorporate them as active participants or agents to influence and shape the government and foster innovation. The paper also investigates current educational opportunities for women and senior citizens who want to gain or improve their IT skills for re-employment and for greater participation in e-government.

## Literature Review

Many Japanese studies on the development of e-government highlight their interests on technical and administrative challenges to implement e-services. Those include studies addressing difficulty coding the variety of Kanji Chinese characters [6], cryptographic algorithms for user identification [7][8], and implementing new technologies to compensate users' lack of IT skills [9][10]. Others looked at soft resources, such as a customer relationship management system [11], development of human resources [12], record management [13], and technical, administrative factors to realize e-government [14]. The digital divide or user's IT skills have not been extensively discussed in terms of the advancement of e-services in Japanese literature. Although many 'how-we-do' reports exist, they are not necessarily related to e-government. They are mostly pilot or community projects to provide or support for senior citizens to acquire Internet skills and information literacy through volunteer organizations [15][16], universities [17], and public libraries [18]. Outside of Japan, the majority of e-government studies related to the digital divide have also been from the viewpoint of the technological, system improvement and adjustments [19][20], with the exception of Sipior and Burke's study that highlighted a community education opportunity to train socially-disadvantaged, IT illiterate people to become participants in e-government [21]. This paper suggests that parallel to the technological invention, an e-government service model should include some mechanism to raise citizens' IT skills and information literacy. As those previous studies illustrate, e-government planners, researchers usually focus primarily on technological questions, and to a lesser extent focus on HCI. However, policymakers also need to provide IT training at various levels, especially for those in the shadow of the digital divide. By doing this, as systems develop, users should still be able to take advantage of these expanding services. The author hopes this paper would encourage policymakers to make IT education an integral part of modeling e-government schemes.

## The Development of e-Government in Japan

The development of e-government in Japan began with the *e-Japan Strategy* approved by the Yoshiro Mori Cabinet in 2001. The Strategy consists of four policy areas: establishing e-government, ultra high-speed network infrastructure, facilitating e-commerce, and nurturing high-quality human resources. The e-government plan was explained as "all the administrative procedures [would be] available via the Internet by 2003" [22]. Following the initial strategy, a series of white papers on IT, policies, and acts were established to transform the nation into one of the most advanced networked societies. The *e-Japan Strategy II* (2003) would allow the central and local

governments to build administrative portals to offer “one-stop/nonstop” services [23]. By 2010, the *New IT Reform Strategy* (2006) aimed 50% of applications to be processed online by both national and local governments. While those early initiatives produced significant progress on building IT infrastructures with some attention to usability, the 2008 IT Strategic Headquarters’ review included the following criticisms:

- More than half of online services were not used in a given year. They need improvements to become easier and more accessible to the extent that users perceive the convenience.
- Only about 1.8% of citizens have a “basic resident registration card” which is necessary to use e-government services.
- The IT infrastructures between prefectural and city/district/town/village offices do not work well together, which limits potential cooperation between offices.
- Electronically submitted files are still printed on paper at government offices. Government workers need education and training on how to maximize e-services.

In short, IT should be harnessed to become a useful and convenient system for citizens [24]. Reflecting these criticisms, during 2009-2012 under a coalition government led by the Democratic Party of Japan (DPJ), the provision of e-government was revised. However, none of these schemes became fully implemented until the Liberal Democratic Party (LDP), which ruled Japan for most of the postwar era, regained control over the Diet in 2013. In the next section, we will examine an Abe Government’s approach which made a major breakthrough to become an advanced IT nation.

### **Striving for a Citizen-Oriented System**

The newly-elected Abe Cabinet passed bills to establish the “My Number System” and a “Government CIO,” and issued the *Declaration to be the World’s Most Advanced IT Nation*. It promised to take down vertical organizational barriers and implement IT measures to provide convenient e-government services, reform national and local governments’ information systems, and reinforce IT governance [25]. The national government developed the shared government platform, Kasumigaseki Cloud to connect ministries and agencies to consolidate hardware to cut expenses and to share information and streamline functions [42]. The local government LAN (LGWAN: Local Government Wide Area Network) is also able to share information held by prefectures, cities, towns, and villages. The LGWAN-ASP (application service provider) further allows exchange of information and provides services between all local and national governments [26]. Cloud computing and other IT services are the underpinning of the Japanese e-government, which enable “youth, women, senior citizens, caregivers, and handicapped persons” work and make their work free from specific locations [27]. On the basis of the networked IT infrastructures, e-services were designed with the viewpoint of primarily citizen’s convenience and government efficacy. Figure 1 illustrates this scheme.

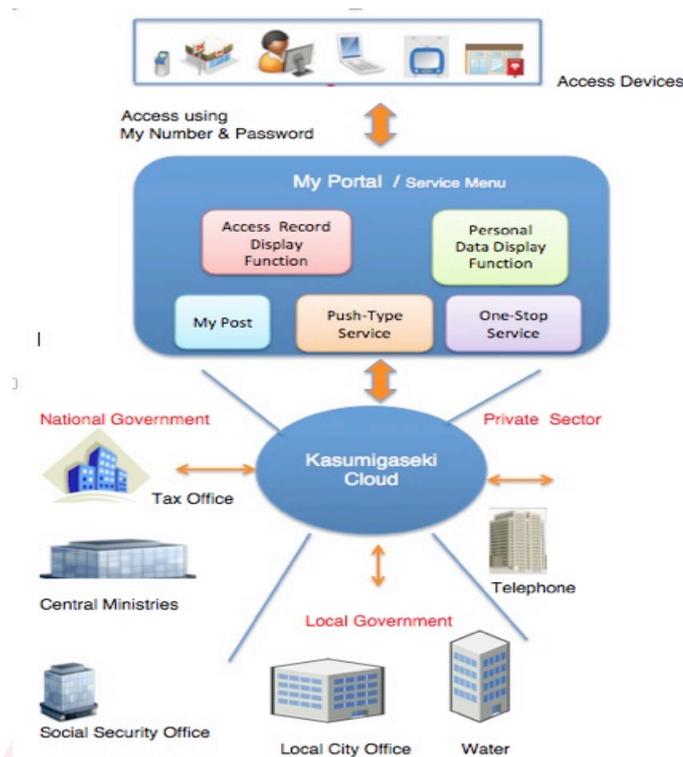


Figure 1. My Government Services [28]

### ***Access Points***

The plan called for citizens to be able to interact with government offices via various channels, such as cable television, PC, mobile phone, and in-person, in order to obtain necessary certificates and other documents from their homes, convenience stores, and other locations 24-hours a day.

### ***My Number and My Portal***

Following years of planning, the Japanese government has been implementing the “My Number” system during 2016 and 2017 as a key tool for administrative procedures related to social security, taxation, and disaster response. Somewhat like a social security number in the United States, a My Number is a twelve-digit reference assigned to an individual citizen in order to improve administrative efficiency, public convenience, and fair taxation and welfare [29]. Using My Number, citizens can check their own government information and oversee how these records are used by government agencies. “My Portal” is to facilitate such queries. More importantly, My Portal will allow individuals to submit forms and fees, which traditionally required obtaining multiple departments’ records and documents. The following sections will explain various services as a part of My Portal, the My Government platform [30].

### ***One-Stop Service***

Historically, the Japanese government is infamous for being bureaucratic and unresponsive. Providing convenient services has never been its priority. Although it has been improving, recent financial constraints have created enormous challenges for

local governments and agencies to quickly respond to citizens' various needs. According to a government study, currently paperwork regarding a move requires seven visits and 13 documents in various offices, such as schools, police, local Department of Transportation, etc. Thus, we can see that this "One-Stop Service" idea as the conceptualization of e-government is quite revolutionary in Japan. If My Government is successful as a shared government platform, the plan is to open it to the private sector. For example, hospitals might be able to send bills to national health insurance system and also annotate users' private medical record. The goal is to eliminate redundant systems and integrate networks. In addition, all government information systems will be shifted to cloud computing, in turn drastically cutting costs [31]. The service is estimated to save approximately \$1 billion/year for governments, private sector, and individuals combined [32].

### ***My Post (e-PO Box)***

This free and secure service will allow citizens to receive important documents and information sent from government agencies and eventually companies they chose over the Internet. The users of My Post are able to receive bills and statements via e-mail, pay them electronically, and archive records in their e-PO Box. The government envisioned that it, if successful, would eventually break down the boundaries between public and private sector information and help stimulate new businesses.

### ***Push Service***

Japanese local governments provide a wide range of information on various services through pamphlets, newsletters, mailings, and websites; however, there is no guarantee that the right information is received by the citizens needing it. A notification system or "Push Service" is developed to approach users from the government instead of waiting for citizens' applications or requests. The Push Service selects the target individuals and sends appropriate information directly to their My Portal. For example, a city office could send information on a vaccination to mothers who have children of a certain age using My Portal. At the same time, in My Post, the mothers could download a voucher from the city office to receive free vaccinations at a local clinic. Unlike a print approval form sent to their homes, a mother who is visiting her parents house could receive the notification by logging onto her My Portal and get her child vaccinated at the closest neighborhood clinic. The hope is that senders and receivers could select desired information levels and topics, rather than be bombarded with irrelevant information, i.e. information overload. By using an official system people can also have greater trust compared with public e-mail, which often contain scams targeting vulnerable citizens.

### ***Convenience Stores***

Although convenience stores came to Japan from America, they have greatly developed since and become integral parts of Japanese life in small towns and inner cities alike. Convenience stores already offers kiosks where people can wire money, reserve tickets, and pay utilities, but it was a major innovation to make them part of e-government. Its proliferation was especially attractive to the government, as it tried to save funds by merging smaller municipalities and closing government offices. The administrative kiosk in convenience stores is similar to an ATM machine. With

his/her My Number and password, users can request, receive, and pay at the kiosk [33]. It is an economically advanced system for all participants. For example, for citizens living in Ichikawa City in Chiba, they could save about \$20 per transaction including transportation costs and time missing work, and will save about \$3 million/year (based on processing 470,000 certificates). For the city office, the benefits include responding users' requests promptly, reduce expenses for labor, equipment, and office supplies. Even after subtracting expenses paid to participating convenience stores, the city office would save about \$2.8 million/year.

### **Digital Divide and e-Government**

Although the IT infrastructure and administrative systems have been greatly improved, in terms of becoming a citizen-centered system that could enhance quality of life, it can be noted that citizens are not yet adequately seen in the scheme as active users of IT in society. In the aforementioned 2013 IT Strategy, an IT society was envisioned as making people free from various disadvantages, such as homebound women with babies, people with disabilities, senior citizens and people living in remote areas by employing cloud computing and IT services. The government hoped that this would encourage greater social participation, flexible employment, such as telework by all citizens to help address the nation's problems: a low birth rate and the chronic shortage of labor. Besides the groups mentioned above, foreigners, immigrants, and unemployed youth (especially those in the so-called "lost generation") are also members of Japan's digital divide, who need special attention. No IT strategy or plan alone will be truly successful if people are unable to fully adopt the technologies. The following sections will examine the current status of IT readiness for seniors and women in Japan, as examples of groups not yet addressed by Japan's e-government model.

### **Senior Citizens and Women as Workforce**

In 2014, fully one fourth of the Japanese population is age 65 or older, which marked the highest percentage in its history. Statistics show that the employment rate of these senior citizens (defined as people 65 or older) is equivalent to 10% of the national workforce and this percentage has been increasing each year for ten years. It is the highest rate among developed countries. Senior citizens as well as women have been perceived as a not-fully-tapped resource to solve various social problems. The government established legislation and other measures to encourage seniors to stay in or even return to the workforce. According to the 2006 *White Paper on National Life*, compared with the United States and European countries, Japanese men who are in their 60s show a much higher employment rate, so did Japanese women in their 60s. On the other hand, the same survey indicated that there were many seniors in their 60s who could not find a job even if they wished to work. Among the respondents, companies planning to hire people over 60 represented only 10.9% while those with no plans to hire in the age group was 36%. Over 30% of the latter companies, regardless of their size, claimed they had "no appropriate jobs for them." To the question "what do you think should have been done in order to become re-employed," participating senior citizens responded that they needed to obtain "professional knowledge and skills (51.2% for men, and 48.5% for women)," and "computer skills (41.9% for men, and 33.8% for women)" [34].

The same study also examined the circumstances surrounding employment of women after pregnancy and parenting. It found that women who had left the workforce for more than two years felt their abilities deteriorated in areas such as proposing projects, presentations, management, foreign languages, and computer skills. When the participating companies were asked why recruitment had not reached the quota they wanted to hire, 44% of the respondents gave “a lack of ability, experience, and qualifications” of candidates as their reasons. In order to support women’s return to the workforce, the study suggested that during their leave period, women should receive various training at vocational-development schools administered by the national or local governments.

However, there are many factors preventing women to receive such education. The *White Paper on National Life* showed the graduates of vocational schools had a good employment rate (between 60% and 76%), and more than 60% of the students were women; however, in order to be admitted, candidates need to meet some conditions and pass an entrance examination. Therefore, many of them (35.7%) were young people under age 30. [35]. Further, those programs or schools may not be located in their community, so job seekers may need to spend hours commuting and face other expenses. If they are taking care of small children or family members, this may be impossible. It would be even harder for senior citizens to seek such training or education. Therefore, the majority of the disadvantaged population, women, seniors, immigrants, and people with disabilities need educational opportunities that are free of charge, conveniently located in their communities, and provide resources and training with comfort. Although none of the government studies and documents on Japan’s IT development mentioned public libraries as a resource, many aspects of the institution meet these conditions. There are more than 3,200 public libraries in cities, towns and villages nationwide. In addition, the 2015 Ministry of Internal Affairs and Communications’ report indicated that citizens’ most used government online service was the public library (60.2% of all services offered) such as reserving books, followed by e-services at cultural and sports facilities (55.7%), such as making reservations. This demonstrates that public libraries are well used and are already becoming key parts of citizens’ online life, which indicates great potential as an educational facility for community members to receive information literacy and training. Japanese librarians interested in developing IT labs and vocational IT classes might look at colleagues in the United States where public libraries have a long history of leading in this area as a learning center to counter the effects of the digital divide.

## **Conclusion**

Much of this paper may be seen as a series of government white papers pointing to various digital government futures, but we should recognize that this is already becoming a reality. A 2015 government report on online use of administrative procedures revealed that 2,669 procedures are already available online. Although it might sound counter-intuitive, the government reduced to this number by 1,099 procedures from the previous year, after conducting a cost-benefit analysis, which found many online services were not utilized [36]. The report also showed a 1.3% increase of online processed administrative documents from 2013, which accounted for 45.4% of all procedures. For local governments, online processed cases rose to 47.1%, which marked a 1.9% increase from the previous year [37]. However, neither

national nor local government online usage rates met the goal set in the New IT Reform Strategy (2006), processing “at least 50% of applications and filings online by both national and local government by FY 2010” [38].

There are many possible reasons contributing to the shortcoming. One scholar, Nemoto criticizes that the government restrictions on businesses such as e-commerce, e-voting, e-books, and Internet distribution of broadcast TV. He argued that without a relaxation of those regulations, Japan will not be able to advance as an IT nation [39]. In his 2014 comparative study of e-government systems between Japan and Korea, Shimada pointed out a major factor why Korea was more successful in becoming an e-government. He found that Korea’s success at becoming one of the most advanced networks was because the national government has a much stronger top-down control over local administrations. In contrast, Japanese e-government is more of a bottom-up operation, where the national government creates legislative regulations and guidelines for local governments to follow but does not enforce them [40]. This means that each municipality, prefecture, and national office may have greatly invested in their own software, which was created around their own needs rather than on developing systems that are interoperable and citizen-centered.

It is far too early to analyze the success of Japan’s e-government initiatives, since 2016 is a transition year with the implementation happening just now. However, the digital divide certainly exists for people with certain socio-economic backgrounds. The digital divide can be addressed using multiple channels supported by advanced IT for delivering public services, which is the current approach of Japanese e-government scheme. The expensive IT infrastructure to be built received many criticisms especially in the early stage, but it meets the present nation’s IT literacy level and needs. This approach echoes the description of custom-centered services that Helbig and Gil-García called for. They stressed that “policies aimed at reducing the digital divide, should consider the specific type of gap they are aiming to bridge and the multiple perspectives carried with them.” [41]. However, only by providing education and access, can unemployed women, senior citizens, and the disadvantaged population be truly integrated into Abe’s vision of Japan as a leading IT society with a highly functioning e-government system.

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## ***Collaborative Construction of Advance Organizers as A Learning Event for Online Instruction***

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### **Abstract**

Instructional strategies for online learning vary from face to face learning in many aspects. However, only a few studies suggested appropriate strategies for online learning. Classic instructional theories such as advance organizer has been proved to be effective for teaching. It is traditionally developed by professional instructional designers. But in a collaborative construction online learning environment, the role for developing advance organizer may shift from instructional designers to the learners.

In this study, we proposed to employ user-developed advance organizer as a learning event after they have learned instructional contents. This instructional event may be considered as a reinforcement for newly learned knowledge. After regular instruction, learners will be asked to develop their own advance organizers collaboratively, and instructor will provide interactive feedbacks during the collaborative construction process.

This study will employ Google Sites to create the collaborative learning environment. Selected topics on Experimental Statistics course will be the subject matter to be taught. Research subjects will be Master's students. They will be assigned to either experimental group or control group and several sub-teams will be formed to perform collaborative works. The difference between the experimental group and control group is that the former uses the collaborative construction of advance organizer to be the reinforcing strategy but the latter uses practice-and-drill type of exercise as the reinforcing strategy. Posttests will be given to both groups to evaluate the learning outcome and investigate the significance of using collaborative construction of advance organizer as reinforcing strategy.

Keywords: advance organizer, collaborative construction, online learning

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## Introduction

The concept of advance organizers has been used in education for a long time. Some studies pointed out that advance organizers has a positive impact for learning performance and learning attitudes (Ambard & Ambard, 2012; Jafari & Hashim, 2012). Another study compared the learning effectiveness of different types of advance organizers. Learners not only had a positive attitude but also indicated advance organizers could help them to dismantle the course and emphasize important concepts (Chen & Hirumi, 2007). And the other study explored the effect of visual advance organizers and the result showed that advance organizers could promote the English reading comprehension (Lin & Chen, 2007). During the past 50 years, many aspects regarding the application of advance organizer have been discussed, including teaching strategies, learning retention, and learning satisfactions.. However, there were less studies paying attention on who should be the designers of the advance organizers.

The Cognitivism include Piaget's cognitive-developmental theory, Vygotsky's social constructivism, Ausubel's meaningful learning theory and Bruner's discovery learning theory. And the similarity argument of these theories are that learners' knowledge is not directly instilled by teachers, but construct their own knowledge through interacting with the environment. However, Lu (2011) mentioned that in recent years, the development of Web2.0 brought a new way of network cooperative learning, so people can participate actively, share resources and create knowledge together. That means people interact with the online environment to build knowledge and become the constructor of knowledge. In the constructive online learning environment, the instructional methods as well as the role between instructors and students are very different from the traditional instruction. Learners have more control over their learning while teachers become assistants alongside them.

The purpose of this study is to employ Google Sites to create the collaborative learning environment, and propose to employ user-developed advance organizer as a learning event after they have learned instructional contents. After regular instruction, learners will be asked to develop their own advance organizers collaboratively, and instructor will provide interactive feedbacks during the collaborative construction process. After the online instruction, we will evaluate the learning outcome, learning experiences and investigate the significance of using collaborative construction of advance organizer as a reinforcing strategy.

## Collaborative Construction of Online Learning

The concept of the collaborative learning comes from the constructivist teaching, emphasizing that the way of acquiring knowledge is not through the teacher but student take the initiative to learn. The construction of knowledge is not necessarily only an individual process of exploring learning but may be influenced by groups which have a social interaction (Seng & Yu, 2005).Based on the characteristics of collaboration, the network technology Web2.0 provides a new learning channel and collaborative space, and supports the interaction, feedback and maintenance of interpersonal relationship. Some educational researchers believe that Web2.0 system is one of the potential educational technologies which can be used to assist teaching and enhance learning outcomes (Alexander, 2006).

For the past few years, some studies reported that the development of the joint construction of narrative brought a strong dynamic in a social learning environment which allowed learners making lots of knowledge-building conversations (Barron, 2003). The collaborative learning focuses on the real problem situation or learning tasks, leading learners to solve problems or complete their learning tasks, and is considered to be an effective teaching method to promote a form of online learning community (Gersh,2001).In traditional learning, the learning environment was led by teachers. In a constructive learning environment, learners are encouraged to learn from each other, and accommodates a variety of learning styles. In other words, instructors and textbooks will not be the only sources of information.

### **The Application of Advance Organizer**

Ausubel (1960) believed the development of learners' cognitive architecture was derived from reforming materials, combined with their original cognitive architecture, and produce a new cognitive architecture. Ausubel thought that the most important factor was the learner's cognitive architecture to determine whether the new learning materials were effective for learners.

Yang (2006) mentioned that the advance organizer could make a meaningful link between students' past experiences and new knowledge. That is, advance organizer was a bridge between students' cognitive structure and the instructional materials. Prior studies have proved that advance organizer has positive effective for learning outcomes or learning attitudes (Ambard & Ambard, 2012; Hashim, 2002; Chen & Hirumi, 2007; Lin & Chen, 2007).

Chien, Jen and Lai (2011) pointed that the application of advance organizer could make the organization and structure of the teaching more complete, and make students got the point more easily. Li (2009) found that the content of advance organizer must be closely related to the content of learning in his study. Chen, Hiram and Zhang (2007) mentioned there has no obvious effectiveness of advance organizer may because of its loose structure and its guide for use was not detailed.

According the concept of advance organizer and the results of past studies, we can understand the real situation of applying advance organizer in teaching, and help us to develop principles to evaluate advance organizer.

### **Learning Experience**

Based on social constructivism, people work together and complete a task. The aim of constructing knowledge actively is a characteristic of a powerful learning environment. Liaw (2003) mentioned that a web-based learning environment provides students with more equal opportunities for retrieving information and interacting with each other actively because it has appropriate characteristics such as hyperlink networks, and synchronous or/and asynchronous communication.

So and Brush (2008) pointed out that student's perception of collaborative learning would influence satisfaction. Strijbos and Laat (2009) indicated that a greater sense of responsibility can increase an individual group member's awareness to the group's goal and subsequently increase group efficacy. The positive interdependence will be

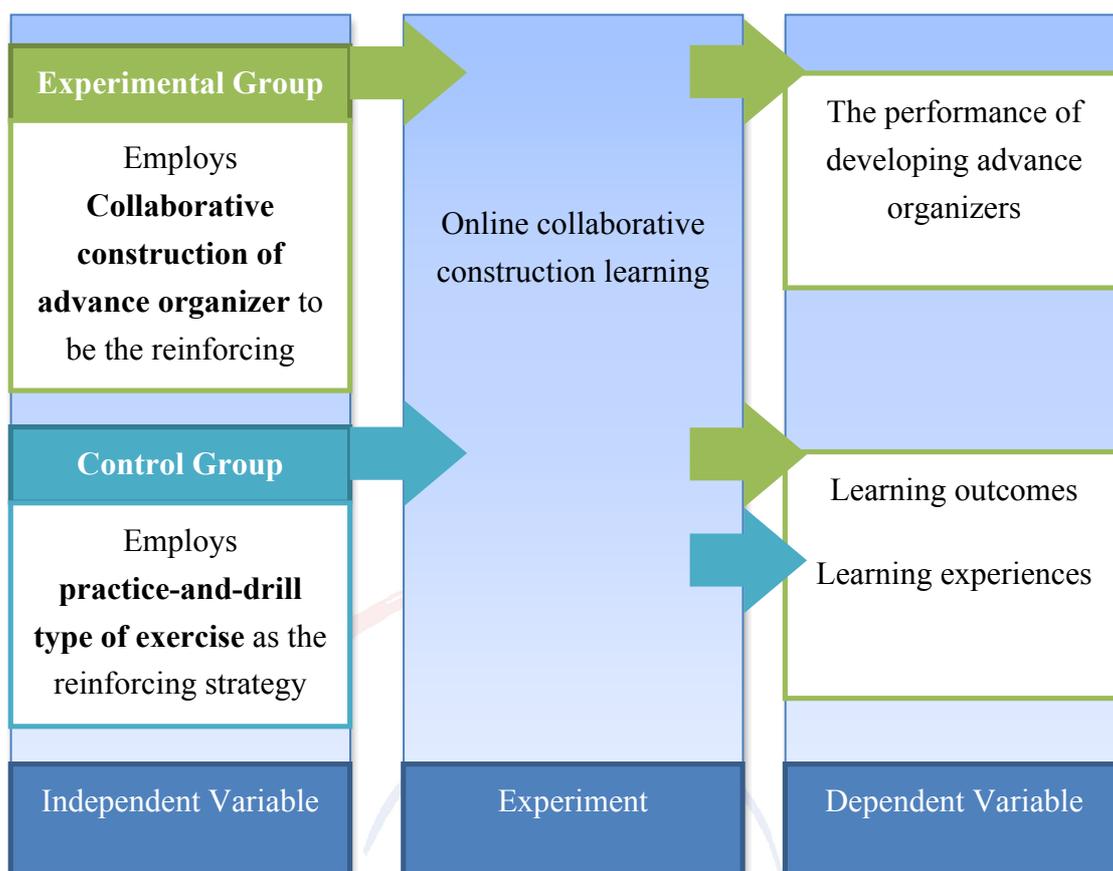
generated when the performance of a single group member depends on the performance of other members, and it can enhance internal cohesion.

Dewiyanti, Brand-Gruwel, Jochems and Broers (2004) mentioned that students' participation in collaborative learning makes important contributions to group members when they are collaborating to solve a problem or to accomplish a task. And they explained the important elements which may influence students' participation are course characteristics, individual characteristics, different aspects of collaborative learning process and satisfaction. In Liaw and Huang's (2006) study, learners' feelings and learners' attitudes toward a collaborative e-learning environment were investigated. They considered five elements when designing a web-based computer support collaborative learning environment: learners' attitudes, environmental characteristics, environmental satisfaction, collaboration activities, learners' characteristics, and environment acceptance.

In conclusion, there are various types of factors will affect learning experience. In this study, we will integrate these possible factors and modify its contents to develop the measures to examine learners' experience in accordance with our research purposes.

## **Method**

In this study, we employ Google Sites to create the collaborative learning environment. Fundamentals of Experimental Statistics for Master's students will be the subject matter to be taught. Participants will be assigned to either the experimental group or the control group and several sub-teams will be formed to perform collaborative works. After regular instruction, posttests will be given to both groups to evaluate the learning outcome, investigate the learning experiences and the significance of using collaborative construction of advance organizer as reinforcing strategy. Research framework is shown in Figure 1.



**Figure 1:** Research framework

### Participants

All 26 participants will be Master's students selected from a major university of Taiwan who enrolled for the Experimental Statistics course. They have an average age of 23 and will be separated to 7 groups mixed of males and females. Each group consists of 3 or 4 students. The 26 participants finally form 4 experimental groups and 3 control groups.

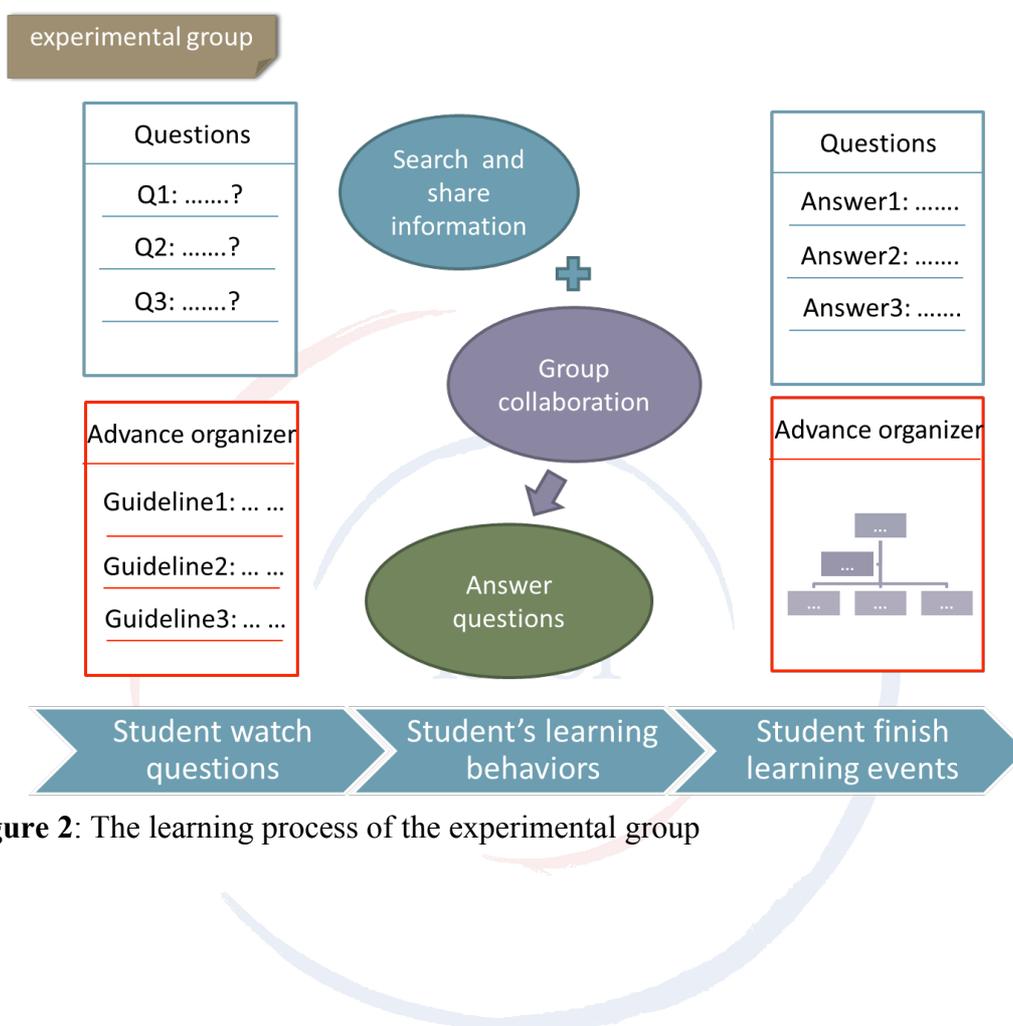
### Procedure

The major learning events will be designed separately for the experimental group and the control group with equal loads. The experimental group will be assigned to use the collaborative construction of advance organizer, the control group will use practice-and-drill type of exercise as the reinforcing strategy. A 3-week online learning activity is designed for the experiment.

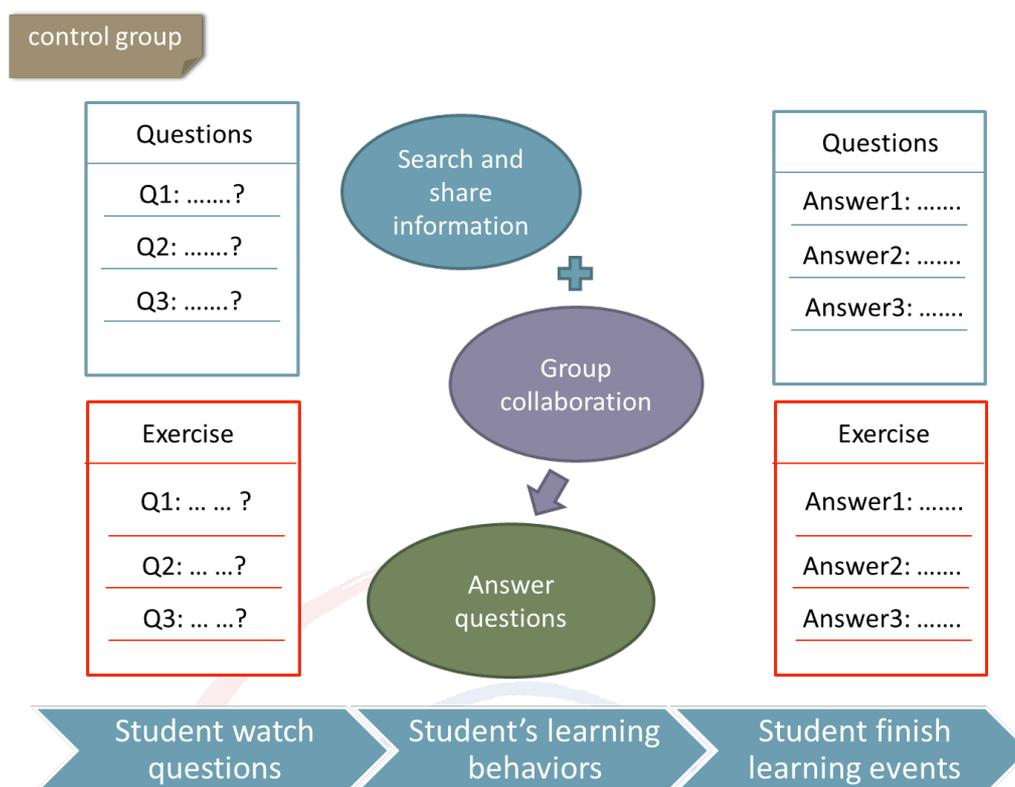
In order to explain the collaborative construction online learning process, an orientation will be given to all participants. At the same day, instructor will introduce the principles of advance organizer to the experimental group and will give the Experimental Statistics pretests to both groups.

In the beginning of the collaborative construction online learning, two groups will be asked to watch some learning questions related learning objectives designed by instructor on Google Sites. Then they will need to collect materials, share information with their group members, join their group discussions, collaborate and organize their

information and write down the answers below the questions. At last, the experimental group will need to follow the guidelines to develop their own advance organizers collaboratively and the control group will need to complete an exercise collaboratively. During the collaborative construction process, instructor will provide interactive feedbacks to participants. Learning process of two groups has shown in Figure 2 and Figure 3, and the different learning events had marked in red.



**Figure 2:** The learning process of the experimental group



**Figure 3:** The learning process of the control group

After the collaborative construction online learning, the Experimental Statistics posttests and the questionnaire of learning experience will be given to both groups. And then will invite three experts to evaluate the questionnaire for the performance of advance organizer.

### Instrument

Questionnaire for advance organizer is designed to examine the performance of the advance organizer developed by each experimental group. This questionnaire consists of two variables, the content and structure of advance organizer. There are about five questions in each variable. The format of all questions is a Likert-type scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

Questionnaire for Experimental Statistics test with 21 questions is designed to examine the variety of students' academic achievements during the collaborative construction online learning. Questions are designed according to the teaching objectives and learning contents.

Questionnaire for learning experience with about 36 questions is designed to evaluate how students feel and experience during the collaborative construction online learning. It consists of five variables including the environmental characteristics, environmental satisfaction, individual characteristics, collaborative learning experiences, collaborative learning satisfaction. The format of all questions is a Likert-type scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

In order to gain a deeper understanding of learners' true feelings and learning difficulties in the collaborative online learning, we will develop a semi-structured interview outline according to research problems. It consists of three variables including the performance of collaborative construction, learning experience and learning event.

### **Expected Result**

This paper proposed an innovative learning strategy for collaborative construction online learning that may enhance the effectiveness of learning. Although this research is still ongoing, we expect that the following questions may be answered:

1. Is there an impact on learning outcomes while the role for developing advance organizers shifts from instructional designers to the learners?
2. Would there be a relation between the performance of advance organizers developed by learners and their learning outcomes?
3. What are learner's perceptions and experiences during this collaborative construction of online learning?

This work expects to provide teachers with applicable strategies for designing collaborative construction of online learning. In the future works, instructional designer can focus on how to enhance learner's learning motivation or compare the effects of using different types of advance organizer as learning strategies.

### **Acknowledgements**

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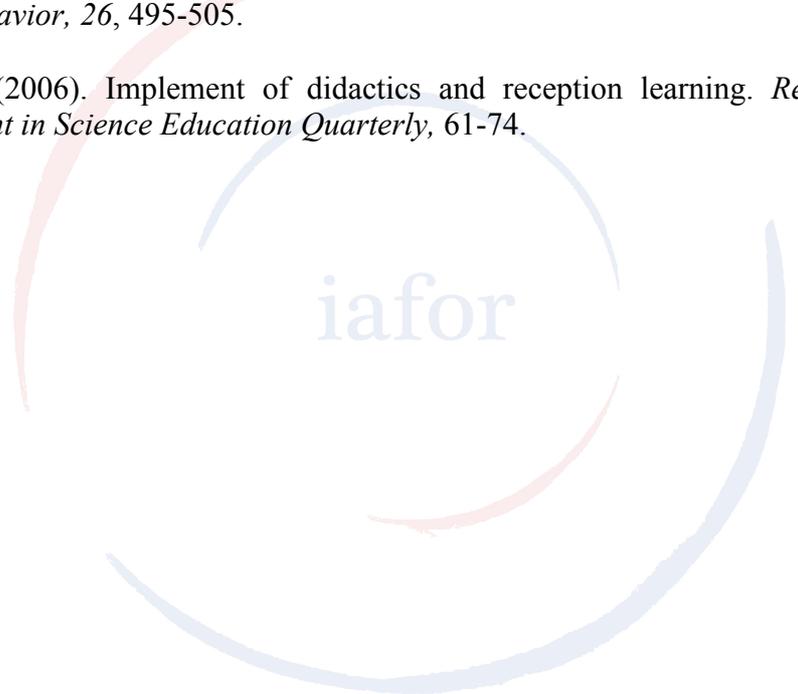
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The logo for 'iafor' is centered on the page. It consists of the lowercase letters 'iafor' in a light blue, sans-serif font. The text is surrounded by several overlapping, semi-transparent circular arcs in shades of blue and red, creating a dynamic, circular graphic effect.

## ***Exploring Learning Effects of Using Different Scaffoldings on Problem-Based Learning***

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The Asian Conference on Society, Education & Technology 2016  
Official Conference Proceedings

### **Abstract**

The essence of problem-based learning is to construct knowledge, to share knowledge, to approach their goal, and to solve the problems. However, in online collaborative construction environments, environmental changes and personal characteristics will considerably affect the effectiveness of the problem-based learning. Therefore, online instructors need to provide facilitations to help learners completed their learning tasks. In this study, our aim is to develop several strategies that employing scaffolding theory to facilitate online problem-based learning, three types of scaffoldings are to be included: meta-cognitive scaffolding, procedural scaffolding, and blended scaffolding that integrates the first two. The effects of various scaffolding schemes will be explored in terms of learning performance. Google Site platform will be used to create the online constructive environment. The subject-matter for the problem solving instruction is electricity generation. The research subjects will be fifth graders from a selected elementary school. They will be divided into three groups: procedural scaffolding group, meta-cognitive scaffolding group, and blended scaffolding group. Each group will be guided by different strategy, and they will learn related knowledge from problem solving. We will evaluate their learning outcomes of three groups to analyze the differences of the three groups.

Keywords: problem-based learning, meta-cognitive scaffolding, procedural scaffolding

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## Introduction

Problem-based learning (PBL) is defined as learner-centered learning. Learners discuss the issues through open-ended questions, and then build team knowledge as appropriate. Online learning overcomes space constraints, allowing rapid exchange of information, and effective team building. environments, environmental changes, and personal characteristics will affect the construction results (Zheng & Zhuang, 2008).

Learners' self-construction of their learning content may be difficult. Students need to adapt to a new environment and learn new technology and new information to do so (Johnson & Johnson, 1996). In addition, individual differences also cause unequal participation of students. In cyberspace, student's learning processes are more self-directed with compared to traditional classrooms learning. Such self-directed learning processes need to be guided, assisted, and monitored by online instructors. (Lee, 2010). Previous studies indicate that incorporating scaffolding instructional strategies with online collaborative learning results in better learning outcomes. In recent years, scaffolding strategies have widely been used in the network software tools, courses, and other resources to help students to achieve successful learning. Although the teacher plays a important role in the instructional process, the student is also an active participant so that scaffold interactions are a function of participation by the teacher and the learner. (Puntambekar & Hubscher, 2005).

Currently, metacognitive scaffolding was commonly used in construction learning programs. Metacognitive scaffolding can help learners recall prior knowledge, so that learners take the initiative to recall the knowledge learned in the past and take the initiative to find relevant information. On the other hand, procedural scaffolding uses web site maps, operating procedure instructions or navigation maps, etc., to clarify learning steps to reduce cognitive load and elucidate the learning objectives.

Sharma and Hannafin (2007) suggested that a complete learning activity is most likely to be achieved if there are a balance and fusion between the metacognitive scaffolding and the procedural scaffolding. Therefore, in this study, we attempt to propose a blended scaffolding strategy, combining the cognitive hints provided from the metacognitive scaffolding and the operational guidance provided by procedural scaffolding.

This study will discuss the impact of different types of scaffolding in online problem-based learning courses, we attempt to propose an improved scaffolding strategy, combined with the meta-cognitive scaffolding and procedural scaffolding's characteristics. Through this study, we will set up the cognitive scaffolding, the procedural scaffolding and the blended-scaffolding into the problem-based learning course and explore the different level effect brought by different scaffolding strategies. In addition, we also concern to students whether they have different influences on the satisfaction of the course and learning process after the course.

## Literature Review

### Scaffolding in the Online Environment

Scaffolding theory is widely used as a teaching strategy. It is originated from Vygotsky's (1978) sociocultural theory of cognitive development, emphasizing adults and experts as sources of children's social experience and knowledge. Wood, Bruner, and Ross (1976) defined scaffolding as adults or experts providing appropriate assistance in the learning process and helping learners to achieve learning goals until they are able to complete the task independently. Scaffolding is adjustable and flexible, and it can help students with different learning skills, backgrounds, and learning styles (Ling & Harun, 2014). When adults or experts construct the scaffolding, they must have a common understanding of learning objectives with learners, monitor and assess learners at any time in terms of progress and status, revise the contents of the scaffold as appropriate, and give support and feedback (Azevedo, Cromley, Winters, Moos & Greene, 2005).

Quintana et al. (2004) found that the environment of network communication technology flourished with provision of appropriate scaffolding that can reduce the cognitive load of students and help students manage their learning tasks. Use the scaffolding in online environment is also helpful to logical thinking and the correct use of the strategy. Sun, Wang, and Chan (2011) also mentioned that digital scaffolding can enhance learning motivation.

Past studies have well categorized scaffoldings. Hill and Hannafin (2001) argue that mentors need to provide different types of scaffoldings in different learning situations. They specified four categories of scaffoldings: conceptual, procedural, metacognitive and strategic. In this study, we will employ procedural scaffolding and metacognitive scaffolding as they seem to be more appropriate for online environment.

Procedural scaffolding helps learners understand how to use learning resources so that they can understand their learning needs. It also can reduce students' cognitive load, so they can focus more on the main learning tasks, it is usually presented as simple text guidance for the site map, and such learning maps are able to guide students learning resources (Hill & Hannafin, 2001). Procedural scaffolding allows learners to adapt to unfamiliar learning environments, reduce cognitive load, and focus more on learning activities (Molenaar & Slegers, 2014).

Metacognitive scaffolding can help students assess their prior knowledge and learning deficiencies; it is presented like simple hints or questions about the learning objectives and content, and it helps students organize their knowledge (Hill & Hannafin, 2001). Reiser (2004) states that the knowledge problematizing and addition the course can help students to make basic inferences about concepts and to think about whether their ideas are correct.

In line with the above discussion, we understand the advantages of the scaffolding application in the network environment, and we will try to use metacognitive scaffolding and procedural scaffolding simultaneously in the PBL courses in the present study. Sharma and Hannafin (2007) also pointed out that procedural scaffolding and meta-cognitive scaffolding can make the learning content focus on the

learning topic. However, there is a need to strike a balance between learning activities to improve the degree of completion.

### **Employing scaffolding strategies in problem-based learning**

PBL is defined by Barrow and Tamblyn (1980) as the process of question-realizing and problem-solving, which allows learners to control the path of learning. As such, PBL is closely related to our daily life. PBL is an approach to learning where curricula are designed with problem scenarios central to student learning in each curricular component (Savin-Baden & Wilkie, 2006). The purpose of using PBL includes learning knowledge building, enhancing problem-solving skill, and promoting self-directing and learning motivation (Barrows, 1986).

In recently years, PBL is not just used with face-to-face teaching—it is also applied to the online environment. Savin-Baden and Wilkie (2006) asserted that PBL in an online environment is not an approach to replace the traditional form of learning, but is about complementing and developing what is already in existence. In online PBL, students use web-based tools to share information and construct knowledge.

Fund (2002) examined the effect of scaffolding in a computerized environment for students solving problems about science in a simulation of laboratory experiments. With this study finding showed that scaffolding provides a structured component of the course and provides a framework for problem solving. The scaffold has a powerful influence on learning outcomes. On the other hand, Hmelo-Silver, Duncan and Chinn (2007) pointed out the PBL is a powerful and effective model of learning. When an instructor applies the scaffolding in PBL, it can reduce the cognitive load and help students to learn in complex domains.

PBL is a learning mode that focuses on discussion, sharing, and problem solving. Scaffolding can be used as a guide in the discussion process, helping to enhance the learner's discussion and improve the interaction between the groups.

### **Objectives of the Study**

In this study, we will use different scaffolding strategies in PBL online course, including meta-cognitive scaffolding and procedural scaffolding, and a blended scaffolding that combines the two characteristics. This study intends to answer the following questions:

1. In the online problem-based learning, which scaffolding type is more effective to guide students' learning?
2. When we provide different scaffolding supports in the same course, does blended-scaffolding or single-scaffolding yield better learning outcomes?

## Research Methodology

### Methods

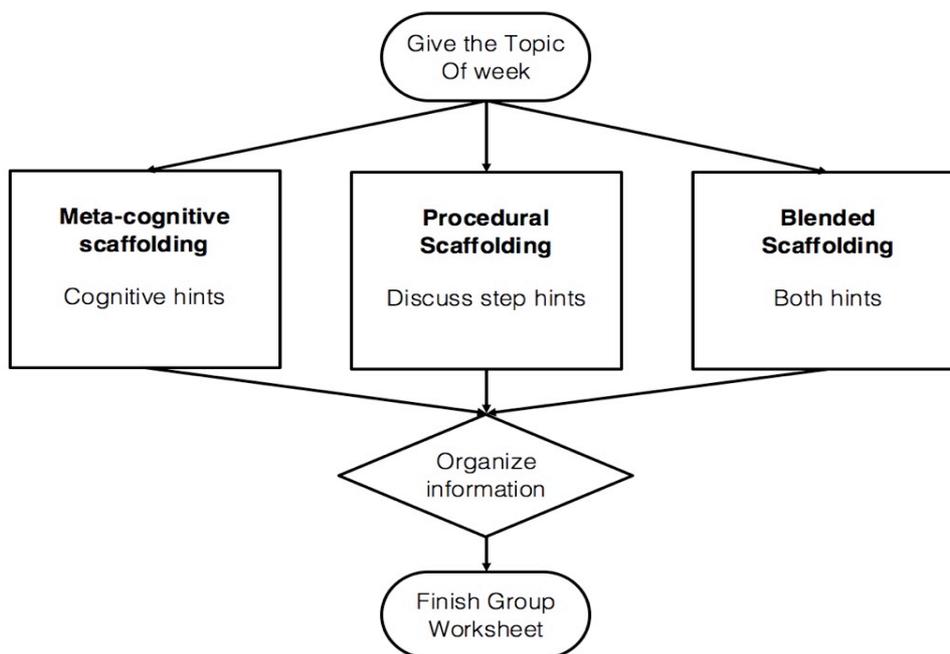
This experiment will be created using Google-Site, a web-based collaboration platform. The subject of the course is “Electricity in Taiwan.” In this course, a student-led learning process, the mentor will give assistance. At the beginning of the course, it will be explained in the classroom to the student. They will need to share information, discuss problems, and construct knowledge on the platform. In addition, the learning content of each group is the same; the difference is that they will receive different additional assistance.

### Participants

The experiment subjects fifth graders from a selected elementary school who enrolled for the science course. They will be divided into 9 groups for three categories: 3 meta-cognitive groups, 3 procedural groups and 3 blended groups.

### Procedure

This experiment will execute for 3 weeks. Before the course beginning, instructor will introduce about the meaning of PBL, and how to use the platform. Learning activities process shown as Figure1.



**Figure 1.** Learning activities process

At the beginning of the course, the learner will be informed about the subject. Every group then begins to discuss with the members to search and figure out for relevant information they found. The scaffolding will be mainly built in this step. The details of the different scaffolding types are described below:

### (1) Metacognitive Scaffolding: Cognitive hints

Cognitive hints assist learners to recall the past experience and think about how to solve a problem. Examples are as follow:

1. I have seen on television many nuclear-related news items; have you seen any of these? You can share with the members any information you have from such sources.
2. Nuclear power generation does not seem to be an excellent power generation option. Maybe you can start looking for some information about nuclear power generation with your teammates and share it with us.

We want use life-related issues to attract the attention of students; problematizing meta-cognitive scaffolding can lead students to think, and promote group cooperation and discussion (Molenaar & Slegers, 2014).

### (2) Procedural Scaffolding: Discuss step hints

Procedural scaffolding focus on the steps to complete the learning task, giving hints as to what the learner needs to finish next. The following are examples:

1. Now use “nuclear power” as a keyword, and collect information with your teammates.
2. From the information you found, please explain what nuclear power generation is, as well as its advantages and disadvantages.

Through such guidance, students can immediately know what needs to be done, improving the likelihood of achieving the goal. Through the systematic process of understanding the complexity of learning content, the students can more clearly form their own learning tasks (Puntambekar & Hubscher, 2005).

### (3) Blended Scaffolding: Metacognitive and procedural

This group will be prompted by a mixture of the other two groups (i.e., given the contextual content and given the specified steps to complete the course). The following is an example:

1. Have you seen news about nuclear energy on TV? Perhaps you can tell me about nuclear power generation, and its characteristics, review the relevant information together with your teammates, and then share it with us.

Combined with the advantages of the other two kinds of scaffolding, blended scaffolding can lead students to think at the same time, but also to complete the expected learning goals.

After they finish the information searching, and organize their information, they will receive the group worksheets. The worksheet is a quiz about the discussion topic, we

will use it to evaluate their learning outcomes and use the score to analyze differences between groups.

### **Expected Results**

In this research, we wanted to find out:

1. How to use scaffolding strategy in online PBL
2. What kind of scaffolding strategy can lead students to discuss efficiently and promote learning achievement.

We seek to use different scaffolding strategies for the PBL curriculum of the same topic, including a combination of metacognitive scaffolding and procedural scaffolding. It is expected that such blended scaffolding can redress the deficiencies of the other two single scaffolding types. The study is also expected to provide a new teaching strategy for online PBL to help students. Although this research has not yet been finished, we are continuing to develop it in expectation of its completion.

The results of the study could yield suggestions to instructional designers. Additionally, we suggest researching other types of scaffolding. Scaffolding has many various forms and application; as a future study, instruction designers can focus on how to improve interactivity and enhance learner's learning motivation.

### **Acknowledgements**

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## ***Designing the Multimodal Network in an Agriculture Supply Chain in Thailand***

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The Asian Conference on Society, Education & Technology 2016  
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### **Abstract**

In terms of economic situation towards logistics implementation, it is found that one of the most important factors to consider about is transportation costs which need to be handled in many ways in order to get the best effectiveness and the lowest costs for the best profitability. For land transportation, rail transportation costs cheaper when compared with road (truck) transportation because rail transportation can load a lot of goods in one time and can avoid traffic troubles. This research is made to study a simulation of decision making on means of logistic transportation for tapioca which comes from 20 different originals that considered as having the largest productivity and delivered to train stations for further multimodal transportation. The so-called train stations are decided by the government as double-track railways for reasons of further benefits in the future. Each station has next destination at Leamchabang Station (final destination) and the goods will be transferred to another Ship marine Port. This demonstration of decision making is designed using mathematic simulation by setting target of transport quantity of each transport destination. Moreover, terms and conditions of transport quantity, quantity of goods from the origin to destination, different types of transport vehicles, transport capacity and quantity of vehicles, by using Microsoft Excel Solver programme for calculating the lowest cost. As a result after the simulation of decision making, the transportation cost can be 183 Million baht reduced compared with the previous mean in which the products will be transported by truck starting from farms to river port and shipped to seaport. Also the decision of model able apply with other agriculture products.

Keywords: Distribution Network, Agriculture Supply Chain, Rail transportation, Linear programming model

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## 1. Introduction

Thailand is a country that grows and exports tapioca the most in Asia. Thailand also exports tapioca to overseas, and the biggest buyer is China. China imports tapioca for processing it to consumption ethanol including processing into many other kinds of product. Largely, Thailand has areas for growing agricultural products and this is a main reason that Thailand can grow tapioca in each region all around the country. Nowadays, when the product is ready for harvesting, agriculturists will gather tapiocas which are ready to be delivered and load them on a truck, and transferred to the destination. After that, the tapioca will be on road transportation, and then shipped by barge. It can be seen that, transportation costs mainly take place at road (truck) transportation with the highest cost. Nevertheless, the transportation of tapioca can be managed in several means and on many routes of transportation. Thus, this research studies transportation routes which can support transport activities in accordance of requirements of each distribution center properly. By this, the transportation by train, which newly supported by the government recently, was added to be one of the ways of railway transportation. Double-track railway was also built for further benefits in the future. Therefore, its advantages was realized in terms of reducing cost, that it may help reduce the cost more effectively than the previous mean of transportation; by truck. Furthermore, the distribution center of tapioca which has trains passing by was considered as a starting point and transferring to inland destination, passing to the nearest seaport and ending at Port of Ko Sichang. A new way of transportation was simulated to be replaced the previous one in which the products will be delivered to estuary, then to Port of Ko Sichang by barge which takes longer time.

## 2. Objectives

- 2.1 To reduce the costs of agricultural product transportation (case study of tapioca)
- 2.2 To build decision-making model for allocation of the distribution centers where the train passed.

## 3. Literature Review

The previous researches have focused on how to select and manage goods storage by providing many means of transportation, creating mathematic simulation to help making decision on product delivery by using trouble-shooting programs such as AMPO, CPLEX, etc. for considering controlled factors and adjusting figured as required.

For this research, the basic programs installed in Microsoft Office Excel, a menu in Add Ins called "Solver" were picked up as the important tools as they are simple, easy to understand and suitable for analyzing small-size data quickly.

## 4. Research Methodology

4.1 Studied about the quantity of tapioca productivity delivered to each distribution center. After studying and choosing the origin of logistics for tapioca products, it was found that Thailand can grow and produce plenty amount of products, and harvesting areas expanded in each region; North Eastern, Northern, Eastern and

Western parts of the country while Central and Southern parts rarely grow tapioca as their topography is not so applicable.

Nonetheless, if taking all data and information of each area into account for simulating a transportation model, the large amount of information may be needed to analyze while basically all data cannot be evaluated. Thus, only top 20 areas that have largest productivity in the country was selected. A table below shows productivity of each area.

**Table 1: showing productivity of tapioca in each area**

Area	Productivity (ton)	Remark
Khon Buri	765,111	Nakhon Ratchasima Province
Seangsang	750,340	Nakhon Ratchasima Province
Nongboonmak	742,599	Nakhon Ratchasima Province
Khanuworalukburi	694,671	Kanphaeng Phet Province
Mueng Kamphaeng Phet	632,736	Kanphaeng Phet Province

(Source: Centre of Agricultural Information, Office of Agricultural Economics 2015)

According to Table 1: Tapioca productivity in the top 5 different areas in 1 year's time, it can be seen that only 2 provinces; Nakhon Ratchasima and Kamphaeng Phet have the outstanding amount of product. However, as these 2 provinces are in the different regions, so we need to consider their transportation route to destination separately. And this research considers information and data from the top 20 areas.

4.2 Studying the recent transportation routes in order to apply with the new transportation routes.

Currently, transportation of tapioca is performed mainly by truck in which its crucial limitations are delivery quantity per one time, traffic jam, high petrol cost, etc. Therefore, the benefits from the multimodal transport are realized by considering adding railway transport into the entire of carriage. One of the government projects is to develop double-track railway more effectively, so this idea is taken into account for simulating a model of setting destination as the same location as double-track train station completed in the near future. In addition, building 12 routes of double-track railway is decided as accelerated project in order to be the distribution center for the above 20 areas.

4.3 Simulation of decision making under conditions of quantity, cost and transportation route.

Regarding the simulation of decision making, this research designs mathematical equation based on relations of environmental factors and conditions using linear programming as follows;

The lowest total cost Min Z ;

$$\sum_{o=1}^O \sum_{d=1}^D \sum_{w=1}^W C_{odw} Q_{odw} \tag{1}$$

“o” is the origin source of tapioca in each area while “d” is a destination of distribution center in each station, “w” is each mean of transportation, “C” is cost in THB per ton calculated from the distance multiplied by cost per unit (baht-ton/km.), and “Q” is quantity of carriage (unit is ton).

$$\sum_{w=1}^W \sum_{o=1}^O Q_{odw} = Q_o \quad ; \quad \forall_o \tag{2}$$

Total amount of tapioca from each origin “o” to destination “d” by each mean of transportation; 4-wheel, 6-wheel and 10-wheel trucks; must not be over the total quantity from the starting point. “w” is a pattern of transportation from the starting point of each area and the cost will be varied by different amount of product each time. “Q” is gross amount of tapioca from the starting point.

$$\sum_{w=1}^W \sum_{o=1}^O Q_{odw} \leq Q_d \quad ; \quad \forall_d \tag{3}$$

For the total amount of tapioca in each origin “o” to destination “d”, all means to transportation need to deliver the goods in the amount not over the limit (Q<sub>d</sub>) at the destination “d”

$$\sum_{d=1}^D \sum_{o=1}^O Q_{odw} \leq Q_w \quad ; \quad \forall_w \tag{4}$$

The total number of rounds of carrier in each area “o” to purchasing spot “d” should not have amount of product exceeded the transport capacity (Q<sub>w</sub>). Conditions of transport capacity are as follows;

**Table 2: showing transport capacity in one round (unit is ton) as well as costs of each type of trucks**

Type of trucks	Amount of transport/round (ton)	Cost per unit (baht-ton/km)
4 wheels	2	6.44
6 wheels	12	5.08
10 wheels	30	6.63

According to table 2, it can be applied for setting the number of transport rounds in each origin “o” to destination “d” but not over the amount of the number of transport round in each area “d”. Moreover, it shows cost per unit in each mean of transportation (Ref: petrol price at 29.94-33.33 baht/liter)

For choosing transportation routes, the choices are designed to provide transferring from farm of each area to double-track train station so that the goods can be delivered further to Laemchabang train station, a station that is near to the location that can transfer the goods to a barge in the harbour.

**Table 3: showing terms and conditions of the number of transportation rounds of each mean of transportation**

Means of transportation	The limited number of transport rounds
4 wheels	500,000
6 wheels	100,000
10 wheels	20,000

The above Table 3 shows about limitations of the number of transportation rounds to simulate the number of vehicles used in transportation that were assumed for decision making.

#### 4.4 Input data in the simulation for decision making

This research uses the Microsoft Excel Solver program to analyze and calculate to managing tapioca from starting point to the final distribution center located in double-track train station. The program will decide the amount of tapioca taken from the starting point, a mean of transportation, the proper amount delivered to each station in which all of them are relating with each other.

#### 4. The research's result

As a result of calculation for choosing a mean of transportation, it can be said that the selected method is a method which has the lowest cost and supports product logistics under its conditions.

**Table 4: showing decision of transporting tapioca from starting point to each purchasing spot**

Nb.	Origin	Demand	Destination											
			Chachoengsao		Saraburi		Prachuap Khiri Khan		Nakhon Ratchasima	Khon Kaen	Lopburi	Chumphon	Nakhon Sawan	Nakhon Pathom
			Chachoengsao	Khlung Sip	Kaeng Khoi	Map Kabao	Prachuap	Huehin	Thanon	Khon Kaen	Lopburi	Chumphon	Palnumpo	Nakhon
1	Khon Buri	765,111	0	0	0	0	0	0	765,111	0	0	0	0	0
2	Soeng Sang	750,340	0	0	0	0	0	0	750,340	0	0	0	0	0
3	Nong Bun Mlk	742,599	0	0	0	0	0	0	742,599	0	0	0	0	0
4	Khanu Wrdakaburi	694,671	0	0	0	0	0	0	0	0	0	0	694,671	0
5	Kamphaeng Phet	632,736	0	0	0	0	0	0	0	0	0	0	632,736	0
6	Dan Khun Thot	612,761	0	0	0	0	0	0	612,761	0	0	0	0	0
7	Sidao	500,762	500,762	0	0	0	0	0	0	0	0	0	0	0
8	Khlung Lan	429,718	0	0	0	0	0	0	0	0	0	0	429,718	0
9	Sikhio	403,543	0	0	0	0	0	0	403,543	0	0	0	0	0
10	Saram Chai Khret	388,638	388,638	0	0	0	0	0	0	0	0	0	0	0
11	Nie Wang	372,208	0	0	0	0	0	0	0	0	0	0	372,208	0
12	Thep Sathit	353,543	0	0	0	0	0	0	353,543	0	0	0	0	0
13	Lao Khwan	347,959	0	0	0	0	0	0	0	0	0	0	0	347,959
14	Nam Yuen	342,638	0	0	0	0	0	0	342,638	0	0	0	0	0
15	Ladyao	336,298	0	0	0	0	0	0	0	0	0	0	336,298	0
16	Sai Yok	323,981	0	0	0	0	0	0	0	0	0	0	0	323,981
17	Tha Takap	305,993	305,993	0	0	0	0	0	0	0	0	0	0	0
18	Wang Sombun	274,103	274,103	0	0	0	0	0	0	0	0	0	0	0
19	Sung Noen	262,096	0	0	0	0	0	0	262,096	0	0	0	0	0
20	Khlung Hat	258,727	258,727	0	0	0	0	0	0	0	0	0	0	0

As a result of decision making on tapioca transportation, it was found out that, there is a program selecting transportation from farm to train stations of double-track railway properly before transferring to a port. The program selected to use all provided resources under conditions of quantity, capacity of delivery- purchasing, product weight that can be loaded on the truck, the number of truck's rounds and the lowest cost. It selects transportation by 6-wheel truck which has low cost at THB 8,207,726,132.13 altogether. The cost reduces 183 Million baht comparing with the previous mean of transportation. Moreover, it created a new mean of transportation model which considers about limitations of each mean of transportation, and therefore it selected a double-track train station as a distribution center in order to get the advantage of transportation as much as possible.

As a result, we can get benefits from management of transportation routes from each area (region) to each destination which has the lowest cost. Utilizing double-track train as a product gathering center (tapioca's distribution center) is a way to transfer the product via railway. With the method, the transportation cost will be lower than other road transportation. Furthermore, we can manage and select the best mean of transportation suitable with transportation cost, ability including limitation each kind of transportation for the best effectiveness.

## **5. Suggestion**

This route model is designed to help making decision of transportation routes which do not have too many conditions or factors as the program can respond to only 200 items. As a result, decision making might not be so accurate. The number of truck's rounds was also only an assumed number, but if the actual numbers could be figured out, it will help analyze more correctly.

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