

**ความเชื่อมั่นด้าน TPACK ของนิสิตครูจากรายวิชาเทคโนโลยีสารสนเทศ
สำหรับครูวิทยาศาสตร์**
**ICT FOR SCIENCE TEACHER COURSE ON PRE-SERVICE SCIENCE
TEACHERS' CONFIDENCE IN TECHNOLOGICAL PEDAGOGICAL
CONTENT KNOWLEDGE**

ผู้วิจัย

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Received: November 13, 2019

Revised: December 04, 2019

Accepted: December 06, 2019

บทคัดย่อ

ความรู้ในเนื้อหาผนวกวิธีสอนและเทคโนโลยี (TPACK) เป็นกรอบความคิดในการพัฒนาวิชาชีพครูในศตวรรษที่ 21 งานวิจัยนี้มีเป้าหมายในการตรวจสอบมุมมองทางด้าน ICT ในการสนับสนุนการสอนและการเรียนรู้วิทยาศาสตร์ ผ่านกรอบแนวคิด TPACK โดยรายวิชาเทคโนโลยีสารสนเทศสำหรับครูวิทยาศาสตร์ถูกออกแบบมาสำหรับนิสิตครูชั้นปีที่สาม เพื่อพัฒนาทักษะการสอนโดยใช้เทคโนโลยีคอมพิวเตอร์ รวมถึงการใช้โปรแกรมคอมพิวเตอร์ในการสร้างสื่อการสอน e-Book และรายวิชาออนไลน์บนระบบ Moodle เครื่องมือวิจัยประกอบด้วย แบบสอบถาม จำนวน 25 ข้อ แบ่งเป็น 4 กลุ่ม คือ ความรู้ด้านเทคโนโลยี ความรู้ด้านเทคโนโลยีผนวกความรู้ ความรู้ด้านเทคโนโลยีผนวกการสอน และความรู้ในเนื้อหาผนวกวิธีสอนและเทคโนโลยี เครื่องมือได้รับการตรวจสอบผ่านการวิเคราะห์ปัจจัยเชิงสำรวจ มีความเชื่อมั่นเพียงพอ (Cronbach's $\alpha = .90$) แบบสอบถามถูกใช้ก่อนและหลังเรียน การวิเคราะห์ข้อมูลใช้การวิเคราะห์ค่าที พบว่าความมั่นใจในทุกทักษะ TPACK เพิ่มขึ้น โดยเฉพาะความมั่นใจในการใช้ Web 2.0 ($t(42) = 3.64, p < .001$) และระบบการจัดการเรียนรู้ออนไลน์ ($t(42) = 6.77, p < .001$) นอกจากนี้ยังพบว่านิสิตใช้เวลาศึกษาด้วยตนเองผ่านอินเทอร์เน็ตมากขึ้น ($t(42) = 2.45, p < .01$) แต่ความมั่นใจในทักษะการค้นหาและใช้ภาพเคลื่อนไหวเพื่อสาธิตหรือเพื่อสอนเนื้อหาใดเนื้อหาหนึ่งหรือเพื่อหลีกเลี่ยงความเข้าใจคลาดเคลื่อนยังอยู่ในระดับต่ำ

คำสำคัญ: ความรู้ในเนื้อหาผนวกวิธีสอนและเทคโนโลยี (TPACK) การพัฒนาวิชาชีพครู

ABSTRACT

Technological Pedagogical Content Knowledge (TPACK) is distributed as a framework for teacher professional development in the 21st century. The study aims to investigate the perspective of ICT to support teaching and learning science through the lens of TPACK. The ICT for Science Teacher course was designed

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for the third-year science teacher students to develop teaching skills using current computer technologies. In the course, multiple computer programs were used to create learning material, e-book and online courses on Moodle. The rating scale questionnaire consisted of 25 statements in 4 domains: Technological Knowledge (TK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK). It was validated through exploratory factor analysis and reliability proved sufficient (Cronbach's alpha equals .90). It was administered before and after taking the course. The t-test analysis was conducted and we found that the confidence on all TPACK skills increased, specifically, the confidence on the usage of Web 2.0 ($t(42) = 3.64, p < .001$) and on the online Learning Management System ($t(42) = 6.77, p < .001$). Also, the self-learning time through the Internet significantly increased ($t(42) = 2.45, p < .01$). However, the results show that the teacher students' confidence is quite low in terms of searching and using online animation to demonstrate or teach specific content and avoid science misconceptions.

Keywords: Technological Pedagogical Content Knowledge (TPCK), Teacher Professional Development

INTRODUCTION

To be a teacher in the 21st century, one needs to be able to fluently wield all the technology installed in one's classroom. Slideshows or videos from a projector or on a TV monitor might already be considered old technology when they are compared with the touch screen smart boards or even individual tablets. However, the effectiveness in teaching and learning did not completely depend on the technology itself, rather, it depends on how these technologies are used in teaching and learning.

From pre-assessing student understanding, using cognitive-eased learning materials and activities, to supplementing after-class activities and assessing learning outcome, current technology can help teachers accomplishing these tasks more effectively. Teachers can reach out to students beyond their classroom with challenges and various kinds of supports. From students' view, technology can also be used to support their self-directed learning, to explore their personal interests, and, even, to acquire new knowledge and skills freely available in various forms. To utilize the

technology effectively, teachers need to have certain kind of knowledge and skills to support their students inside and outside of the classroom.

Technological pedagogical content knowledge (TPACK) is the framework for knowledge and skills for a teacher to be effective in the 21st century classroom. This framework was introduced by Mishra and Koehler (2006) to incorporate technology domain into the well-known pedagogical content knowledge (PCK) framework by Shulman (1986). PCK framework is widely used in education, especially in teacher development. It consists of three related domains: content knowledge (CK), pedagogical knowledge (PK), and pedagogical content knowledge (PCK). Teachers need to know the subject matters, the concepts, and maybe the application (CK). They need to know how to teach and to support the learning (PK). Importantly, they need to know a suitable way to deliver specific contents, how to help student construct new concepts and avoiding misconceptions (PCK). The interplay between content knowledge and pedagogical knowledge is the key to effective teaching and learning.

Even though, pedagogical content knowledge seems to cover every aspect of effective teaching and learning, technology used in our education has become another important factor as well. That is why Mishra and Koehler added technology domain into the pedagogical content knowledge framework. Technological pedagogical content knowledge (TPACK) focuses on how to use technology, as well as to incorporate technology into the well-established pedagogical content knowledge domains.

Teachers in the 21st century need to not only be able to use the technology effectively, they have to use it pedagogically right and suitable for the learning content. Some technologies, such as PowerPoint, can help teachers shorten time to prepare their elaborate lecture, however, if the teacher doesn't aware of the program's constraints (Kernbach, Bresciani, and Eppler 2015) and its dilemma (Hill et al. 2012), students may not catch up with their lecture and end up not learning anything. Some technology, such as computer simulation, animated slideshow and flashy multimedia, was believed to attract students' attention, but it obstructed the cognitive process and students cannot learn from it (Mayer 2001). Inquiry-based learning depends a lot on students' initial ability; Inquiry-based learning that allow students to aimlessly search for specific piece of information on the Internet without any guidance or support can cause trouble rather than benefiting students (Soloway and Wallace 1997; Milson 2002; Sheffield and McIlvenny 2014). Individualized learning supporting learning assessment is also possible with learning management system, however, the effectiveness of the feedback depends on many factors (Fakcharoenphol and Stelzer 2014;

Wannagatesiri 2017). To be effective teacher, one must be able to use technology effectively and correctly.

To train effective pre-service teachers for the 21st century, we need to pay attention to the knowledge and skills in all domains of TPACK as suggested by Prongsamrong, Wannagatesiri and Fakcharoenphol (2018). The current curriculum for pre-service science teacher at Kasetsart University Kamphaeng Saen Campus consists of various courses to cover all aspects of being a good teacher. In this research on the effect of the Information and Communication Technology for Science Teacher course, we focused only on the technology used in education, i.e. technological knowledge (TK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and technological pedagogical content knowledge (TPACK). The questionnaire on the computer programs, Internet usage, as well as the confidence on the 4 technology sub-domains were collected before and after the course.

Information and Communication Technology for Science Teacher Course

The Information and Communication Technology for Science Teacher course was design for the third-year science pre-service teacher. It was taught the first time in Fall 2015. The course emphasized on using educational media already available on the Internet to build a short learning media and a short online course on a science topic.

In the course, students gradually explored the educational technology and media already available to public, such as science computer simulation, science demonstration, online learning media, and online courses (Khan Academy, Coursera). They also

explored a bit further as a homework to find technology applicable for education to present to the class. Their chosen technologies concentrated around computer programs, mobile applications and websites.

We discussed on how these different technologies could suitably be used in the classroom. Some are suitable for introducing new information and idea, such as info graphics and most multimedia. Some science experiments are dangerous and difficult to test in the classroom; videos of the experiments might be a good alternative. Some technologies are suitable for training skills such as using geoguessr.com to train observation skill and using Google Maps to train communication skill. Some technologies are suitable for conveying science concepts such as PhET (Wieman, Adams, and Perkins 2008). These technologies could play different, but important roles in the classroom, if they were used correctly.

After seeing various examples of technologies used in education, students need to learn how to create one by themselves, starting from a learning media in the form of E-book or html or interactive PowerPoint. For this individual project, they can freely choose their own topics with the aim of 5 to 10 minute-worth of information. These digital media were drafted and anonymously peer reviewed for error and suggestion for improvement. They were asked to make a short quiz of their learning media. At the end of this part, they have to present their learning media to the class with the quiz for their friends.

In this peer review process, they should learn how to design a good learning media, what is the important information other people is looking for. They must criticize other people's work, as well as

receive the feedback from other people. From this, they should learn how to criticize other people's work productively and learn how to comprehend the feedback. Then, they could use the feedback to adjust and improve their learning media. The whole process of designing, getting feedback, and adjusting accordingly is necessary for making good products including the learning media.

Then, we explore available online courses such as Coursera, edX, and Khan Academy. These systems are fully functional as an online course with formative assessment, instructional media, quiz, homework, group discussion, and even extra supports from the instructors. Coursera and edX offer various kinds of courses from computer science to politics from many famous universities around the world. Each course was organized by its instructors and it was completed within the course. For Khan Academy, their courses were arranged differently; Since their courses were organized by one organization into subjects, the courses were arranged to help students construct their knowledge from the foundation up to the top. These online systems are the front-runners of the online learning.

After the conventional online courses were explored, group of students were assigned to create their own course using Moodle Cloud platform which is the same platform used for the ICT for Science Teacher course website. They learn how to construct a learning management system from instructional videos. They were encouraged to reuse the educational materials already available online, such as video clips, info graphics, games, interactive multimedia, mobile applications, computer programs, etc. If they cannot find suitable materials already available,

they were encouraged to create one themselves using the skills learned from previous project.

As a creator of the online course, students not only choose the learning materials used in the course, but also need to arrange them in a suitable order by adding conditions for learning activity progresses. To oversee the whole structure of the online course requires another level of learning management skill. Not only that they must use effective learning materials, they must organize them in order to support the user's learning progress through the course.

Another capability of the online course is the assessment system with instant and delay feedback. Similar to the pre-quiz system used in Khan Academy, Moodle allows the course creators to use formative assessment, as well as the quiz at the end of each section to determine the user's initial ability and the learning outcome. In this project, students were encouraged to use formative assessment, as well as summative assessment within their courses.

Similar to the learning process used in previous project, the online course creation project required students to draft their ideas, concepts, and main components used in their online course. However, since this project is much bigger than the first one, each group needs to discuss their idea with the instructor before start creating the online course. During discussion, the idea of formative assessment and the immediate feedback system were suggested and emphasized. Also, the attempt to look at their online course from learner's perspective were discussed. These discussions were for making sure that their online course would be well-organized and educationally practical.

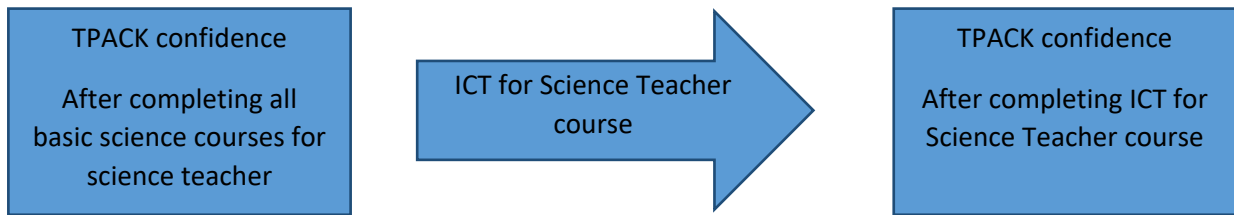
Then, they are going through the drafting processes with, again, anonymously peer review before finishing their online course. At this point, they should have learned how to criticize other people's work productively and to use the feedback to adjust their online courses. Finally, the complete online courses were presented to the class.

In this course, students should have learned how to choose the right/effective learning materials and should be able to create their own effective learning media, such as E-book, website, and interactive presentation. They also experience the peer reviewing process of their products, how to criticize productively and how to use the feedback to improve their products. At the end, when they were in charge of creating the whole online course by themselves, they have to apply all they have learned from previous course into their online course, including formative assessment and feedback system. They must arrange their learning activities in appropriate order to support the learning of their online course users. The Information and Communication Technology for Science Teacher course should adequately introduce these young teacher students into what could be done in the classroom with current technology.

Research Framework

The third-year science teacher students should complete all basic science courses and thus have enough science-subject knowledge to teach in school. The question is whether they are ready to teach and thus we ask for their confidence on TPACK at the beginning of their third year (already completed all basic science courses) and again after taking ICT for Science Teacher course (where they

need to use the science-knowledge in teaching with technology).



The purpose of this research is to compare the confidence on TPACK of the third-year science teacher students before and after taking ICT for Science Teacher course.

METHODOLOGY

Population

The Information and Communication Technology (ICT) for Science Teacher course was designed for the third year science teacher students to develop the teaching skills using current computer technologies. In 2015, there were 44 third-year teacher students. However, one of the survey was incomplete, so we discarded it and ended up with 43 in total.

Variable

Independent variable: ICT for Science Teacher course.

Dependent variable: the confidence on Technological Pedagogical Content Knowledge (TPCK)

Research Design

This research is one-group pretest-posttest design.

T_1 X T_2

Research Instruments

The survey consisted of two parts: personal information and confidence rating questionnaire. The surveys were collected from all of the third year science teacher students before and after taking

the ICT for Science Teacher course by the instructor who did not teach the course.

Personal information including gender, GPA, fluently-used computer programs, and average Internet usage both related and non-related to learning.

The questionnaire consists of 25 statements (See table 3) divided into 4 domains: 10 in Technological Knowledge (TK), 3 in Technological Content Knowledge (TCK), 8 in Technological Pedagogical Knowledge (TPK) and 4 in Technological Pedagogical Content Knowledge (TPCK). The Likert-scale rating range from 1 (not confidence) to 6 (very confidence). It was validated through exploratory analyses and reliability proved sufficient (Cronbach's alpha equals .90).

Data Collection

The survey was collected at the beginning and at the end of the ICT for Science Teacher course by the faculty who was not the course instructor.

Survey

The survey consisted of two parts: personal information and confidence rating questionnaire. The surveys were collected from all of the third year science teacher students before and after taking the ICT for Science Teacher course by the instructor who did not teach the course.

Personal information including gender, GPA, fluently-used computer programs, and average Internet usage both related and non-related to learning.

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Analysis

The confidence scores before and after taking ICT for Science Teacher course were analyzed

Table 1 *Self-report information in the questionnaire*

Self-report	Pretest	Posttest	Statistics
Total time spent on the Internet each day	6.5 ± 0.7 h	7.1 ± 0.5 h	t(42) = 1.0, p = .16
Time spent on the Internet for learning each day**	1.9 ± 0.2 h	2.6 ± 0.2 h	t(42) = 2.5, p < .01
Number of programs student say they are fluent***	1 ± 0.1	2 ± 0.2	t(42) = 5.6, p < .001

* p < .05

** p < .01

*** p < .001

From the personal information from the self-report indicated that these students spend a big chunk of time (6 -7 hours) per day surfing the Internet, however, they reported that about a third of that time were spent on learning. The time spent on learning significantly increased after taking the ICT for Science Teacher course from 1.9 hours per day to 2.6 hours per day. Also, the number of programs they said they were fluent in significantly increased from 1 program to 2 programs. (See table 1)

The data from the 25 confidence rating questionnaire were collected and analyzed using pair-wised t-test. Five of them (11th, 18th, 19th, 20th, 21st, 24th, and 25th statement) showed statistically significant difference between pretest and posttest (see table 2). The rating in the posttest almost all increased, except on the 2nd and 5th statements.

using dependent sample t-test on self-report information and on TPACK confidence before and after taking ICT for Science Teacher course.

Result

The personal data of the 43 third-year teacher students both before and after taking the ICT for Science Teacher course were analyzed using pair-wised t-test on the time spent on the Internet for both related and non-related to learning. The number of programs students reported to be fluent in were counted and analyzed using pair-wised t-test.

Table 2 Questionnaire statements collected before and after the ICT for Science Teacher course

Statements	Pretest	Posttest	Statistics
1. You can search and use online animation to demonstrate or teach science. (TPCK)	3.61± 0.20	3.98± 0.19	t(42) = 1.5, p = .07
2. You can use Internet to search for common science misconceptions for students. (TPCK)	4.30± 0.14	4.26± 0.17	t(42) = 0.2, p = .41
3. You can use technology or digital measuring tools to help student in inquiring, exploration, and science experiment. (TPCK)	4.23± 0.15	4.26± 0.16	t(42) = 0.1, p = .46
4. You can use technology or digital measuring tools to collect scientific data. (TPCK)	4.21± 0.15	4.42± 0.15	t(42) = 1.1, p = .15
5. You can use technology to improve your teaching. (TPCK)	4.70± 0.12	4.63± 0.15	t(42) = 0.4, p = .34
6. You can use technology to communicate or consult with students. (TPK)	4.56± 0.11	4.77± 0.12	t(42) = 1.2, p = .11
7. You can manage the technology installed in the classroom. (TPK)	4.26± 0.13	4.47± 0.14	t(42) = 1.1, p = .13
8. You can use technology to stimulate student's interest. (TPK)	4.40± 0.13	4.56± 0.12	t(42) = 0.9, p = .18
9. You can use technology to improve your teaching presentation. (TPK)	4.21± 0.13	4.47± 0.12	t(42) = 1.5, p = .07
10. You can use technology to stimulate student learning. (TPK)	4.21± 0.10	4.44± 0.10	t(42) = 1.3, p = .11
11. You can use technology to assess student learning outcome. (TPK)*	4.28 ± 0.14	4.60 ± 0.13	t(42) = 1.9, p < .05
12. You can use scientific tools and technology to observe and measure. (TCK)	4.00± 0.14	4.14± 0.12	t(42) = 0.9, p = .19
13. You can use scientific tools and technology to present data or pictures of natural phenomenon. (TCK)	4.07± 0.16	4.23± 0.15	t(42) = 0.8, p = .22
14. You can use scientific tools and technology to collect data or pictures. (TCK)	4.33± 0.17	4.49± 0.14	t(42) = 0.8, p = .22
15. You can save pictures from website to your computer. (TK)	5.21± 0.16	5.47± 0.15	t(42) = 1.4, p = .08

Statements	Pretest	Posttest	Statistics
16. You can search for interested information from websites. (TK)	5.37± 0.14	5.58± 0.14	t(42) = 1.2, p = .11
17. You can send e-mail and attached file with your e-mail. (TK)	5.63± 0.12	5.77± 0.12	t(42) = 0.9, p = .19
18. You can use Microsoft PowerPoint for presentation. (TK)*	5.47 ± 0.10	5.74 ± 0.12	t(42) = 2.0, p < .05
19. You can use Microsoft Word to create documents or graphics. (TK)*	5.19± 0.15	5.51± 0.15	t(42) = 1.7, p < .05
20. You can learn using new program by yourself. (TK)*	4.30 ± 0.17	4.67 ± 0.18	t(42) = 2.0, p < .05
21. You can install new programs.(TK)*	4.51± 0.19	4.81± 0.20	t(42) = 1.8, p < .05
22. You can edit pictures. (TK)	4.74± 0.13	4.88± 0.17	t(42) = 0.8, p = .22
23. You can edit video clips. (TK)	4.05± 0.23	4.21± 0.22	t(42) = 0.7, p = .23
24. You can use Web 2.0 such as blog and facebook. (TK)***	4.14 ± 0.23	5.16 ± 0.18	t(42) = 3.6, p < .001
25. You can create website or learning management system. (TPK)***	3.14 ± 0.23	4.95 ± 0.18	t(42) = 6.8, p < .001

* p < .05

** p < .01

*** p < .001

All statements were categorized into 4 sub-domains: technological knowledge (TK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and technological pedagogical content knowledge (TPACK). The average confidence of each sub-domain was analyzed using pair-wised t-test and found that the confidence in TPK and TK sub-domains significantly increased (see table 3).

Table 3 Average confidence rating from the questionnaire (1 is "not confidence" and 6 is "very confidence")

Domains	Pretest	Posttest	Statistics
TPACK	4.09 ± 0.16	4.23 ± 0.17	t(42) = 0.9, p = .18
TPK**	4.22 ± 0.14	4.61 ± 0.14	t(42) = 3.1, p < .01
TCK	4.13 ± 0.16	4.29 ± 0.14	t(42) = 0.9, p = .17
TK**	4.86 ± 0.17	5.18 ± 0.17	t(42) = 2.4, p < .01

* p < 0.05

** p < 0.01

*** p < 0.001

CONCLUSION

The research found that the confidence on all TPCK skills increased, specifically, the confidence on the usage of Web 2.0 ($t(42) = 3.64, p < .001$) and on the online Learning Management System ($t(42) = 6.77, p < .001$) after taking ICT for Science Teacher course. Also, the self-learning time through the Internet significantly increased ($t(42) = 2.45, p < .01$). However, the results show that the teacher students' confidence is quite low in terms of searching and using online animation to demonstrate or teach specific content and avoid science misconceptions.

DISCUSSION

The Information and Communication Technology for Science Teacher course were aimed to develop skills of young teachers to choose and use current technology in education effectively. There are a huge collection of educational media and technology already available on the Internet, these teacher students need to learn to select a good and appropriate one for their future students. In the course, they had to create the learning media for individual projects and the online course for the group projects. These educational products covered various topics taught in primary to secondary levels. However, the goal of this course was not on the final products, rather, it was on the processes along the way. They need to learn by creating the educational material themselves, reviewing their friends' product, and adjusting their projects from their friends' feedback. Learning by doing and learning to take other's perspective should help these young teachers developing and improving their confidence in their technology skills in education.

The results from the survey showed that the confidence in technological pedagogical knowledge (TPK) and technological knowledge (TK) sub-domain significantly increased after taking the ICT for Science Teacher course, similar to the results of Graham et al (2009) and Tatlı, Ipek Akbulut, and Altınışık (2016). These results of improving confidence in these sub-domains are as expected, since the statements in the questionnaire corresponded very well to the activities used in the ICT for Science Teacher course. Students were introduced to various kinds of online learning materials: instructional media (Youtube), science simulation (PhET), and learning management system (Moodle). They were trained to choose, create, and use them in the right context. During the processes, they had to come across quite a few computer programs, some programs were new to them. They also learned to use and create assessment within their online course. At the end of the course, they should gain more experience and have higher confidence on the online learning.

For the confidence drop on the 2nd and 5th statements in TPCK sub-domain, it is unexpected, but not a surprise. The course activities focused mostly on choosing and organizing the learning media whereas the idea of science misconceptions was never mentioned in the course. Also, the online courses created by teacher students were reviewed by their peers only, so they did not know the actual feedback from the real targeted students. These drops suggested an adjustment to the course in the future. The idea of science misconceptions should be introduced, as well as the science concepts in the course. Also, the project on online course should

be tested with real students, so that these teacher students could learn from the feedback of the actual students. With these adjustments, the future ICT for Science Teacher course should cover these gaps.

Online learning is in demand from students' point of view. From our study, the Internet usage of six or seven hours per day is quite normal for now a day, with the social network and various kinds of media. Comparing to that, students said that they spent around two hours per day using Internet for learning. This might be an important indicator for the coming trend in education, online learning. Students spent their two to three hours per day on their own learning. This behavior is mostly beyond the teacher's control. Thus, students were mostly learning for their own interest, which is the best practical goal for any learning. Universities should be accustomed to this demand and start adapting their learning system to support this kind of learning behavior.

The activities in the ICT course encourage students to use the Internet for learning purposes. Most of the activities and tasks of this courses required the use of the Internet, from finding available learning media examples, finding suitable program or applications to be included to their projects, learning how to use the programs, such as Photoshop,

Moviemaker, and PowerPoint more effectively, to create the online learning course through Moodle Cloud. Even though, the posttest was collected long after the end of the course, the self-report data showed that the time that students spent on the Internet for learning was still significantly higher than on the pretest. This meant the ICT for Science Teacher course might affect students' behavior on learning on the Internet and the effect is quite persistent.

Even though the confidence in technological sub-domain is very high initially and significantly increased after taking the course, however, their confidence on searching and using online animation to demonstrate or teach science is quite low, 3.98 in 1-to-6 Likert scale. Not only that, their confidence on the 2nd and 5th statements which are in the same TPACK sub-domain dropped. This suggested that they are not confidence in applying their technological knowledge that they are very confident in their teaching. This problem could come from the lack of actual teaching experience or actual use of their educational products with real students. This could be a challenge for the course to provide the teaching experience with real students using of their digital educational products.

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