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Short-term ICT Training Program for Non-Computer Science Major Teachers in Developing Countries for Improving ICT Teaching Efficacy

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Abstract

The purpose of this study is to develop a short-term ICT training course that helps teachers from non-computing disciplines in developing countries acquire flipped-learning content creation skills. A field application is performed by applying the developed ICT training course to secondary school teachers of non-ICT subject specialisms in Laos. In the field study, participating teachers' teaching efficacy on ICT and satisfaction toward the training course are measured. The result of t-test on ICT teaching efficacy showed statistically significant increases in teachers' self-efficacy related to ICT use, both personal efficacy and outcome expectancy. The satisfaction survey performed after training showed that trainees were highly satisfied with the training course. The results of this field study could be used to propose a short-term teacher education model that could be applicable to teachers in other developing countries.

***Key words**: ICT Teacher Training, Non-major Teachers of Developing Countries, ICT Teaching Efficacy*

1. Introduction

In today's technology-oriented society, information and communication technology (ICT) and software development have become essential knowledge that determines future competitiveness of countries and individuals [1-4]. And the gap between the skills people learn and the skills people need is becoming more obvious, as traditional learning falls short of equipping students with the knowledge they need to be thrive. Furthermore, today's job candidates must be able to collaborate, communicate and solve problems with ICT. In this context, the World Economic Forum (2016) asserted that ICT literacy is one of the 21st-century skills every student needs [1]. Such a trend has increased worldwide interest in the uptake of ICT in education, which encourages governments, industries and all other education stakeholders to use computer-related technology in their teaching and learning [5-15].

A number of international organizations committed to working to ensure inclusive and equitable quality education help schools and educational institutions in developing countries have better ICT infrastructure [16][17]. They also provide ICT training programs that help teachers learn the best use of ICT in their

teaching. However, existing teacher training programs often neglect to take into account the difference in individual teachers' ICT knowledge or subject specialism, and this decreases the usefulness of training programs and teachers' self-efficacy. It is likely that a large number of teachers from developing nations are not proficient in ICT due to poor ICT infrastructure, and they are in great need of ICT training programs to successfully use ICT in the subjects they teach.
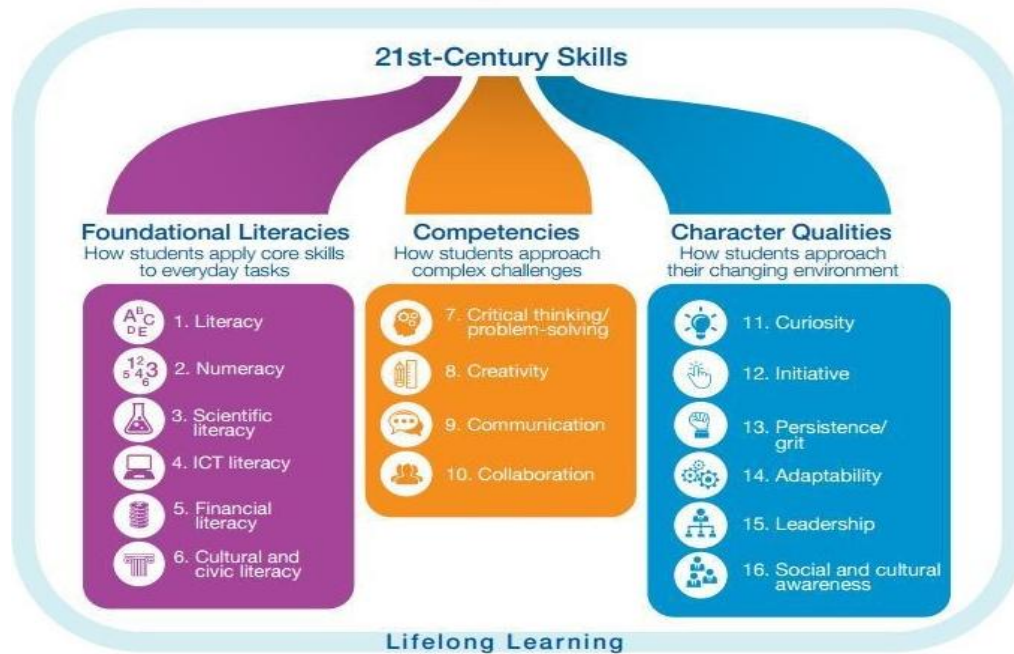
Figure 1. 21st-Century Skills

In this study, we developed a short-term ICT training course that helps teachers from non-computing disciplines in developing countries acquire flipped-learning content creation skills. A field application was performed by applying the developed ICT training course to secondary school teachers of non-ICT subject specialisms in Laos.

In the field study, participating teachers' teaching efficacy and satisfaction toward the training course are measured. The results of this field study could be used to propose a short-term teacher education model that could be applicable to teachers in other developing countries.

2. Related Studies
2.1 Approaches to computing-related training program
Computing-related training programs can be either training about computing technologies or training of other subjects via computing technologies [18]. Training about computing technologies teaches the principles and diverse aspects of computer science, computer engineering, or computing technology, in order to improve ICT expertise. Training of other subjects via computing technologies uses computing technologies as a tool to increase training/learning effectiveness in various disciplines. In the former, both trainers and trainees need to be ICT specialists. On the other hand, the latter does not require trainees to have a degree in computing. It aims to help participants from all kinds of disciplines utilize ICT in their respective knowledge areas.

The short-term training course for teachers developed in this study belongs to the latter category. The goal

and content of the training course are set by considering the fact that teachers who participate in the training can have various subject specialisms as well as different ICT proficiency levels.

2.2 The need for ICT training for non-major teachers in developing countries

UNESCO adopted the Education 2030 Framework for Action in accordance with the education goal of the Sustainable Development Goals (SDGs), and the Qingdao Declaration in 2015 and in 2017, the first global declaration on ICT in education, outlined a roadmap to 2030 to achieve the ten targets of the education goal in SDGs [19][20]. The Qingdao Declaration recommends the use of ICT to foster access and equity in education and encourages sharing technology-supported innovations in education around the world. In particular, it stresses the paramount role that teachers have to play in harnessing the power of ICT in the classroom. UNESCO has created an international benchmark which sets out the competencies required to teach effectively with ICT, namely UNESCO's ICT Competency Framework for Teachers (see Figure 2) [21]. Used by countries around the world, the UNESCO ICT Competency Framework for Teachers highlights the role that technology can play in supporting six major education focus areas across three phases of knowledge acquisition, as illustrated in the Figure 2. UNESCO helps developing countries with ICT teachers, resources, and training programs to guide the use of ICT in teaching and learning.

|	TECHNOLOGY LITERACY	KNOWLEDGE DEEPENING	KNOWLEDGE CREATION
UNDERSTANDING ICT IN EDUCATION	Policy awareness	Policy understanding	Policy innovation
CURRICULUM AND ASSESSMENT	Basic knowledge	Knowledge application	Knowledge society skills
PEDAGOGY	Integrate technology	Complex problem solving	Self management
ICT	Basic tools	Complex tools	Pervasive tools
ORGANIZATION AND ADMINISTRATION	Standard classroom	Collaborative groups	Learning organizations
TEACHER PROFESSIONAL LEARNING	Digital literacy	Manage and guide	Teacher as model learner

Figure 2. UNESCO ICT Competency Framework for Teachers

The Republic of Korea has transformed from being an aid recipient to a donor in less than 50 years. It is presumed that educational developments are one of the driving forces behind such an unprecedented rapid growth. Many developing countries have paid attention to this and want to learn relevant experiences and know-how. In particular, they are interested in national and local programs for the use of ICT in education. Korean Education Offices and the Korea International Cooperation Agency (KOICA) are providing a variety of ICT teacher training programs to developing countries [17].

Given that ICT resources and infrastructure are very limited in developing nations, teachers from developing countries expect that ICT training programs for teachers enable trainees without profound ICT knowledge and skills to easily integrate ICT into their teaching domains. This work develops a short-term ICT training course for teachers of non-computing subject specialism in developing countries. The developed course allows teachers from non-computing disciplines to easily create flipped learning content in the specific subjects they teach, thus increasing teachers' self-efficacy related to ICT use. This work also performs a field study in which the developed course is applied to teachers in a developing country, Laotian middle and high school teachers.

2.3 ICT and teacher education in Laos

Laotian government promotes local innovation, utilization of science, technology and telecommunications, and management and application of ICT, as stated in the 8th National Socio-economic Development Plan (2016-2020). Unfortunately, Laos suffers a lack of ICT infrastructure and resources. In particular, there is a large gap between cities and rural areas. According to Lao Statistics Bureau (LSB)'s population and housing census (2015), 94.7% of city households have mobile phones, whereas 68.7% of households have mobile phones in rural areas. While 24.5% of city households own computers, the computer ownership rate decreases by over 5% in rural households. The Internet was first introduced in 1997 and the country still faces great barriers in internet access and use. Only 18.2% of the total population uses the internet as of 2015 in Laos [22].
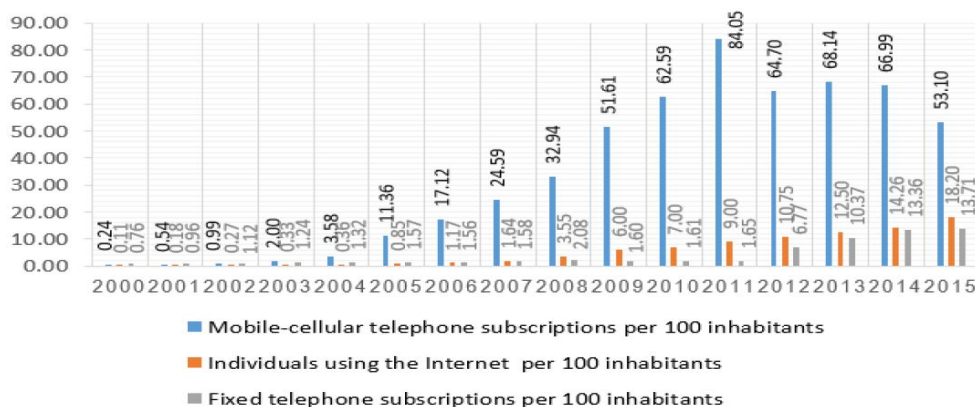
Figure 3. Telecommunication Subscription per 100 inhabitants in Laos

Laos' poor ICT infrastructure give rise to many challenges in the effective application of ICT-integrated education programs for teachers. A number of pilot projects have been carried out, but they often fail to consider the actual conditions of the learning environment, thus hindering teachers' sustainable ICT knowledge build-ups and progresses. It is also observed that there exists big discrepancy in individual teachers' ICT competency and experience. This leads to teachers' low self-efficacy in using ICT in their teaching and learning processes.

2.4 ICT teaching efficacy

Teaching efficacy refers to the beliefs that teachers hold about their instructional capabilities. Bandura (1977) defined self-efficacy as "people's beliefs about their capabilities to produce designated levels of performance [23]." Gibson and Dembo (1984) identified teaching efficacy as "the teacher's belief in his or her capability to organize and execute courses of action required to successfully accomplish a specific teaching task in a particular context [24]."

There are studies that examine teaching efficacy in association with specific disciplines. For example, mathematics teaching efficacy (Chung, 2001), science teaching efficacy (Kim, 2010), and music teaching efficacy (Lee & Kim, 2014) were studied [25][26][27].

Lee, S. (2017) examined how a TPACK-based teachers' training course that teaches an educational programming language influences teaching efficacy of informatics teachers in elementary schools, and defined 'informatics teaching efficacy' as the belief and expectancy that informatics teachers have about their instructional abilities and skills. In Laos, the term 'ICT' rather than 'informatics' is commonly used to refer to computing-related subjects taught in schools and educational institutions [28]. The ICT training course for

teachers of non-computing disciplines developed in this work employs the term ICT instead of informatics. This is to prevent confusion when measuring informatics (or ICT) teaching self-efficacy of Laotian teachers in the field study.

3. Development of short-term ICT training program for non-CS major teachers

3.1 Purpose and vision

Low ICT teaching efficacy of teachers due to poor ICT infrastructure and resources in developing countries could be a barrier to try ICT-integrated education in their classrooms. ICT training programs for teachers that do not consider such obstacles cannot give useful lessons to teachers of non-computing subject specialisms in developing countries. Therefore we developed a short-term ICT training course that enables teachers from non-computing fields to easily acquire flipped learning content creation skills. The proposed teacher education course has the following purposes.

First, it helps teachers gain basic ICT knowledge and skills required to understand ICT-integrated education. Second, it helps teachers gain positive teaching efficacy toward the use of ICT in their teaching irrespective of their subject specialism. In addition, it allows teachers to have a sense of accomplishment and confidence by giving opportunities to perform an ICT-based learning content creation project, from planning to implementation.

3.2 Criteria for contents design

The short-term ICT training course for teachers is designed using the following criteria based on theoretical background research. First, the contents of the training course should enable trainees to gain ICT-integrated education experiences. Second, the tools of the training course should be easy-to-use and freely accessible so that participating teachers can continue to use them after training. Avoid newly appeared or complicated tools. Third, the project assignments of the training course should attract interest of teachers from non-computing disciplines and motivate them to use ICT. Allow participating teachers to find the topics of the assignment in the subject they are teaching.

3.3 Design of the training program

Table 1 shows an overview of the developed ICT training course for non-major teachers of developing countries.

Table 1. The Contents of Short-term ICT Training Program

Session	Contents
1	Introduction of training course
	Team building and Ice breaking
2	What is Flipped Learning?
3	How to make a presentation with Powerpoint
4	Choosing Themes, Data collecting
5	How to make an computer simulation with Algodoo
6	Designing Flipped Learning contents
7	How to make a Flipped Learning movie clip with Ocam
8	Creating contents for Flipped Learning
9~10	How to upload videos to Youtube
	Sharing outcomes with other groups

It is a five-day program consisting of ten sessions, 3-hour morning and afternoon sessions per day. It has a balanced allocation of theoretical and practical sessions throughout the training period. Participating teachers can experience the planning, design, and implementation of flipped learning contents related to their teaching subjects. Session 9 and 10 that are allocated to conclude and share trainees' project assignments can have a flexible schedule. In terms of class tools, Microsoft's PowerPoint along with Algodoo and Ocam, which are freeware, is used. In case that Microsoft PowerPoint is not available, Libre Office and Google Docs are introduced as a replacement.

4. Experiments

4.1 Research hypothesis

The following hypothesis was set to investigate the influence of the developed short-term ICT training course on ICT teaching self-efficacy of teachers from non-computing disciplines in developing countries.

Research Hypothesis: The short-term ICT training course of flipped learning content creation gives a positive impact on ICT teaching self-efficacy of teachers from non-computing disciplines in developing countries.

4.2 Research objects

For the field study, volunteers who want to take the developed ICT training course were gathered from Laotian schools, and the training was conducted in Vientiane Secondary School. 32 teachers of 9 subject specialisms participated in the field study. Table 2 presents the details about the participants.

Table 2. The Number of Participants of the Study

Subjects	Number of participants	
	Male	Female
Civics	1	1
English	2	4
History	1	1
Lao language	0	1
Biology	1	2
Chemistry	2	3
Mathematics	4	3
Physics	3	1
ICT	0	2
total	14	18
	32	

4.3 The Design of Field Study

The field study was performed as part of the training program of Laotian teachers' ICT use jointly organized by the Ministry of Education of the Lao People's Democratic Republic and the Korea Education Frontier Association (KEFA). Laotian teachers of 9 different disciplines from diverse areas of the country took part in the field study in which the developed short-term training course of flipped learning content creation took place. In the field study, participating teachers were grouped by considering the subjects they are teaching. The training was performed over 5 days, from November 3 to November 10, 2017, for a total of

30 hours, 3 hours in the morning and 3 hours in the afternoon. A pretest regarding ICT teaching self-efficacy was performed at the orientation session before training, and a posttest along with a satisfaction survey was carried out right after the training is competed. ICT teachers, who specialize in teaching ICT-related subjects, are allowed to take part in the field study, but they were excluded in the result analysis.

The purpose of this field study is to examine whether or not the developed short-term ICT training course gives a positive impact on ICT teaching efficacy of teachers from non-computing disciplines in developing countries. The research design to achieve this purpose is shown in Table 3.

Table 3. The Design of Research

G1	O1	X1	O2, O3

G1 : Experimental group

O1 : Pre test (ICT Teaching Efficacy)

X1 : Short-term ICT Training Program for Creating Flipped Learning Contents

O2, O3 : Post tests (ICT Teaching Efficacy, Satisfaction)

4.4 Testing Instruments

Lee. S. (2017) created a questionnaire for informatics teaching efficacy measurement by modifying the existing questionnaire for science teaching self-efficacy measurement [28][29][30]. In the field study, the questionnaire for informatics teaching efficacy measurement was adopted to measure ICT teaching efficacy. The term 'informatics' in the questionnaire is replaced with 'ICT' or 'ICT training.' Because the term 'ICT' rather than 'informatics' is commonly used to refer to computing-related subjects taught in schools and educational institutions in Laos. The questionnaire consists of 21 question items, each of which uses a 5-point Likert scale. The questionnaire is composed of two subsections: 'personal efficacy' and 'outcome expectancy.' Table 4 shows the definition of the subsections in the questionnaire and the number of question items in each sub-factor.

Table 4. The Sub-factors and Definitions of the ICT Teaching Efficacy Test [27]

Sub-factors	Definitions	Questions
Personal Efficacy	Teacher's personal judgment about ICT teaching ability	11
Outcome Expectancy	Teacher's positive beliefs about the relevance between teaching and learning outcomes	10

The reliability coefficient of each subsection in the informatics teaching self-efficacy questionnaire was measured in So-Yul Lee's work (2017). The coefficient alpha (Cronbach's α) of the questions in the personal efficacy subsection was 0.914 and that of the questions in the outcome expectancy subsection was 0.859, both of which are highly reliable [28]. In the field study, the reliability coefficient of the questionnaire for ICT teaching self-efficacy measurement was measured with the responses of 32 Laotian teachers. Cronbach α was 0.901, indicating that the questionnaire is highly reliable.

For the questionnaire of trainee satisfaction survey, 9 multiple choice questions with a 7-point Likert scale and 1 short answer question were newly devised.

A comparison of differences in the mean values between pre and post-test was analyzed via two-dependent samples t-test. The statistical software used in result analysis was IBM SPSS Statistics 22.

5. Results and Discussion

5.1 Results of the ICT teaching efficacy

The paired sample t-test (p < .05) of the ICT teaching self-efficacy scores that were measured in the pretest and posttest is presented in Table 5.

Table 5. The Results of the ICT Teaching Efficacy

Subareas	test	N	M	SD	t	p
Personal Efficacy	pre	30	3.13	.259	-6.189	.000**
	post	30	3.51	.304		
Outcome Expectancy	pre	30	3.60	.362	-2.207	.035*
	post	30	3.79	.297		
Total (ICT Teaching Efficacy)	pre	30	3.37	.227	-4.793	.000**
	post	30	3.65	.225		

The overall ICT teaching self-efficacy scores of the Laotian teachers who participated in the field study were low (below 4 points) in both pretest and posttest. However, statistically significant increases in ICT teaching efficacy were observed in both personal efficacy and outcome expectancy subsections.

It can be interpreted that the overall ICT teaching efficacy score was low because the participants were from non-ICT disciplines. Nevertheless, the developed training course that allows teachers of non-ICT subject specialism to create flipped learning contents related to their respective subject gave a positive impact on ICT teaching efficacy - both personal efficacy and outcome expectancy. In particular, increases in personal efficacy were very big (p < .01), which indicates that individual teachers largely gained ICT teaching efficacy through the developed ICT training course.

5.2 Results of satisfaction survey

Table 6 and 7 show the results of the trainee satisfaction survey. 28 teachers took part in the satisfaction survey of the developed ICT training course for teachers.

Table 6. The Results of the satisfaction survey (selective form)

No.	Question	Number of response (N=28) Positive →							M
		1	2	3	4	5	6	7	
1	Are you satisfied with the ICT contents training program?					1	9	18	6.61
2	Do you agree that it was easy to follow the training instructions?				5	2	8	13	6.04
3	Was our training duration sufficient to meet you expectations?			1	4	5	10	8	5.71
4	Do you think that the teachers have got enough knowledge and skill?				2	3	3	20	6.46
5	Was the training program organized in an effective manner?					4	9	15	6.39
6	Do you think you can use ICT applications and contents for your teaching?				2	4	7	15	6.25
7	Do you think that the training materials were helpful for your better understanding of ICT education?					5	7	16	6.39
8	Did you get any good idea or concept from this training program					4	7	17	6.46

	that may be easily applied to your teaching in school?				
9	Would you like to participate in the in-depth training program focusing on digital educational contents design and development in the future?	2	8	18	6.57

Table 7. The Result of the satisfaction survey (subjective form)

No.	Responses
1	I would like to take this kind of training every year. This is because the training includes many programs that can be used in education.
2	I will do a lot of practice on ICT from now on. And I will remember and utilize what I learned in this training.
3	It was good to be able to learn the contents which can be used in the class. I would like to have more of this kind of training in the future.
4	I want to receive training every year. I am thankful to the professor and the teacher who taught me in the training.
5	If possible, I hope there will be more opportunities for such training. It is very useful for teaching at school.
6	I am very grateful to be with you this year. I have learned a lot from this training and will use what I have learned in the subjects I teach.
7	I hope to have such a good training every year.
8	In the future, I think that I can use this ICT much in the mathematics curriculum that I teach. I learned a lot from this training, and I hope I have such opportunities in the future.
9	I can learn many things that I can use in class in this training, so I want to learn more.
10	The training was very good and I would like to participate if I have a training to make games in the future.
11	This training program was very good to me and very useful. The instructor, who is in charge of the training, delivered it to the trainees with a lot of knowledge and skills. If you have a chance, I would like to visit a Korean school or a model school using ICT.
12	I am very grateful for participating in this ICT training. I would like to receive this training several times in the future, and I think other teachers will think the same if given opportunity.
13	I would like to participate if this kind of training opportunity is given in Korea.
14	I think this training program is a very good program for this school and its teachers in Laos. Especially, it was good that we were able to make the training results by utilizing what we teach to students. I am very grateful to the instructors from Korea.
15	I am grateful to learn a lot of knowledge related to ICT through the lecturers from Korea.
16	I would like to participate again if I have the opportunity to do the training next time. I was sorry that the training period was short.
17	I would like to have this training about 2-3 times a year. I would also like to participate if I have the opportunity to go to Korea for training.
18	If I study in the same group for the next opportunity, I would know more.
19	I learned a lot through this training. And I think there are many ideas that I can teach students better. I would like to attend the next opportunity.
20	If I have a chance next time, I want to receive training again.
21	I would like to visit the ICT model school in Korea.
22	I was very happy to be part of this training, and I wish I could have the chance to attend the next opportunity too. Thank you.
23	Next time I would like to participate again and have a chance to have a training program in Korea.
24	I hope this training continues.

The satisfaction scores of the survey questions other than the question about the course duration were in 5.71-6.61 range. The average satisfaction score was 6.32. Some of the short answer question responses were "I can start to use the ICT skills taught in the course in my classroom," and "I expect that there will be the follow-up courses." Such responses imply that the participating teachers had a high level of satisfaction toward the ICT training course and gained confidence in using ICT in their teaching

5.3 The Outcomes of training program

Figure 4 and 5 show examples of the project outcomes submitted by the teachers who completed the short-term ICT training course.
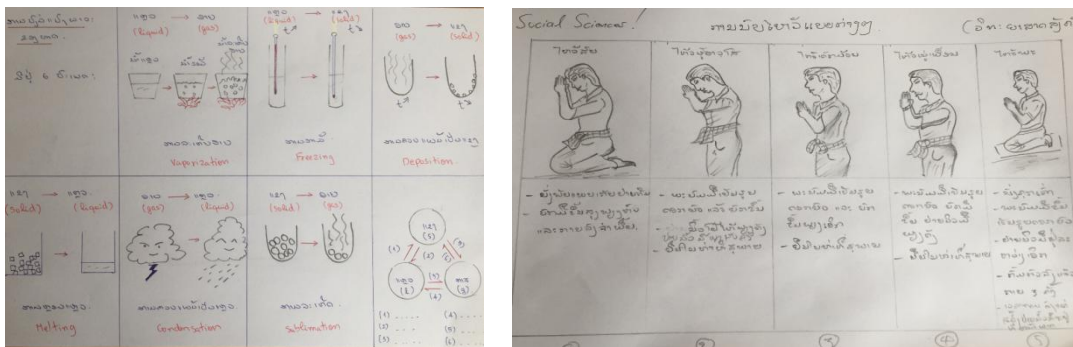

Figure 4. Storyboard design examples of participants

The Laotian teachers taking the developed ICT training course actively participated in classroom. They took notes during class, asked questions, and voluntarily make time to do assignments instead of immediately leaving after class. The majority of the participants was enthusiastic about using ICT in their teaching and showed a great interest in creating storyboards and video-based learning content. They showed a positive, proactive attitude towards learning and took the initiative to improve their ICT skills, e.g., making in-depth enquiries and doing revision at home.
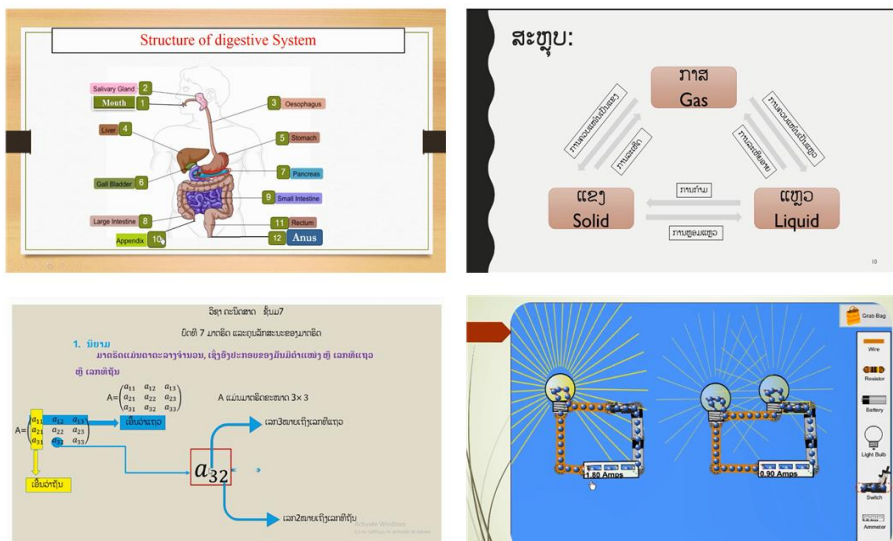

Figure 5. Flipped-learning video screen shots

Figure 6. Scenes of training program

6. Conclusions

This work developed a short-term ICT training course that enables teachers of non-computing subject specialisms to easily create flipped-learning content, and performed a field study by applying it to secondary school teachers in Laos. In the field study, ICT teaching efficacy and satisfaction of the participating teachers were measured and analyzed to propose an enhanced ICT training model for teachers in other developing countries. The teacher training course of flipped-learning content creation was designed to take into account the difference in teachers' subject specialism and ICT proficiency. The developed course allowed teachers to gain a sense of achievement and confidence by giving them opportunities of personally planning and producing education contents related to the specific subjects they teach. This led to improved ICT teaching self-efficacy of teachers from non-computing disciplines.

In terms of class tools, easy-to-use and freely accessible tools were chosen so that training participants can continue to use them in their respective fields after the course is completed. In terms of teaching methods, a combination of theories and practices was employed along with collaborative group activities that give trainees hands-on experience with ICT skills.

Previously made flipped-learning contents provided in the course allowed trainees to understand education paradigms and features in flipped learning. Trainees could determine the features that can be used in creating their own learning content and deepen their understanding through an actual creation of flipped learning content. This helped teachers of non-ICT subject specialism to overcome fear and apprehension towards ICT. For instance, there were many field study participants who were relatively old. They showed difficulties in adapting to ICT-based teaching techniques at the beginning of the training, but step-by-step practices and project works throughout the course eventually enabled them to create education contents that are based on their own teaching experiences and philosophy.

The ICT teaching efficacy scores measured before and after training showed statistically significant increases in teachers' self-efficacy related to ICT use, both personal efficacy and outcome expectancy. The

satisfaction survey performed after training showed that trainees were highly satisfied with the training course. The developed training course can give teachers, who are enthusiastic about enhancing the quality of teaching, the opportunity to encounter innovative international education paradigms and ICT authoring tools to implement technology in the classroom. Hence, it can play an important role to bring about the change in the Laotian education practice.

In an effort to provide equitable access to ICT enabled education worldwide, a global network of expertise and knowledge-sharing on ICT in education is formed, creating various ICT training resources for teachers in developing countries. Such teacher education programs should consider teachers' ICT proficiency and specialty in order to achieve the intended goals, i.e., enabling teachers to have confidence in using ICT in their teaching and to extend their use further in the future. We hope that the teacher training course developed in this work would serve as a basis for developing ICT training programs targeting teachers in developing countries.

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