Improving Teachers' Qualifications for Preparing ICT Based Educational Materials

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ABSTRACT

The preparation of ICT-Based materials is an integral part of teachers' daily learning and teaching processes. The aim of the study is to work with in-service teachers and a) determine their needs pertaining to ICT use, b) develop an in-service training program for improving their skills in terms of preparing ICT-based educational material c) to implement this program and d) to examine any improvement of teacher skills in this regard. The study has been conducted as action research and was carried out with a study group of 16 teachers. Findings obtained in the study revealed that teachers' scores on the TPACK-deep scale increased significantly compared to the pre-study. It was also shown that the in-service training activity that was carried out increased the knowledge and skills of teachers about current technologies that can be used in the learning-teaching process, as well as increasing their self-confidence and self-efficacy for developing ICT-based educational material. As they adopted the use of ICT-based educational materials prepared within the scope of in-service training during school courses, teachers have also been shown to report that students' interest, desire to participate, curiosity and excitement and motivation towards the lesson had increased. On the other hand, teachers who teach lessons with ICT-based educational materials stated that they felt their selves more useful in lessons, their performance increased, and that such materials facilitated the teaching in crowded classrooms.

Keywords: *Preparing ICT-based educational material, in-service training, teacher, action research*

INTRODUCTION

Rapid development and changes in information and communication technologies (ICT) shape the teaching and learning processes and methods. In order to increase the success and motivation of using ICTs properly and correctly in the process of education, it is frequently mentioned in the researches of the literature that it has many benefits such as increase student success and motivation (Katrancı & Uygun, 2013; Kunter et al., 2013) positive contribution to learning (Ghavifekr et al., 2014; Hicks, Lee, Berson, Bolick, & Diem, 2014; Katrancı & Uygun, 2013) developing high-level thinking skills and supporting the structuring of knowledge (McMahon, 2009) and class management (Opfer & Pedder, 2011). The use of ICTs in the education process has a key role in improving the quality of the school and the success of the learner and in creating new learning opportunities for the learner (Castillo, Fernández-Berrocal, & Brackett, 2013; Ertmer &

Ottenbreit-Leftwich, 2010; Jamieson-Proctor, Finger & Albion, 2010). In order to benefit from the opportunities offered by ICTs, which are in continuous development and change, there is a need for well-equipped teachers with lifelong learning ability (Kabakci, Odabasi, & Kilicer, 2010).

The necessity of teachers to use current technologies effectively, which was specified by the Ministry of Education in 2013 in Turkey (MoNE), have also been expressed in the teacher qualifications. Similarly, it is stated that teachers should use information and communication technologies effectively in the process of learning and teaching process of teacher competencies certificate which is updated as general field competencies in 2017. On the other hand, within the scope of Turkey's 2023 educational vision, leading teachers, who have a culture of effective use and development of digital content, are raised; this culture is intended to spread in schools and in-service trainings are planned for teachers who are on duty to gain these skills (MoNE, 2019).

In this context, it is necessary for teachers to be able to adapt to the ever-changing and developing ICTs and to have in-service training within their professional lives in order to be able to use these technologies effectively (Balta, 2014). Teachers with in-service training activities; may be aware of new teaching methods and techniques gain knowledge, skills, behavior and positive attitudes specific to the field (Desimone, 2009; Koh, Chai, & Lim, 2017;) and integrate new knowledge and skills into the teaching-learning process. On the other hand, it is frequently mentioned in the literature that in-service training contributes to the development of teachers' self-confidence and helps them to communicate with individuals in the school and society (Gültekin & Çubukçu, 2008) where it improves teacher quality and contributes positively to the quality of all stakeholders in the school (Opfer & Pedder, 2011).

THEORETICAL BACKGROUND

Teachers' Professional Development

In order to eliminate the deficiencies of the teachers regarding both technological and content knowledge or to increase their competencies, in-service training activities with many distance education activities, various congresses, seminars and workshops are carried out in Turkey organized by both MoNE and various institutions and organizations (Balta 2014; MoNE, 2018; Sarıtepeci, Durak, & Seferoğlu, 2017). One of these activities is some of the important in-service practices organized by the Intel Teachers Program and Innovative Teachers programs (MoNE, 2018) and aimed at ensuring that information technology tools can be used more effectively and efficiently in educational activities. Within the scope of the training activities of Movement of Enhancing Opportunities and Improving Technology (FATİH) project, the trainings of hardware and various applications are dominant elements (Sarıtepeci et al., 2016). In spite of all these educational activities, teachers state that these in-service trainings for the use of ICTs in education processes include the following shortcomings such as lack of training time (Cimer, Çakır & Çimer, 2010), not being effective in terms of durability and lack of qualified trainers (Balta, 2014; Usluel, Kalaycı, Bilgiç, & Uslu, 2011; Yıldız, Sarıtepeci, & Seferoğlu, 2013; Sarıtepeci et al., 2016) and it is emphasized that there is a need for various studies to ensure that teachers become technology literate (Sarıtepeci et al., 2016; Yıldız et al., 2013). Indeed, the researches suggest that in-service training activities should not be directed towards the use of new technological tools included in the learning environment, but rather it is stated how these technologies should be used in the courses (Attewell, Savill-Smith, & Douch, 2009).

Teacher Practices with ICTs

A lot of research has been carried out to determine the ICT practices that teachers use in the education process as well as the educational activities they perform with these practices. In this context, it is observed that a large part of the research carried out is the studies to reveal the current situation (Badri, Alnuaimi, Mohaidat, Yang, & Al Rashedi, 2016; Guma, Faruque, & Khushi, 2013; Yamamoto & Yamaguchi, 2016) and structural equation modeling (Alt, 2018; Scherer, Siddiq, & Tondeur, 2019). In these studies, it is frequently mentioned that teachers who are educated about using ICTs in before service training and in-service trainings mostly use these technologies for their administrative or individual works in the school, whereas they do not transfer these technologies adequately to education-teaching processes (Mama & Hennessy, 2013; Mumcu

& Usluel, 2010). Low self-efficacy and motivation, negative attitude and low technology literacy level are shown as the most important reasons why teachers cannot transfer ICTs to education processes (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Koehler & Mishra, 2009; Mumcu & Usluel, 2010; Player-Koro 2012; Scherer, Tondeur, Siddiq, & Baran, 2018).

In order to use ICTs more effectively in the education process, few studies have been conducted which include professional development or in-service training activities carried out by teachers and academicians. Besides revealing the current situation in these studies, it is also possible to see the studies referring to semi-experimental and experimental (Al Salami, Makela, & de Miranda, 2017; Gröschner, Schindler, Holzberger, Alles, & Seidel, 2018; Jimenez & O'Shanahan, 2016; Shevchenko & Kryzhanovskyi, 2018) or design-based researches (Brown, 2017; Wang, Hsu, Reeves, & Coster, 2014) in order to overcome possible problems and obstacles.

Aim of the Study

Despite all these training activities aimed at enhancing the professional development of teachers, it is frequently mentioned in the literature that much more and more in-service training is needed (Balta, Aslan, & Duru, 2015; Desimone, 2009; Koh et al., 2017; Sarıtepeci et al., 2016). In line with this in-service training, which is indicated in the work of international and national literature, the MoNE plans to organize 436 in-service training activities in 2018 and it has been decided to provide various vocational development trainings to approximately 73.000 teachers through these activities (MoNE, 2018). In spite of increasing in-service training activities to support the professional development of the MoNE, the fact that only 73.000 (14.1%) of the 1.030.130 teachers serving in 2018 had a lower than the average of teachers (88.0%) (OECD, 2014) participating in the TALIS survey in 2013 and stating that at least one professional development program has taken place in the last 12 months, there is a need for many in-service activities that need to be carried out. On the other hand, in many in-service training activities carried out by both the MoNE and its affiliated institutions, as well as private sector representatives and academicians, technological tools and applications were mostly introduced to teachers and a few activities were carried out on how to develop an educational material using these technologies (Atman Uslu, 2013; Mumcu, 2011; Mumcu & Usluel, 2010) and these activities were limited to the samples of the applications. On the other hand, it is frequently mentioned in the literature researches that in order to be able to use ICTs more effectively in education process and in the elimination of obstacles arising from the teacher, there is a need for in-service training which includes features such as informing new teaching methods, gaining knowledge and skills in professional sense, developing self-confidence and developing positive attitude (Al Salami et al., 2017; Atman Uslu, 2013; Gröschner et al., 2018; Koh et al., 2017; Mumcu, 2011; Tondeur et al., 2012; Shevchenko & Kryzhanovskyi, 2018). The main aim of the research carried out in this context is to determine the needs of teachers for the use of information and communication technologies in preparing the ICT-based educational material which is a part of the learning and teaching process. Within the framework of identified needs, it is preparing in-service training program for preparing ICT-based educational material, implementing this program and the development of teachers in this process. For this general purpose, the answered to the following research questions were sought:

- What are the competencies of teachers in terms of preparing educational material?
- What are the competencies of teachers' using ICT in education?
- Is there a significant difference between the average scores for each of the TPACK competences sub-dimensions before and after teachers' in-service training activity?
- TPACK competency score averages before and after teachers' in-service training activity;
    - Does it differ according to the gender variable?
    - Does it differ according to the variable of the seniority?
    - Does it differ according to the variable of the education level?

RESEARCH METHOD

Research Design

The study has been conducted by using an action research design which is one of the qualitative research methods. Action research is the process of systematic data collection by teachers or other stakeholders in the teaching / learning environment to demonstrate and improve how the education works, how learning occurs and how learners can learn better (Mills, 2011). This process in the action research begins by determining the problem state and then consists of the following stages respectively: Data collection, doing data analysis, determining the action plan, implementing the action plan, assessing the effectiveness of decision-making and implementation of an alternative action plan (Yıldırım & Şimşek, 2018).

Study Environment

This action research was carried out at a state high school in Edirne Province. In the high school where the study was conducted, a total of 40 teachers are working in 14 different branches, 24 of them are female and 16 of them are male. In the selection of the application school, the presence of the school's 3D Technology Laboratory, Computer Assisted Language Laboratory and Maker Laboratory was effective. Educational activities were carried out in Computer Assisted Language Laboratory.

Participants

The participants of the study were determined by criterion sampling from purposive sampling methods. Purposive sampling is a suitable method for identifying the problems that may arise in the study of a new situation and for investigating the situations that have rich knowledge (Yıldırım & Şimşek, 2018). In the purposive sampling, the researcher determines the participants who have the most appropriate and desired characteristics for research purposes according to his/her own judgement (Balcı, 2015). In the study, it was tried to be formed as equal as possible with the participants (in-service teachers) on the basis of gender. On the other hand, it is aimed that the teacher from all branches would participate in the research. In this context, 16 teachers who met the determined criteria formed the research sample.

At the beginning of the application process, in order to be able to identify the participants better, and to determine the computer and Internet usage situations that may be considered as the effects of the research, the participants were asked to fill in the "Personal Information Form" prepared by the researcher. Demographic data of the study group from which the research data are obtained are presented in Table 1.

Table 1. Teacher Demographics

Gender	**n**	**(%)**
Woman	7	44.0
Man	9	56.0

Age	**n**	**(%)**
30-39	4	25.0
40-49	7	44.0
50-59	5	31.0

Highest Educational Level Attained	**n**	**(%)**
Formation	3	19.0
Bachelor Degree	9	56.0
> Bachelor Degree	4	25.0

Work Experience	**n**	**(%)**
6-15 years	3	19.0
16-20 years	7	44.0
21 years or more	6	37.0

Subject Matter Expertise	**n**	**(%)**
Turkish Language and Literature	3	19.0
English	3	19.0
Mathematics	2	13.0
Chemistry	1	6.0
Guidance and Counseling	1	6.0
Religious Culture and Morals	1	6.0
Physical Education	1	6.0
Philosophy	1	6.0
Visual Arts	1	6.0
History	1	6.0
Biology	1	6.0

Developing the In-Service Training Program

In the process of developing in-service training program; the following criteria were taken into account, combination of theory and practice as well as instructor's being a model for the teacher (Tondeur et al., 2012), working on concrete examples that can be linked to teaching practices (Usluel et al., 2011), cooperation between teachers (Polly & Hannafin, 2010) and reflecting attitudes about the role of technology in education (Doherty, 2011; Tondeur et al., 2012). In-service training program was carried out with ADDIE instructional design model. The process of developing the in-service training activity program for preparing ICT-based educational material has been presented in Figure 1.

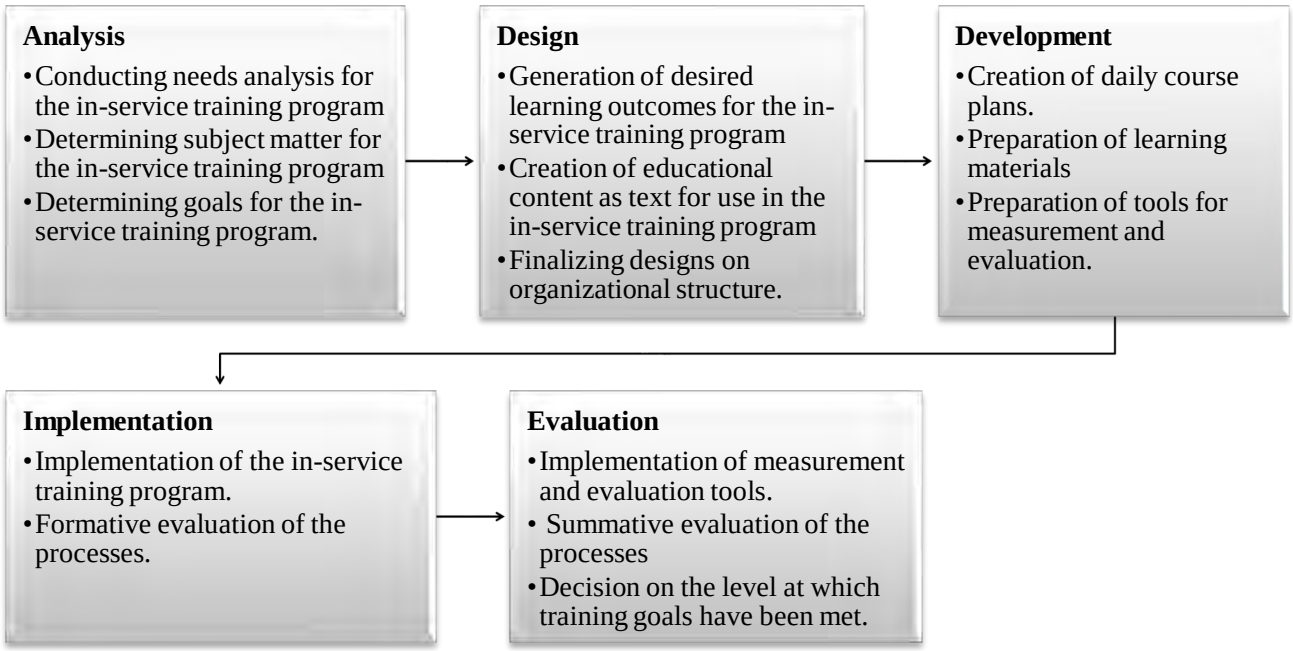

Figure 1. Diagram Detailing the Instructional Design Process for The In-Service Training

Needs Analysis

In order to determine the area to be focused in the research, a questionnaire which was developed with the support of field experts within the scope of the literature on the recognition and usefulness of the applications and software that can be used to prepare the ICT-based educational material for 156 teachers working in different branches in five schools including the high school where the research was conducted. (α =.79). While the findings obtained from the survey revealed that nearly almost all teachers (89.1%) did not prepare ICT-based educational material before, the majority of teachers (78.3%) did not know about the applications and software that could be used to prepare these materials. Prior to the action research, teachers' perceptions of using ICT in education were also tried to be measured by Şad & Nalçacı (2015) with the Information and Communication Technologies (ICT) Perceptions of Proficiency Scale for Teachers (α =. 89) which include ability "*to prepare materials such as lecture notes, presentations, worksheets*" and "*regulate the learning environment by taking into consideration the principles of use of information and communication technologies*". The findings presented in Table 2 reveal that a significant majority of teachers (49.4%) consider themselves to be "Partially Qualified".

Table 2. Teachers' Perceived Levels of Self-Efficacy in Using IT in Education

		Quite Inept	Inept	Partially Adept	Adept	Quite Adept	Total
Perceived level of self-efficacy in IT use	**f**	6	33	77	30	10	156
	%	3.8	21.2	49.4	19.2	6.4	100

Design and Development

A training content has been designed, in the light of the findings obtained in the design process, the indicators of training discussed in the previous stages and the needs analysis with the teachers. In the study, objectives were expressed in terms of acquisition and lesson plans, in-service teacher guidebook, prepared and how to create appropriate learning environments to organize learning environments to achieve these achievements. It has also been ensured that the instructional content is dealt with a procedure that conforms to design, exertion, ethics and proficiency, which are sub-dimensions of TPACK competency. In Table 3, the content of the in-service training activity for preparing ICT-based educational material has been summarized.

Table 3. Weekly Schedule for the In-Service Training Program

Week	Content	Method	Time	Homework	Support Materials
1st Week	Preparation of a course plan with IT integration	Lecturing and discussion	90 min.	Preparation of a course plan with IT integration	Youtube Channel Facebook Group
	Techniques for giving effective presentations, getting acquainted with computer presentation software to prepare effective presentation documents	Demonstration and practice	120 min.	Improving upon the presenation material for a given course	
2nd Week	Introduction to image editing tools and image manipulation.	Demonstration and practice	150 min.	Preparation of an image as educational material for a given course	
3rd Week	Introduction to audio editing tools and audio manipulation.	Demonstration and practice	150 min.	Preparation of an educational course as an audio recording	
4th Week	Introduction to educational video editing tools and creation of educational video material	Demonstration and practice	150 min.	Preparation of an educational video	
5th Week	Introduction to concept map creation tools in the Web 2.0 fashion, creation of concept maps	Demonstration and practice	150 min.	Preparation of a concept map	
6th Week	Introduction to infographic creation tools in the Web 2.0 fashion, creation of infographics	Demonstration and practice	150 min.	Preparation of an infographic	
7th Week	Introduction to measurement and evaluation tools in the Web 2.0 fashion. Creation of a multiple choice test	Demonstration and practice	150 min.	Preparation of a multiple-choice exam	
8th Week	Overview		90 min.		

*Youtube Channel: https://www.youtube.com/channel/UCe5KQ8Q_S792rtZjl00X6Cw
**Facebook Group: https://www.facebook.com/groups/232602790608009/

Formative Evaluation: During application phase, a 1-week pilot application was carried out with 4 teachers with similar characteristics. At the end of the pilot application, improvements and corrections deemed necessary or according to the demands expressed by teachers were made.

Summative Evaluation: In the evaluation stage, which is the last stage of the model, the product-oriented assessment has been realized. The developed contents were presented to the field experts and the monitoring committee and then the necessary changes were made in accordance with the relevant recommendations.

Data Collection Tool and Process

In the collection of quantitative data, TPACK-deep scale and personal information form were used.

TPACK-deep Scale: In the study, as a quantitative data collection tool, TPACK-deep scale made of four factors, consisting of 33 items, was developed by Kabakçı Yurdakul et al. (2012). Cronbach Alpha reliability coefficient of the scale was determined as α =.96. Cronbach Alpha reliability coefficients of Design, Exertion, Ethics and Proficiency dimensions with scale sub-dimensions were determined αs between α=85 and α=.92 (Kabakçı Yurdakul et al., 2012). Scale has the following items such as "*leading the dissemination of current technologies that will contribute to my field in the teaching process of the scale, ethical behavior when using technology for pedagogical purposes*", "*using technology to measure success in a specialized subject*", "*using technology to design materials that are compatible with the elements necessary for effective teaching*".

Personal Information Form: In the personal information form prepared by the researcher, there are a number of questions prepared to obtain some demographic information such as gender, education level, seniority year and branch.

In evaluating the effectiveness of in-service training for preparing ICT-based educational material, due to the limited number of in-service teachers (N = 16) there was no control group in this study, one group pre-test and post-test experimental design was therefore employed. The dependent variable of the study is TPCK competence, the independent variables are gender, education level and seniority. In Table 4, information on the groups and transactions included in the research pattern is presented.

Table 4. Research Design – Quantitative Data

Pretest	Intervention	Posttest
TPACK-deep Scale	In-Service Training for Preparing ICT-Based Educational Materials	TPACK-deep Scale

In the study, quantitative data collection tools were applied at the beginning of the in-service training activity. At the end of 20 hours of training, the same measurement tool applied again and the collected data were separated into pre-post tests and the data analysis phase was started.

The researcher carried out the application by himself/herself, free from his/her own prejudices and personal assumptions, he also used his own perception and interpretations as data through reflective diaries. One of the data collection tools used in the research during the eight-week implementation period is the reflections of activity. The researcher used reflections on the activities at the end of each course as data. Another data collection tool is video recordings. Video recording was used to give a general information about the verbal and non-verbal behaviors and the attitudes and attitudes of the in-service teachers in the course (Johnson, 2012). These video recordings are recorded on the computer by writing the date of each course.

Another qualitative data collection tool used in research was semi-structured interviews. The semi-structured interview form was developed by the researcher by scanning the literature to demonstrate the purpose and scope of the research The opinions of three academicians were consulted to ensure the scope validity of the interview form. In line with suggestions from field experts academics, the form was rearranged and finalized. In order to test the comprehensibility and applicability of the questions, adhering to the principle of voluntariness, a pilot study was conducted with two teachers and no problems were encountered in this process. Through the form finalized according to expert opinions, semi-structured interviews were

conducted with each teacher. Before the interviews were made, permission was obtained from each teacher with the interview confirmation form. The interviews were conducted with each teacher in the library and laboratory of the school and recorded with a voice recorder. During the interview, the researcher avoided directives that could affect the perspectives of the in-service teachers. In determining the in-service teachers, by purposive sampling, research data and expert review and approval for their findings, using the research process and findings, such as detailed description of the research report; the credibility, transferability, consistency and confirmability of the research were tried to be provided. During the implementation process and in semi-structured interviews, avoiding any directive that could affect the views of the in-service teachers, the research and data collection process was realized in a natural and objective manner.

Action Cycle of Research

The researcher followed a cyclical process by collecting information about the problem, conducting a source scan, developing actions to solve this problem, and improving some of the steps at different times. In this context, in the realization of the objectives, the action research cycle determined by Mills (2011) was followed by defining the focus area, collecting data, analyzing and interpreting the data and developing an action plan in the study.

Developing an Action Plan: The researcher reflective logs held after the application every week and his findings from video recordings submitted to the validity committee consisting of 2 field experts. In line with the opinions of the experts, activity topics were reviewed and action plans were prepared every week. Experts played a facilitating role for the teacher in model implementation in terms of theoretical knowledge sharing with the researcher, sharing the correct course of the course, in terms of discussing the wrong directions. Researcher shaped the next week's action plan with the views he received from the experts during the whole process and the views he got from the student reflections (Figure 2).

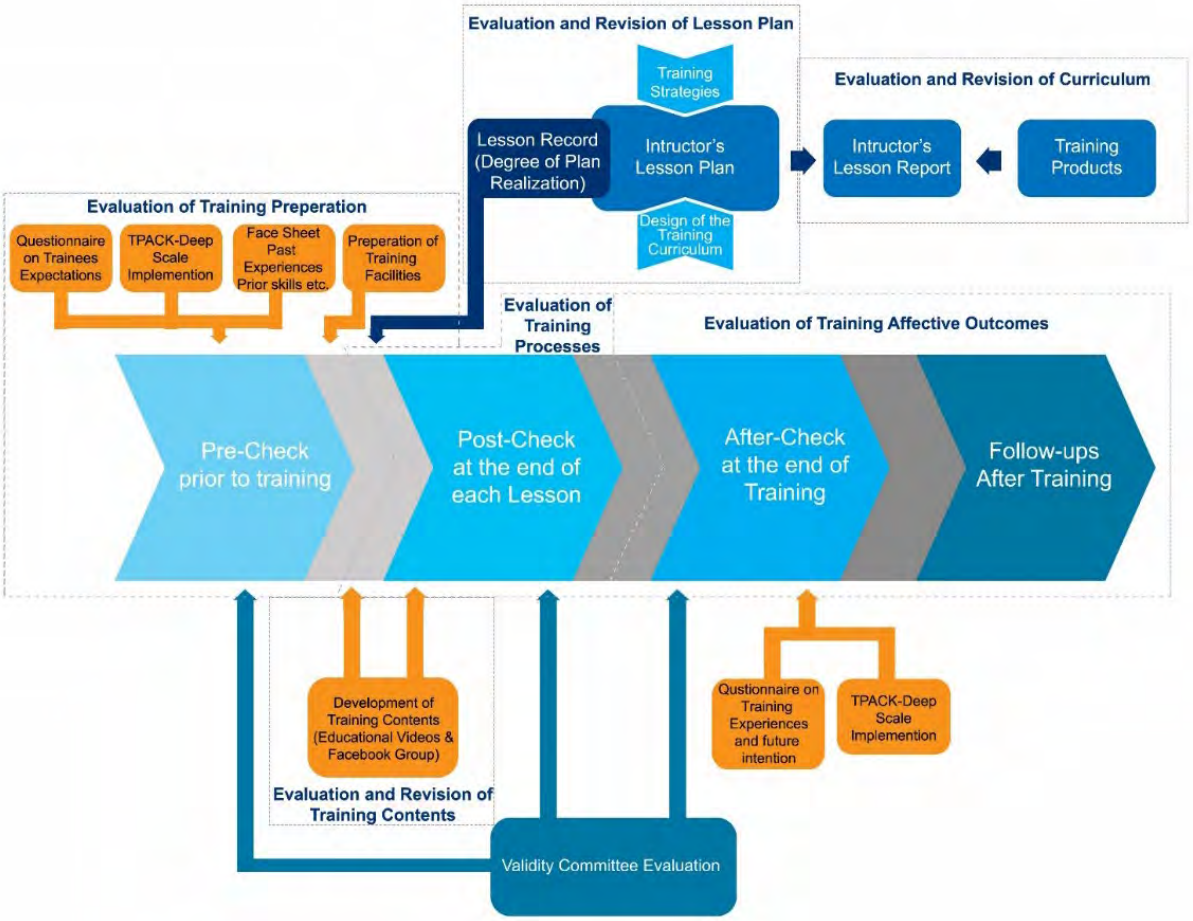

Figure 2. In-service Training Program Activity

Data Analysis

The research was carried out face to face; firstly, the teachers were informed about the research topic and the data collection tool before research and the approvals of in-service teachers in the research were taken in writing. The scale was answered in approximately 12 minutes. The accuracy of the data input and the appropriateness of the distribution of the variables to the normality were tested before the quantitative data analysis and Shapiro-Wilk test result (p =. 453) was found to be p> .05 for variables. In the analysis of data collected before and after in-service training for technopedagogical education, accompanied by arithmetic mean and standard deviation values a series of analysis was performed. The t-test has been used for the paired groups to address changes in design, exertion, ethics and proficiency competencies with TPACK competency sub-dimensions during pre-test and post-test. In the following process, TPACK competence scores were analyzed individually, and there was a significant difference between TPACK competence scores and pretest-posttest averages according to in-service teachers' gender, education levels and seniority years with the t-test, independent groups t-test and one-way analysis of variance (ANOVA). Level of significance in comparisonswas determined as 05.

In the analysis of the qualitative data, the opinions of the teachers about the in-service training were taken by the semi-structured interview form and the data obtained were subjected to content analysis. The purpose of content analysis is the definition of the data, creating the themes by encoding the data, identification of findings and interpretation of the results by performing the interpretation (Yıldırım & Şimşek, 2018). For the internal reliability of the study, two researchers independently coded data separately and then these codes were compared (Creswell, 2013). In order too determine the level of inter-coding compatibility of the encoders on the same data set, Cohen's Kappa analysis was used. As a result of the analysis performed, the Kappa valuewas determined as .87. This value indicates that the reliability of the developed coding list is very good (Wood, 2007). Detailed explanations about the steps taken in the research process in order to enable transferabilityand purposive sampling were used. In this sense, in this study, research model, study group, data collection tool, data analysis, findings and results are presented in detail (Miles & Huberman, 1994). In relation to external reliability, confirmability, research process has presented in detail, the researcher avoided directing the teachers during the interviews and negatively affecting the data collection process of the research and research documents have been kept by the researcher (Yıldırım & Şimşek, 2018).

FINDINGS

In this section, variables such as gender, education level, seniority year of teachers' changes in TPACK competence before and after in-service training are discussed. In this chapter, in addition, content analysis findings of teachers' opinions about in-service training were shared.

Effect of In-service Training on TPACK Competence and Sub-dimensions

Table 5 shows that there is a significant difference between TPACK-deep scale of the teachers after in-service training and with the means obtained from all sub-dimensions and the pre-education averages ($t_{(15)}$=5.92, p<.05, η^2=.60, d=1.48). Average score after training ($\bar{X}$=123.56) was higher than the average score before ($\bar{X}$=97.50) training. This finding is statistically significant for the differences in the TPACK competency levels of teachers before and after the training and indicates that the education process is effective. The calculated η^2value is .60. According to this, it can be said that 60% of the variance observed in TPACK-deep scale scores is related to educational activity.

The differences in the design dimension of TPACK-deep scale sub-dimensions of teachers have been found to be significant ($t_{(15)}$=5.67, p<.05, d=1.41). This finding shows that teachers' competencies related to design have increased statistically significantly according to the beginning of education. Calculated effect size value related to this qualification has been determined as (η^2=.58). According to this, it can be said that 58% of the variance observed in the design dimension scores of the TPACK-deep scale sub-dimensions is related to the educational effectiveness.

Table 5 shows that when another sub-dimension of TPACK competency in the exertion dimension was 35.00 before the training increased to 45.50 after the training, the difference is meaningful and on the other hand the effect size values were examined and there was an effect of educational activity ($t_{(15)}$=5.61, p<.05,

η^2=.55, d=1.40). This finding shows that the in-service education also contributed to the teachers in the exertion dimension.

Another finding obtained in the study pointed out that the difference before and after education is significant and developmental factors may be effective in creating this difference in another sub-dimension of the TPACK-deep scale ($t_{(15)}$=3.27, p<.05, η^2=.41, d=.81). On the other hand, in another sub-dimension of the scale, the pre-training ($\bar{X}$=12.13) and post-training ($\bar{X}$=15.31) TPACK competency of the teachers was compared with the t-test and it was found that the difference was significant ($t_{(15)}$=4.05, p<.05, η^2=.52, d=1.01). Based on this finding, it can be said that the education given has a positive effect on TPACK competence.

Table 5. Independent Samples t-test results showing the change of Self-Efficacy in TPACK, before and after the In-Service training program

TPACK Subdimensions	Measurement	N	$\bar{X}$	Sd	df	t	p	d
Design	Pre-intervention	16	29.31	9.65	15	-5.67	.001	1.41
	Post-intervention	16	37.19	7.20				
Exertion	Pre-intervention	16	35.00	10.49	15	-5.61	.001	1.40
	Post-intervention	16	45.50	6.69				
Ethics	Pre-intervention	16	21.06	5.95	15	-3.27	.005	.81
	Post-intervention	16	25.56	3.14				
Proficiency	Pre-intervention	16	12.13	4.30	15	-4.05	.001	1.01
	Post-intervention	16	15.31	3.63				
TPACK Competency Score	Pre-intervention	16	97.50	27.55	15	-5.92	.001	1.48
	Post-intervention	16	123.56	1821				

Table 6 shows that the difference between the average TPACK-deep scale and the gender variable after the in-service training of teachers is significant in favor of female teachers ($t_{(14)}$=3.09, p<.05, d=.08). The mean score of female teachers ($\bar{X}$=136.29) is higher than the mean score of the male ($\bar{X}$=113.67) teachers. The η^2 value calculated for the gender is .41. According to this, it can be said that 41% of the variance observed in TPACK-deep scale scores is related to gender.

Table 6. Independent Samples T-Test Results Showing The Change of Self-Efficacy in TPACK in Groups, Based On Gender, Before and After the In-Service Training Program

TPACK Competency	Gender	N	$\bar{X}$	Sd	df	t	p
Pre-intervention	Female	7	105.29	25.03	14	1.00	.336
	Male	9	91.44	29.31			
Post-intervention	Female	7	136.29	12.85	14	3.09	.008
	Male	9	113.67	15.68			

Table 7 reveals that there is no significant difference between TPACK-deep scale mean scores of teachers and before and after education ($F_{(2-13)}$=3.05, p>.05; $F_{(2-13)}$=2.58, p>.05).

Table 7. The Effect of Professional Work Experience Upon Change of Self-Efficacy in TPACK Before and After the Intervention, ANOVA Results

TPACK Competency	Source of Variation	Sum of Squares	df	Mean Square	F	p
Pre-intervention	Between groups	3632.12	2	1816.06	3.05	.082
	Within groups	7753.88	13	596.45		
	Total	11386.00	15			
Post-intervention	Between groups	1411.01	2	705.50	2.58	.114
	Within groups	3560.93	13	273.92		
	Total	4971.94	15			

Although the average of teachers' educational level and TPACK-deep scale mean scores increased ($F_{(2-13)}$=6.10, p<.05) significantly after the in-service training activity, it continued to remain similar ($F_{(2-13)}$=6.59, p<.05) after in-service training (Table 8). Before the in-service training, the TPACK average of graduate teachers ($\bar{X}$=117.71) was significantly higher than the average of both education faculty graduate teachers and ($\bar{X}$=83.50) teachers with a pedagogical formation ($\bar{X}$=72.67). Similarly, after the training activity, the average of TPACK teachers with a graduate degree was significantly higher ($\bar{X}$=137.59) than the average of teachers with a pedagogical formation ($\bar{X}$=113.33) and the average of the teachers who graduated from the faculty of education ($\bar{X}$=111.00).

Table 8. The Effect of Highest Education Level Attained Upon Change of Self-Efficacy in TPACK Before and After the Intervention, ANOVA Results

TPACK Competency	Source of Variation	Sum of Squares	df	Mean Square	F	p	Sig. Dif.
Pre-intervention	Between groups	5868.34	2	2934.17	6.10	.014	3-1, 3-2
	Within groups	6251.60	13	480.90			
	Total	12119.94	15				
Post-intervention	Between groups	2503.18	2	1251.59	6.59	.011	3-1, 3-2
	Within groups	2468.76	13	189.91			
	Total	4971.94	15				

1: Faculty of Education Undergraduate Degree 2: Any Undergraduate Degree with Pedagogical Formation License
3: Faculty of Education Graduate Degree

Findings on Teachers' Views on the Quality of In-Service Training Activity

In this study, aiming to develop teachers' competency towards preparing ICT-based educational material through an in-service training activity conducted in the form of action research, the word cloud created from interviews with teachers is presented in Figure 5. It has been determined that teachers' mostly use the words educational (f = 96), activity (f = 80), material (f = 73), thinking (f = 70), education (f = 68) and lesson (f = 61).

Figure 3. Word Cloud Depicting Commonly Used Words in Teacher Interviews

Expectations of teachers before the in-service training activity were questioned. While two teachers stated that they did not have any pre-event expectation in interviews, one of these teachers expressed his/her views as *"Obviously I didn't have much expectation because there wasn't much content in previous similar studies, and frankly it didn't really help me, so I thought something similar would happen."* While a teacher who is expected to contribute to the personal development of the in-service training activity said *"My expectation was to learn how to use the computer more effectively",* one of the teachers who expect that they will contribute to their professional development said "*it is necessary to use slides in the course.", "I always had questions about how I could make these slides to attract students. My expectation was to improve me in this sense."*

Table 9. In-service Teachers Expectations Before the In-Service Training Program

Theme	f
No expectations	2
Contribution to personal development	8
Effective use of computers and software	3
Staying up-to-date with technological advancements	5
Contribution to professional development	11
Staying up-to-date with advancements in the professional field	6
Developing educational material that will improve the course	5

All of the teachers who were asked to meet the expectations of in-service training activities while three learners expressed that the event caused new expectations. A teacher expressed new expectations as *"Obviously, I think this has met all my expectations. For example, for the slides I used before, my students would always pick on me because the slides were very colorful. I thought that if the slides were colored, the student would be more interested in them. After the effective presentation techniques course you gave, I discovered that what I did was not true and I incorporated the presentation there into the training notes to prepare an effective presentation and pay attention to make presentations more interesting and especially less colorful."*

Table 10. Levels of Expectations Met With the In-Service Training Program

Theme	f
Level of expectations met	19
Expectations were met	16
New expectations were born in the process	3

Teachers' overall satisfaction with in-service training activities were also evaluated. *All teachers stated that they were satisfied with the educational activities they attended and the two teachers stated that the activity could be organized in the branches with the following words "I believe that it will be more useful to separate the trainees according to their branches and to organize the educational contents in this sense."* One of the other two teachers, who expressed their satisfaction about the training activity, stated that the duration of the activity should be longer *"If the application is given a little longer time, I think it would be much better for me"*.

Table 11. Levels of Satisfaction With the In-Service Training Program

Theme	f
Program may be improved	4
May be altered to be specific on different branches	2
Duration may be longer	2
I'm satisfied	16

Teachers have developed ICT-based educational materials using information transmitted within the framework of in-service training. Questions were directed to the teachers about the effects of the use of these educational materials in the educational process. The answers regarding the use of ICT-based educational materials developed by teachers during their in-service training were very positive for students and teachers. In the use the related materials in the teaching process of the student; teachers stated that they were effective in increasing their attention, increasing their interest in the lesson. One of the teachers expressed this view with these words *"… the use of such materials in classrooms, in the lessons lead to an increase in the student's interest in the course."* Similarly, teachers expressed that the use of relevant materials helped the student to learn permanently at the end of the study and to increase the satisfaction of the student. A teacher shared his/her opinion saying *"Teaching this kind of materials provides a more permanent learning of the transferred information."* On the other hand, it has been stated that the use of the relevant educational materials in the classroom also positively changed the perceptions of students towards their teachers.

Table 12. Effects of Using the Developed Materials

Theme			f
Student	During the learning process	Increase in attention	5
		Motivation	2
		Excitement	3
		Curiosity	3
		Increased interest towards the course	13
		Increased desire for course participation	12
		Entertainment during learning	3
	At the end of the learning process	Persistent learning	3
		Increase in satisfaction	10
	Shift in perception towards the teacher	Increase of respect	2
		Increased adaptation to the learning environment	3
Teacher	Prior to teaching	Increase in motivation	2
		Increase in the feeling of Readiness for teaching	2

During the teaching process	Ease of delivering courses to a larger group of learners	2
	More efficient delivery of the course	2
	Increase in performance	1
At the end of the teaching process	Professional satisfaction	11
	Perceiving self as meaningful and valuable	3
	Perceiving self as beneficial	2
	Happiness	8
	Satisfaction	3

The effects of using ICT-based educational materials prepared by teachers during the in-service training on the teacher; increased motivation, improved readiness for the course, performance of the course, teacher's performance, job satisfaction and hapiness. One of the teachers expressed these effects as, *"When I think I'm attending a lesson with a material or making the presentation richer, this naturally affects the group, which affects my performance there indirectly."* Similarly, another teacher revealed these effects with the following words *"When the teacher comes to the classroom who puts an effort to design a material, it is recognized by the students and the interest of the interest is increased and the attendance to the course increases, of course, and it satisfies the teacher in a very spiritual way."* On the other hand, a teacher candidate also gave support to each teacher who participated in the in-service training activity in order to assist the education-training processes. In the context of the research, the teacher candidates who observed the effects of in-service training activities on teachers, students and education process expressed opinions similar to the opinions given above about the changes in teachers' themselves and their students. In Figure 4, a visualization of the use of a digital material prepared by the teacher for assessment purposes has been presented.

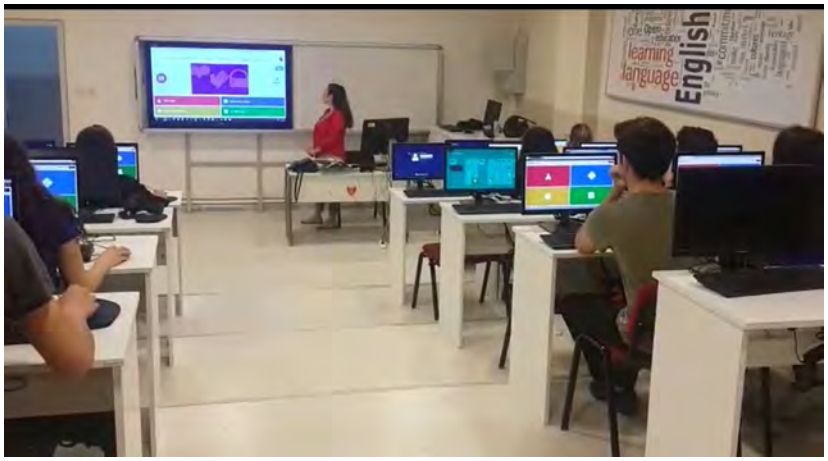

Figure 4. Teachers' Use of Self-Developed Digital Materials in Their Courses

The questions asked about the effects of the in-service training activity on teachers' knowledge and skills indicated that they contributed to the professional development of the related activity, led to an increase in their self-confidence, provided the opportunity to repeat the subjects they already know and made positive contributions to the teaching process. One of the teachers expressed these effects as *"My impression is that I understand what I thought I did not. I got the impression such as 'Oh, it wasn't that complicated'. This is very important for me. It enabled me to get closer to technology. Regarding the preparation of educational materials, I have the feeling that I am more confident and I can make it more confidently."* Another teacher explains these effects with the following opinions,*"I see and feel more competent and resourceful at the moment than before the course"*.

Table 13. The Effect of the Activity upon Skills and Knowledge

Theme			f
Contribution to professional development		Staying up-to-date with technological developments in instructional specialty field	8
		Elevating knowledge and skills for development of educational material in the specialty field	3
Perceived benefit	… in personal life	Boost to self-confidence	7
		Refreshing existing knowledge	2
	… in instruction	Shortening preparation time for courses	3
		Facilitating and enhancing instruction	5

DISCUSSION AND CONCLUSION

In this study, in preparing ICT-based educational material that is part of the teacher's learning and teaching process, it is seen that the needs of information and communication technologies are determined and the in-service training program for preparing ICT-based educational material within the framework of these needs has been examined. In the study, it was found that there was a significant difference between the average of TPACK-deep scale after the in-service training and the mean scores of all teachers before and after education. In other words, this finding indicates that teachers have increased their competence towards design, exertion, ethics and proficiency. Similarly, the significant difference between the scale averages before and after the training was also observed in teachers' views. Before the in-service training, the use of ICT technologies and ICT-based educational material design, the teachers who considered themselves inadequate began to see themselves as competent and sufficient at the end of the activity. Teachers also stated that they had a positive effect on the professional development and teaching processes of the training. This finding is similar to the results of literature research (Gröschner et al., 2018; Hsu & Kuan, 2013; Shevchenko & Kryzhanovskyi, 2018). On the other hand, teachers stated that using ICT-based educational materials that they developed during the in-service training activities had positive effects both in their education and before, during and after the teaching process in many different directions and ways. It is possible to find conclusions in the researches of the literature in accordance with the findings of this research (Doherty, 2011; Katrancı & Uygun, 2013; Zaidatun, Khawla, Noor, & Jamalludin, 2012)

Another finding of the study revealed that the difference between TPACK score averages and gender variable after in-service training of teachers was favorable and significant for female teachers. Despite the fact that there are results in the literature in parallel with the findings of this research (Jamieson-Proctor et al., 2010; Kazu & Erten, 2014) the results of some other researches (Cetin-Berber, & Erdem, 2015; Çoklar, 2014; Gönen & Kocakaya, 2015; Sezer, 2015; Şimşek, 2016) do not overlap. Çil and Çakmak (2014) and Kazu and Erten (2014) attributed this difference in favor of female teachers to the fact that female teachers have higher self-efficacy in the teaching-teaching processes and the use of technology-supported teaching methods. As a matter of fact, it was observed that female teachers were more willing and enthusiastic about developing ICT-based educational material and using these materials in classroom activities during the training activities conducted with teachers.

Another finding of this study is the finding that the difference between the average of the teachers' pre-training and post-training technopedagogical content knowledge and the seniority year variable are not significant. This finding is similar to the results of some studies (Kazu & Erten, 2014; Koh, Chai, & Tsai, 2014). On the other hand, this finding shows that the results of the researches indicate that senior teachers use less technology in the education process because of their negative attitudes towards technology and the effect of age (Lee, & Tsai, 2010; Mumcu & Usluel, 2010). It is thought that the effect of the difference between this finding off the study and the findings of the literature is based on practice and the fact that the participants do not proceed to the next activity without all of them learning the relevant content. More qualitative and quantitative studies are needed to better understand this difference.

In the study, it was found that there was a significant difference between the teachers' educational level and the average of TPACK score before and after in-service training. In other words, it can be said that

the difference in the qualification of technopedagogical education of teachers with postgraduate education before the activity is preserved after the activity. This finding coincides with the results of the studies of Durak and Seferoğlu (2017) and Lin, Tsai, Chai and Lee (2013) and other studies indicating that information technology proficiency levels increased as their educational level increased (Al Salami et al., 2017; Bal & Karademir, 2013). It is thought that in the emergence of this finding may be related with teachers who have graduate education using information and communication technologies in education activities.

Teachers play a key role in enhancing school quality and learner success and creating new learning opportunities for the learner. Therefore, it is of great importance to eliminate the shortcomings of the teachers through in-service trainings, which will have the equipment to fulfill the requirements of the day. In this context, in this study, realized by preparing ICT-based educational material that is part of the teacher's learning and teaching process,It is seen that the needs of information and communication technologies are determined and the in-service training program for preparing ICT-based educational material within the framework of these needs has been examined. The in-service training program was implemented and the development of teachers in this process was examined. It was determined that the in-service training activity increased the competencies of teachers for design, exertion, ethics and proficiency. Before the event, it was revealed that teachers who were not self-sufficient in the use of ICT technologies and ICT-based educational material design, began to see themselves competent and sufficient at the end of the activity. In addition, it was determined that in-service training activity had positive effects on teachers' professional development and teaching processes. On the other hand, it was found that the use of ICT-based educational materials developed by the teachers during the in-service training period led to three positive effects on the teaching-learning process of both teachers and students. In the evaluations made as a result of the training, it was determined that female teachers achieved higher scores compared to male teachers, the seniority period did not lead to a difference in terms of achievement of the goals, and the increase in the level of education was directly proportional to the use of ICT technologies and the qualification related to ICT-based educational material design.

The research has several limitations. The fact that the effects of the in-service training activity on the teaching process has not been evaluated in the eyes of the students is one such limitation. It is suggested that educational activities similar to the in-service training activities should be arranged in a manner that covers various content before being submitted to teachers. On the other hand, a principle of grouping teachers in the same fields due to similarity in their needs may be important in the creation of groups. Attention must be paid to ensure that in-service training activities take place during seminar weeks throughout vacation periods in addition to the beginning and end of the school year in order to facilitate the participation in educational activities of teachers, who otherwise might not be able to allocate time in their schedules during busy school weeks. It is also suggested that a certificate of participation awarded at the end of the in-service training, may increase the satisfaction of participating teachers.

Suggestions

It is suggested that educational activities similar to the in-service training activities should be arranged in a manner that covers various content before being submitted to teachers. On the other hand, a principle of grouping teachers in the same fields due to similarity in their needs may be important in the creation of groups. Attention must be paid to ensure that in-service training activities take place during seminar weeks throughout vacation periods in addition to the beginning and end of the school year in order to facilitate the participation in educational activities of teachers, who otherwise might not be able to allocate time in their schedules during busy school weeks. Guide books with concrete examples that teachers will benefit during and after the course should be developed and distributed to teachers. At the end of the in-service training, a certificate of participation may increase the satisfaction of teachers. It is suggested that taking the opinions of the students about their teachers' use of technology in the teaching process after the in-service training activity, and their development and use of educational materials is important in order to reveal the change in teachers.

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