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# Primary School Preservice Teachers' Technolgical Pedagogical Content Knowledge Competency in terms of Gender and ICT Use Phase

Ahmet Naci Çoklar [1]

**Abstract**

The purpose of the present study was to examine primary school preservice teachers' self-efficacy in technological pedagogical content knowledge (TPACK) in terms of gender and ICT use phases. For this purpose, the TPACK-Deep scale was applied to total of 276 senior preservice teachers from different universities. At the end of the study, it was found out that the preservice teachers had advanced levels of TPACK efficacy and that efficacy was not important except for the proficiency factor of gender. The TPACK changes of the preservice teachers were examined according to these phases. ICT use phases were found to be a direct predictor of TPACK, and ICT use phases were suggested to be taken into consideration while developing TPACK education models.

**Keywords**

Technological pedagogical content knowledge

TPACK

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## Giriş

It could be stated that ICT Technologies including computer and Internet Technologies have been in the education process since 1990s. Following those years, ICT integration focused more on how to use technological tools and less on how to use them for pedagogical and instructional purposes (Jimoyiannis, 2008). Today, technology use knowledge about effective technology integration into the education process is considered insufficient. In this respect, technology integration is defined as a process covering such variables as the curriculum, teacher efficacy and pedagogy (Tinio, 2003). Studies on technology integration in education have changed from technology-based ICT education approaches towards pedagogy-based approaches (Kabakci Yurdakul, Odabasi, Kilicer, Çoklar, Birinci and Kurt, 2012). Thus, there are such models regarding technology integration in education as pedagogy-based Pierson's model of technology integration, Technology Integration Planning Model, and Apple Model of Future Classrooms. One of such models is the model of Technological Pedagogical Content Knowledge (TPACK).

The TPACK model is a technology integration model basically formed by including "technology knowledge" into the structure of "pedagogical content knowledge" developed by Shulman (1986) (Koehler and Mishra, 2005). In general, the TPACK model refers to the interaction and combination of three disciplines: technology, pedagogy and content knowledge. In addition, this model is an approach emphasizing inter-disciplinary interaction. Figure 1 presents the structure of the model (Koehler and Mishra, 2005).

[1] Necmettin Erbakan University, Ahmet Keleşoğlu Faculty of Education, Computer Education And Instructional Technology, Turkey, ahmetcoklar@hotmail.com

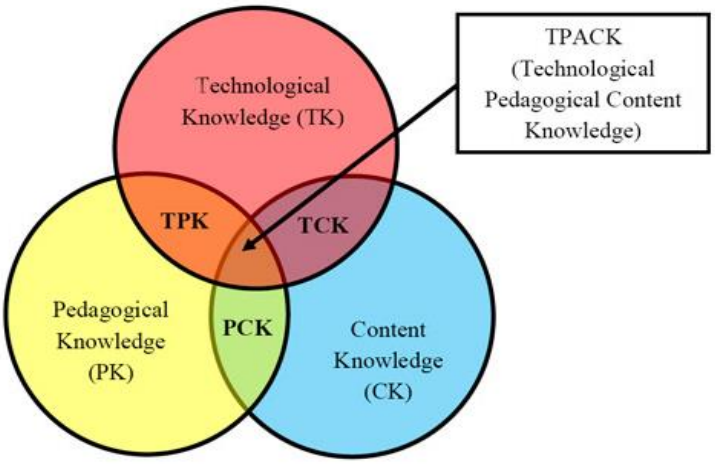


**Fig. 1.** The structure and Components of the TPACK Model (Koehler and Mishra, 2005)

As can be seen in Figure 1, the TPACK model is made up of three basic components such as "Content Knowledge – CK", "Pedagogical Knowledge – PK" and "Technological Knowledge – TK". Other components of the model include the intersection and combination of these basic components. These components are PCK (Pedagogical Content Knowledge), TCK (Technological Content Knowledge), TPK (Technological Pedagogical Knowledge), and TPACK (Technological Pedagogical Content Knowledge) (Koehler and Mishra, 2009; Mishra and Koehler, 2006; Koehler and Mishra, 2005). In this model, the word "knowledge" shows that the focus is on teacher efficacy in the process of technology integration. In this respect, TPACK is generally defined as the knowledge needed for associating pedagogical knowledge with technological knowledge in teaching a specific content field (Schmidt, Baran, Thompson, Mishra, Koehler and Shin, 2009; Koehler and Mishra, 2005). In other words, this knowledge refers to the knowledge of effective and efficient use of technology to increase the effectiveness and quality of instruction in the whole teaching process from planning to evaluation in the process of teaching a specific content. TPACK is more than simply adding technology use into the current teaching process and content field (Koehler and Mishra, 2005).

***Gender and Its Influence on TPACK***

In related literature, there is no research conducted to examine the influence of gender on TPACK. However, the fact that TPACK is a model constructed upon TK, PK and CK features the influence of gender on TPACK. In some studies, it was stated that men have a higher level of Technological Knowledge (TK) – which is use of computer technologies – than female (Koppi et al., 2010; Lasen, 2010). Such a result is thought to influence teachers' TPACK efficacy. On the other hand, there are some other findings demonstrating that female have higher levels of efficacy in the other dimensions of TPACK such as pedagogical knowledge (PK) and content knowledge (CK) than men, which, in other words, means that female are more effective teachers than men (Baylor, Shen and Huang, 2003; Einarsson and Granström, 2002; Hopf and Hatzichristou, 1999). In addition, Meece (1987) stated that male teachers tend to be more authoritative whereas female teachers tend to be more supportive and expressive. (Today is it still valid?) The effects of gender on TK, PK and CK are also likely to influence TPACK and some of its sub-dimensions. For this purpose, in the present study, the influence of the gender of the preservice teachers was examined as well.

***ICT Use Phases and Its Influence on TPACK***

ICT usage phase more related to teachers' innovativeness level stems from individual characteristics than their ICT usage levels. While some teachers follows the new technologies and encourages their colleagues, some teacher uses the technology as a necessity. In other words, ICT usage levels of teachers can be differ from theirs' education, interest, attitude, etc. Also, this difference shows the ICT usage phases of the teachers'.

Jimoyiannis (2008) stated that teachers' perceptions of ICT use in education are mostly technology-based; that is, they mostly relate ICT use to how to use technological tools. However, the TPACK model is constructed upon Technological Knowledge (TK) (Figure 1). In this respect, the TPACK model is influenced by ICT use knowledge. In addition, ICT education given to preservice teachers also influences teachers' ICT use in future (Hammond et al., 2009). Therefore, it is suggested that ICT education given in the teacher training process should be updated constantly and be given on applied basis in line with the applications at schools (Kurt, et al., 2012; Lee, Chai, Teo and Chen, 2008). On the other hand, Tearle (2004) pointed out that ICT use for instructional purposes has three important factors such as whole school environment, ICT implementation process and individual characteristics, and that individual characteristics are important. Individual characteristics that influence ICT use include positive attitudes towards ICT, ICT skills, belief in ICT and ICT knowledge and understanding (Tearle, 2004, p.345). The finding that, as revealed in these studies, teachers and preservice teachers had different *ICT use phases* despite taking the same education could be explained with these individual characteristics mentioned by Tearle (2004).

Another approach focusing on ICT use phases regarding the spread of innovations at schools was developed by Mandinach and Cline (1994). This approach emphasizes that individual characteristics play an important role in the spread of instructional technologies at schools and individuals could be in one of four different phases. These phases also possible to be adapted to ICTs are survival, mastery, impact, and innovation. In the survival stage, teachers struggle to learn the technology by operating mostly by trial and error while maintaining the status quo in their classrooms. As technical competence increases, the mastery stage is reached in which new forms of interactions are developed along with better coping strategies, sounder curriculum models, and less reliance on systems experts. In the impact stage, the classroom becomes more learner-centered, technology becomes infused in learning activities, and use of systems applications becomes more varied. Finally, (for some teachers) the innovation stage is reached, wherein the teacher restructures the curriculum and learning activities by moving beyond the mandated procedures and content (Mandinach and Cline, 1994:23). Although preservice teachers take the same ICT education, their ICT use phases could change depending on their individual characteristics (survival, mastery, impact, and innovation).

Such studies revealed a relationship between ICT use and TPACK efficacy. This study investigated the extent to which ICT use difference caused by individual characteristics (Mandinach and Cline, 1994), which wondered ICT use phases in this study, influenced TPACK efficacy. For this purpose, the influence of preservice teachers' TPACK efficacy and their ICT use phases on TPACK was examined.

### *Purpose of the Study*

The purpose of the present study was to examine primary school preservice teachers' efficacy in technological pedagogical content knowledge and their TPACK efficacy in terms of their gender and ICT use phases. Depending on this purpose, the following research questions were directed:

1. What are primary school preservice teachers' levels of TPACK efficacy?
2. Do primary school preservice teachers' levels of TPACK efficacy differ with respect to their gender?
3. Do primary school preservice teachers' levels of TPACK efficacy differ with respect to their ICT use phases (Survival, Mastery, Impact and Innovation)?

## Methods

This study is a quantative research. In line with the sub-goals, survey model was employed. The major purpose of survey model is to describe the characteristics of a population (Frankel & Wallen, 2006).

### *Population and Sample*

The population of the study included the senior class primary preservice teachers attending education faculties of state universities in Turkey in the academic year of 2010-2011. Due to the time limitations and the cost of reaching such a large population in a large geographical area, the sampling method was applied. In this phase considered to be a norming study, seven state universities were determined with the random-sampling method among all the universities in each geographical region in Turkey. As a result, a total of 276 senior class preservice teachers from the department of Primary School Teaching at the education faculties of these seven different universities participated in the study. Because the senior class preservice teachers gave all courses (Pedagogy, Content and Technology) in education faculty, they were selected as a population. Of all the participants in the study, 59.4% of them were female, and 40.6% of them were male.

### *Data Collection Tools*

As the data collection tools in the study, two different data collection tools were used. The "Technological Pedagogical Content Knowledge Efficacy Scale (TPACK-Deep)"developed by Kabakci Yurdakul et al. (2012) was a 5-point Likert-type scale made up of 33 items. The scale included four factors such as *design, exertion, ethics* and *proficiency*. The Cronbach alpha value for the whole scale was calculated as 0.95. In addition, test-retest reliability coefficient for the scale was found to be 0.80 (Kabakci Yurdakul et al., 2012). The other measurement tool, the "Questionnaire for Information and Communication Technology Use Phases", was developed by the researcher. In this questionnaire, the ICT use phases were determined as "Survival", "Mastery", "Impact" and "Innovation", which were the ICT use phases also stated by Mandinach and Cline (1994). However, after the literature review, the preservice teachers' ICT uses were gathered under such dimensions as "Problem Solving", "Effective Use", "Innovativeness", "Information Updating" and "Integration into Instruction" (Afshari, Abu Bakar, Su Luan, Abu Samah and Say Fooi F, 2009; Tondeur, Van Keer, Van Braak and Valcke, 2008; Lim, 2007). Each one of five dimensions was asked a one questions with four choices. Each one is this choice related to the ICT usage phase from survival to innovation. That is, the preservice teachers gave the five answers (totally minimum 5 point, maximum 20 point). In this way, the preservice teachers' ICT use phases were examined from different aspects. In order to determine the face and content validity of the questionnaire, one professor, two assistant professors, one instructor and six research assistants – 10 field experts in total – were asked for their views. This measurement tool was piloted with 112 preservice teachers from different teaching programs in the academic year of 2009-2010. The results of the analysis (Cronbach alpha=0.87) showed the reliability of the ICT usage phases questionnaire.

***Data Analysis***

In order to be able to collect the research data, first of all, the administrators of the education faculties of seven universities found within the scope of the study were asked for their written permission for the application of the data collection tool. Following this, the research data were collected in the Spring Term of the academic year of 2010-2011.

In line with the research purposes, such descriptive statistics as percentages, frequencies, mean scores and standard deviation were used to determine the preservice teachers' TPACK levels and their ICT use phases. First of all, the normality of data was controlled by using Kolmogorov-Simirnov test. According to the result of Kolmogorov-Simirnov test, it was seen the normality of data ($D_{(276)}$=1.320, p>.05). In order to determine whether the preservice teachers' efficacy in TPACK and in its sub-dimensions differed with respect to their gender, Independent Sample *t*-Test was applied. For the purpose of determining whether the primary school preservice teachers' levels of TPACK efficacy with respect to their phases of information and communication technology use, one-way analysis of variance (ANOVA) technique was applied. In order to reveal which group(s) caused the difference, Scheffe test, one of multiple comparison tests, was used. For the analysis of the research data, the significance level was taken as .05. In addition, for the statistical analyses, the SPSS 17.0 (Statistical Package for the Social Sciences) package program was used.

## Findings

The data collected in the study were analyzed in line with the sub-purposes, and the findings obtained are presented under headings.

***Preservice teachers' Efficacy Regarding TPACK***

Table 1 below presents the results of the analysis conducted regarding the primary school preservice teachers' TPACK efficacy and their efficacies in its sub-dimensions (factors).

**Table 1.** Preservice teachers' levels of efficacy regarding TPACK

| **TPACK-Deep Scale Factors** | $\overline{X}$ | **sd** |
|---|---|---|
| Factor I. Design | 4.05 | .711 |
| Factor II. Exertion | 4.16 | .709 |
| Factor III. Ethics | 4.07 | .732 |
| Factor IV. Proficiency | 3.76 | .796 |
| **TPACK Mean** | 4.09 | .707 |

When the primary school preservice teachers' overall mean scores regarding their efficacies in TPACK were examined, it was seen that the mean score was 4.09 (Table 1). In other words, the primary school preservice teachers considered themselves to be at an advanced level in terms of TPACK efficacy ($\overline{X}$ ≥3.67). When the sub-dimensions were taken into consideration, it was revealed that the preservice teachers found themselves most efficient in the sub-dimension of "exertion" ($\overline{X}$ = 4.16) and least efficient in the sub-dimension of "proficiency" ($\overline{X}$ = 3.76). On the other hand, the primary school preservice teachers had an advanced level of efficacy in all the sub-dimensions ($\overline{X}$ ≥3.67) including ethics ($\overline{X}$ = 4.07) and design ($\overline{X}$ = 4.05).

The primary school preservice teachers considered themselves to have "a moderate level of efficacy" only in three items among all the 33 items found in the TPACK-Deep scale and to have "an advanced level of efficacy" in all the other items. The items in which the preservice teachers considered themselves to have a moderate level of efficacy were solving the technology-based problems likely to occur in the teaching-learning process (the dimension of proficiency - $\overline{X}$ = 3.34), optimizing the training process related to the use of ICTs (the dimension of design - $\overline{X}$ = 3.54) and using ICTs within the framework of intellectual property rules (the dimension of ethics - $\overline{X}$ = 3.60).

***The Difference Between The Preservice teachers' TPACK Efficacy and Their Gender***

Of all the 276 preservice teachers participating in the study, 164 of them were female, and 112 of them were male. The participants' efficacy in TPACK were examined with respect to their gender, and the results obtained for each sub-dimension are presented in Table 2. In addition, in order to determine whether there was any difference in terms of not only the whole scale but also such sub-dimensions as design, exertion, ethics and proficiency, the differences between the groups were examined (Table 2).

**Table 2.** Findings Regarding the Preservice Teachers' Levels of TPACK Efficacy in Terms of Gender

| TPACK Sub-Dimensions | Gender | n | $\overline{X}$ | sd | t | p(<0.05) |
|---|---|---|---|---|---|---|
| Design | Female | 164 | 4.07 | .69 | 0.429 | .668 |
| | Male | 112 | 4.03 | .75 | | |
| Exertion | Female | 164 | 4.15 | .71 | 0.403 | .688 |
| | Male | 112 | 4.18 | .72 | | |
| Ethics | Female | 164 | 4.08 | .69 | 0.254 | .799 |
| | Male | 112 | 4.06 | .79 | | |
| Proficiency | Female | 164 | 3.66 | .81 | 2.257 | .022* |
| | Male | 112 | 3.91 | .74 | | |
| TPACK General | Female | 164 | 4.07 | .68 | 0.424 | .672 |
| | Male | 112 | 4.11 | .74 | | |

As can be seen in Table 2, both male students ($\overline{X}$=4.11) and female students ($\overline{X}$=4.07) had advanced levels of efficacy in terms of the whole TPACK scale. As a result of the t-test analysis conducted to see whether the difference in-between was statistically significant or not, the t value (t= 0.424, p>.05) was not found significant. In other words, gender was not an important factor in terms of TPACK efficacy. Both the female preservice teachers and the male preservice teachers reported similar levels of efficacy.

Considering the sub-dimensions, no significant difference was found between the mean scores of the male and female preservice teachers with respect to such sub-dimensions of design, exertion and ethics (p>.05). In other words, as in TPACK efficacy, in terms of such sub-dimensions as design, exertion and ethics, both female and male preservice teachers similarly had advanced levels of efficacy. On the other hand, proficiency was the only TPACK dimension on which gender was influential (Table 2). In the dimension of proficiency, the male preservice teachers had an advanced level of efficacy with a mean of $\overline{X}$=3.91, while the female preservice teachers had a moderate level of efficacy with a mean of $\overline{X}$=3.66. Depending on this finding, it could be stated that the male primary school preservice teachers considered themselves to be more efficient than the female preservice teachers in terms of proficiency.

***The Difference Between the Preservice teachers' TPACK Efficacy and Their ICT Use Phases***

Table 3 presents the results of descriptive analysis conducted regarding the primary school preservice teachers' levels of TPACK efficacy in terms of such phases as survival, mastery, impact and innovation regarded as ICT use phases.

**Table 3.** Descriptive Statistics Regarding Preservice Teachers' Levels of TPACK Efficacy in Terms of ICT Use Phases

| **ICT Use Sub-Dimensions** | **ICT Use Phases** | **n** | $\overline{X}$ | **sd** |
|---|---|---|---|---|
| Problem Solving | A- Survival Phase | 42 | 3.54 | .494 |
| | B- Mastery Phase | 125 | 3.80 | .445 |
| | C- Impact Phase | 78 | 4.08 | .502 |
| | D- Innovation Phase | 31 | 4.13 | .540 |
| Effective Use | A- Survival Phase | 28 | 3.38 | .406 |
| | B- Mastery Phase | 98 | 3.78 | .472 |
| | C- Impact Phase | 120 | 3.95 | .440 |
| | D- Innovation Phase | 30 | 4.36 | .555 |
| Innovativeness | A- Survival Phase | 32 | 3.29 | .419 |
| | B- Mastery Phase | 97 | 3.88 | .412 |
| | C- Impact Phase | 94 | 3.97 | .468 |
| | D- Innovation Phase | 53 | 4.06 | .586 |
| Information Updating | A- Survival Phase | 31 | 3.40 | .415 |
| | B- Mastery Phase | 103 | 3.83 | .405 |
| | C- Impact Phase | 111 | 3.99 | .518 |
| | D- Innovation Phase | 31 | 4.09 | .637 |
| Integration into Instruction | A- Survival Phase | 30 | 3.61 | .590 |
| | B- Mastery Phase | 82 | 3.73 | .424 |
| | C- Impact Phase | 120 | 3.95 | .490 |
| | D- Innovation Phase | 44 | 4.09 | .552 |
| General | A- Survival Phase | 31 | 3.35 | .470 |
| | B- Mastery Phase | 105 | 3.79 | .428 |
| | C- Impact Phase | 110 | 3.98 | .464 |
| | D- Innovation Phase | 30 | 4.34 | .509 |
| | **Overall Mean** | **276** | **4.09** | **.707** |

As can be seen in Table 3, the primary school preservice teachers' mean scores regarding their levels of TPACK efficacy increased moving from the phase of survival towards the phases of mastery, impact and innovation. In relation to their levels of TPACK efficacy, it was seen that in terms of all the sub-dimensions and of the whole scale, the preservice teachers in the phase of survival had a moderate level of efficacy ($\overline{X}$ <3.68), while those in the phases of mastery, impact and innovation had an advanced level of efficacy. In addition, one-way analysis of variance was conducted to determine the significance of the difference between the groups (Table 4).

**Table 4.** Results of analysis regarding the difference between the preservice teachers' ICT use phase and their levels of TPACK

| Sub-Dimensions | Source of Variance | Sum of Sequares | df | MS | F | p (p<0.05) | Difference |
|---|---|---|---|---|---|---|---|
| Problem Solving | Between Groups | 10.962 | 3 | 3.654 | 15.804 | .001* | A-B, A-C, A-D, B-C, B-D |
| | Within Groups | 62.889 | 272 | .231 | | | |
| | Total | 73.851 | 275 | | | | |
| Effective Use | Between Groups | 15.669 | 3 | 5.223 | 24.418 | .001* | A-B, A-C, A-D, B-D, C-D |
| | Within Groups | 58.181 | 272 | .214 | | | |
| | Total | 73.851 | 275 | | | | |
| Innovativeness | Between Groups | 13.748 | 3 | 4.583 | 20.740 | .001* | A-B, A-C, A-D |
| | Within Groups | 60.102 | 272 | .221 | | | |
| | Total | 73.851 | 275 | | | | |
| Information Updating | Between Groups | 10.078 | 3 | 3.359 | 14.328 | .001* | A-B, A-C, A-D |
| | Within Groups | 63.773 | 272 | .234 | | | |
| | Total | 73.851 | 275 | | | | |
| Integration into Instruction | Between Groups | 5.962 | 3 | 1.987 | 7.963 | .001* | A-C, A-D |
| | Within Groups | 67.888 | 272 | .250 | | | |
| | Total | 73.851 | 275 | | | | |
| General | Between Groups | 17.134 | 3 | 5.711 | 27.390 | .001* | A-B, A-C, A-D, B-C, B-D, C-D |
| | Within Groups | 56.717 | 272 | .209 | | | |
| | Total | 73.851 | 275 | | | | |

When the primary school preservice teachers' overall mean scores were examined, it was seen that their ICT use phases such as survival, mastery, impact and innovation influenced their TPACK efficacies as well [$F_{(3-275)}$=27.390, p<.05]. The primary school preservice teachers' mean scores regarding TPACK efficacy were found to be $\overline{X}$= 3.35 for the survival phase, $\overline{X}$= 3.79 for the mastery phase, $\overline{X}$= 3.98 for the impact phase and $\overline{X}$= 4.34 for the innovation phase, and this difference was significant at the significance level of .05. The results of the analysis conducted to determine between which groups the difference occurred revealed that the difference occurred between all the groups.

In the dimension of problem solving found in the questionnaire of ICT use phases, the phase the preservice teachers were in was significant in terms of their levels of TPACK efficacy [$F_{(3-275)}$=15.804, p<.05]. As a result of the statistical analysis applied to determine between which groups the difference occurred, there were differences between all the groups except between the phases of impact ($\overline{X}$= 4.08) and innovation ($\overline{X}$= 4.13) in the dimension of problem solving.

Considering effective use, it was seen that in terms of their TPACK efficacy levels, the preservice teachers who were in the ICT use phases of survival ($\overline{X}$= 3.38), mastery ($\overline{X}$= 3.78), impact ($\overline{X}$= 3.95) and innovation ($\overline{X}$= 4.36) had different TPACK efficacy levels [$F_{(3-275)}$=24.418, p<.05]. The results of the analysis conducted revealed that in terms of effective use, the preservice teachers did not have any difference only for the phases of mastery and impact and that there was a significant difference in favor of those who had high mean scores in the phases of survival-mastery, survival-impact, survival-innovation, mastery-innovation and impact-innovation.

As for the dimension of innovativeness, it was found out that the preservice teachers' levels of TPACK efficacy differed with respect to their ICT use phases [$F_{(3-275)}$=20.740, p<.05]. As a result of the analysis conducted to see between which groups the difference occurred, it was revealed that the difference occurred only between the survival phase and all the other groups. In other words, in terms of innovativeness, the preservice teachers who were in the phases of mastery, impact and innovation had the same levels of efficacy (advanced level), while those in the phase of survival had lower levels of efficacy (moderate level).

As for the dimension of information updating, the preservice teachers' TPACK efficacy differed depending on their ICT use phases [$F_{(3-275)}$=14.328, p<.05]. As in the dimension of innovativeness, for the dimension of information updating, the primary school preservice teachers who were in the phases of mastery, impact and innovation similarly had advanced levels of TPACK efficacy, while those in the phase of survival had moderate levels of TPACK efficacy.

Regarding the last dimension, that of integration into instruction, there was a significant difference between the groups in terms of the primary school preservice teachers' levels of TPACK efficacy and their ICT use phases [$F_{(3-275)}$=7.963, p<.05]. The results of Scheffe test applied to determine the difference between the groups demonstrated that in terms of integration into instruction, there was a difference only between the primary school preservice teachers who were in the phases of survival ( $\overline{X}$ = 3.61) and impact ( $\overline{X}$ = 3.95), and innovation ( $\overline{X}$ = 4.09) in terms of their TPACK efficacy levels. As for the difference between all the other groups, it was not found statistically significant.

Consequently, ICT use phase was an important indicator for TPACK efficacy level. Such phases as survival, mastery, impact and innovation, which the preservice teachers reported they belonged to, were found to be an important predictor of their levels of TPACK efficacy. This situation was a better predictor for problem solving, for effective use and for the whole scale. On the other hand, the low level of TPACK efficacy of the preservice teachers - who were in the phase of survival - especially for the sub-dimensions of innovativeness, information updating and integration into instruction, was an important predictor of the difference.

## Conclusions and Discussion

The primary school preservice teachers considered themselves to have an "advanced level" of efficacy in terms of overall TPACK efficacy and of all the dimensions of the scale. On the other hand, the dimension of *exertion* including such items as "use of technology in executing educational activities" and "use of technology-aided communication environments in the teaching process" was the one with the highest mean, while the dimension of *proficiency* including such items as "solving the technology-based problems likely to be experienced" and "solving the problems to be experienced in technology-based instructional environments" was the one with the lowest mean. This finding was consistent with that of a study carried out by Kabakci Yurdakul (2012) who reported that preservice teachers' had an advanced level of TPACK efficacy and that there was a difference between their mean scores regarding the sub-dimensions. This result demonstrates that the TK, PK and CK trainings given to preservice teachers are important in gaining TPACK efficacy. Similarly, there are other studies revealing the relationship between TPACK education and TK, PK and CK (Harris and Hofer, 2011; Graham, et al., 2009). Graham, et al. (2009) conducted a professional development program for Science teachers' TPACK developments. The researchers reported that following the education process, the teachers participating in their study had changes in their TPACK values as well as in their TK, CK and PK efficacy. Similarly, Harris and Hofer (2011), in their study, emphasized the importance of activity-based TPACK education and stated that together with TPACK efficacy, TPK, TCK and PCK efficacy increased on the basis of TK, CK and PK. In this respect, TK, PK and CK trainings directly influence TPACK and all its components. All the 276 primary school preservice teachers participating in the study reported that they could use technology effectively in instructional processes in line with the TPACK philosophy thanks to the TK, CK and PK trainings they received during their undergraduate education. This finding is also parallel to that of another study carried out by Doukakis, Koilias and Chionidou-Moskofoglou (2011) who reported that the trainings given during undergraduate education influenced TPACK efficacy.

In addition, gender was not an important variable in terms of TPACK. There was no difference between the female and male primary school preservice teachers with respect to overall TPACK efficacy and with respect to the three factors of the TPACK-deep scale. Both female and male participants similarly had an advanced level of efficacy in terms of the whole scale and of such dimensions as design, exertion and ethics. Although there are some studies demonstrating that use of technology differs depending on gender (Koppi et al., 2010; Lasen, 2010), TPACK efficacy is not influenced by gender. Imhof, Vollmeyer and Beierlein (2007) pointed out that in 1990s, men used information technologies more effectively and that this difference decreased in time thanks to the increasing opportunities for

accessing such technologies. Similarly, Kennedy, Liu, Dawson and Cavanaugh (2010) reported female are now able to use educational technologies effectively as well. On the other hand, recent studies have demonstrated that gender does not cause any difference in the use of educational technologies (Alba and Zubillaga, 2010; Chudgar and Sankar, 2008). This difference might have been caused by the fact that as mentioned by Baylor, Shen and Huang (2003), Einarsson and Granström (2002), Hopf and Hatzichristou (1999), female consider themselves more efficient in the profession of teaching than men – in other words, female find themselves more efficient in PK and CK. However, the proficiency dimension of TPACK, which requires advanced level of technology use such as solving the problems likely to occur in technology-based instructional environments and solving the problems likely to be experienced while using technology in any phase of the teaching processes, was the only TPACK dimension in which a difference was found. In this dimension, female considered themselves to be at moderate level, while men considered themselves to be at advanced level. This finding could be explained with the findings of a study carried out by Akkoyunlu and Orhan (2003) who reported that men are more efficient in technology use requiring high-level skills than female although male and female basically have similar educational technology use skills. The dimension of proficiency of TPACK includes advanced ICT use skills; therefore, gender is an important variable for the dimension of gender and TPACK.

ICT use phase is an important predictor of TPACK efficacy level. A preservice teacher found in such phases as survival, mastery, impact and innovation - which could also be regarded as levels, respectively – could have a TPACK efficacy level different from preservice teachers in other phases. For instance, a primary school preservice teacher in the phase of survival has a lower level of TPACK efficacy than a primary school preservice teacher in the phase of mastery, while a preservice teacher in the phase of innovation has a higher level of TPACK efficacy than a preservice teacher candidate who is in such phases as impact, mastery and survival. In this respect, ICT use phase is an important variable and predictor for TPACK efficacy, and an increase in ICT use phase could also be said to reflect upon TPACK efficacy. Literature to date has reported that preservice teachers who have acquired higher levels of technological skills are more willing to use technology in class (Hammond et al., 2009; Paraskeva, Bouta and Papagianna, 2008). According to the result of Yavuz Konokman, Yanpar Yelken and Sancar Tokmak (2012) research, the TPACK perceptions of Primary School Preservice teachers' differ from the ICT usage levels.

Chai et. al. (2011) state that individuals keeping up with the developments in ICTs could integrate these technologies more easily into pedagogical values for instructional purposes. Similarly, Doukakis, Koilias and Chionidou-Moskofoglou (2011) emphasized that ICT education is important for TPACK and that such individual characteristics of preservice teachers as learning styles, attitudes towards ICT and ICT use self-efficacy are equally important. In this respect, it could be stated that despite taking similar ICT education, individual characteristics of preservice teachers influence their ICT use and TPACK as well. Thus, different TPACK education models could be developed for preservice teachers who are in different ICT use phases to help them gain TPACK efficacy.

On the other hand, the TPACK efficacy is affected from ICT usage phases in all of the determining sub-dimensions of ICT usages (problem solving, effective use, innovativeness, information updating and integration into instruction). In the literature, it is states that the individual characteristics on ICT usage affects the problem solving, effective use, integration into instruction (Afshari, et al., 2009; Lim, 2006; Smeets, 2005), innoativeness and information updating (Tondeur, et al., 2008; Drent and Meelissen, 2007). Therefore, the different ICT usage sub-dimensions can be affected in case that the giving technology education is in accord with ICT usage phases in teacher education.

In the ligh of the research findings, it can be recommended to design with the other departments of education faculties and to conduct including the different ICT usage parameters.

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