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Research Article

Examining the Impact of Instructional Technology and Material Design Courses on Technopedagogical Education Competency Acquisition According to Different Variables*

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Abstract

The need to integrate technology into education has made necessary a thorough examination of teachers' technopedagogical competencies. While training preservice teachers, it is of particular importance that they acquire technopedagogical education competences during their preservice education. Practical and theoretical course content and Instructional Technology and Material Design (ITMD) courses are thought to be essential for preservice teachers' technopedagogical education competency acquisition. However, the role of ITMD courses in preservice teachers' technopedagogical education competency acquisition has remained obscure in the literature. As such, the study aims to describe the effect that ITMD courses have on technopedagogical education competency acquisition. The research was conducted with a total of 186 preservice teachers studying in the departments of classroom teaching and preschool teaching in a Faculty of Education in Turkey. The research data were gathered using the Technopedagogical Education Competency Scale (TPACK-deep), developed by Kabakci Yurdakul, Odabasi, Kilicer, Coklar, Birinci, and Kurt. This five-point Likert type scale consists of a total of four factors, i.e. design, proficiency, ethics, and exertion. The internal reliability coefficient of the 33-item scale was .95. The scale was applied by faculty members in-line with the course description designated by the Council of Higher Education (YÖK) as a pre- and post-test at the beginning and end of the semester that the course was given. A paired samples t-test and CHAID (Chi-squared Automatic Interaction Detection) analysis were incorporatedly employed to analyze the data. The research showed that ITMD courses influenced preservice teachers' acquisition of technopedagogical education competencies. The following were observed to be critical predictor variables in technopedagogical education competency acquisition: having received computer training prior to taking the ITMD courses and the average time one spends using a computer per day.

Keywords

Technopedagogical education competency • Instructional technology • Material design • Preservice teachers • Technology integration

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The rapid developmental of information and communication technologies (ICT) and their social impact have reflected onto education and have resulted in changes in the teaching-learning process (Neal & Miller, 2006). Again, the roles of teachers have been amended when faced with the change-provoking impact of ICT (Archambault, Wetzel, Foulger, & Williams, 2010). These changes have provided an ample scope for learners' learning, have created an opportunity for students to obtain more feedback, and have introduced a more student-centered approach in the teaching process. In this context, the contribution of ICT to the education process and its eligibility for certain content areas and teaching methods have rendered the integration of technology into teacher training programs a priority (Archambault et al., 2010; Chai, Ling Koh, Jessie Ho, & Tsai, 2012). ICT's contributions to the educational process are frequently mentioned in the literature. To illustrate, teachers have been provided with the following opportunities: social interaction platforms through web based technologies and social networking tools (Grosseck, 2009), teacher-student interaction and communication development (Cheon, Song, Jones, & Nam, 2010; Hartshorne & Ajjan, 2009), learning community development, shareable educational resources, learning context development in accordance with colloborative learning approaches (Grosseck, 2009; Purdy, 2010), and improved interactions with colleagues and students (Cheon et al., 2010; Hartshorne & Ajjan, 2009).

Despite all these opportunities, the integration process of ICT into education is considered a long term procedure since it primarily requires vast array of sources and creates certain teacher based obstructions and challenges (Goktas, Yildirim, & Yildirim, 2009; Murray & Campbell, 2000; Sabaliauskas & Pukelis, 2004). For instance, purchasing opportunities and the variety of products and their benefits/restrictions caused by the constantly changing and developing nature of ICT have been shown among the main difficulties that teachers experience while using ICT (Koehler & Mishra, 2009). However, despite all of these challenges, ICT has continued to spread exponentially, developing at such a rapid pace that national education systems have been affected and teacher training institutions have had to make changes in their professional competencies (Ferdig, 2006). What is more, it has acquired an aspect that individuals actively employ at almost every level. This change and development now compel teachers to espouse teaching strategies enriched by ICT and use them in learning environments (Kuşkaya-Mumcu, Haşlaman, & Koçak-Usluel 2008; Mazman & Usluel, 2011).

Various models for integrating technology into schools have been suggested today out of necessity. Among these, the following are of note: Pierson's Improved Model (Pierson, 2001), the Technology Integration Model (Roblyer, 2006), the Systematic ICT Integration Model (Wang & Woo, 2007), the Social Model (Wang, 2008), and Mishra and Koehler's (2006) Technological Pedagogical Content Knowledge (TPACK) model, based on Shulman's (1986) PCK or pedagogical content knowledge to help teachers analyze how to integrate technology into teaching effectively.

Koehler and Mishra's (2009) TPACK model provides teachers with a useful conceptual framework to define the types of information that they have to teach in field-specific topics through technology. However, those information fields need to be discussed holistically – not separately – for an effective integration of technology (Koehler, Mishra, & Cain, 2013; McKenney & Voogt, 2017). TPACK, the main components of TPACK, and data components at the points of interface are presented in Table 1.

Table 1

Main Components of TPACK and Data Components

Content Knowledge (CK)	Includes the information taught and the information about the subject focus to be learned.
Pedagogical Knowledge (PK)	Includes information about the teaching-learning process and such practices as fostering student learning, the learning process, classroom management, lesson plan development, various teaching practices, strategies and methods, and evaluation.
Technological Knowledge (TK)	Includes the use of information technologies, hardware, software, and tools by teachers.
Pedagogical Content Knowledge (PCK)	Includes pedagogical information to be applied to teach particular content.
Technological Pedagogical Knowledge(TPK)	Includes information about appropriate pedagogical approaches toward technological tools and how to change teaching and learning through the technology employed by teachers.
Technological Content Knowledge(TCK)	Includes information about how to employ instructional technologies for content development and display or in research conduct and what field-specific technologies take place.
Technological Pedagogical Content Knowledge (TPCK)	Includes information about complex relationships between the technology, pedagogy, and content that enable teachers to develop content specific special teaching strategies.

Reference: (Koehler & Mishra, 2009; Koehler, Mishra, Kereluik, Shin, & Graham, 2014).

While TPACK classifies the knowledge and skills necessary to integrate technological knowledge under *field knowledge*, it classifies professional teaching knowledge under the *educational process*. This classification that gives rise to the concept of *technopedagogical education*, which is defined as the instructional planning, practice, and evaluation based on technopedagogical content knowledge in an attempt to increase the effectiveness of the teaching process (Kabakçı Yudakul, & Odabaşı, 2013). Technopedagogical education emphasizes the incorporated employment of technology, pedagogy, and content knowledge in the teaching process in addition to a close relationship between technology, pedagogy, and content knowledge in order not only to use appropriate technologies but also to integrate different technologies into classroom environments.

Techno-pedagogical education consists of four factors: (i) design, (ii) proficiency, (iii)ethics, and (iv) exertion (Figure 1) (Kabakçı Yurdakul & Odabaşı, 2013).

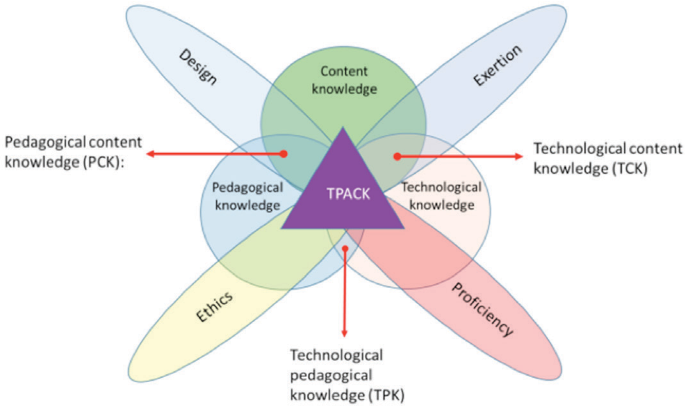

Figure 1. Factors of technopedagogical education competencies (Kabakçı Yurdakul & Odabaşı, 2013).

Table 2

Factors of Technopedagogical Education Competencies and Definitions (Kabakçı Yurdakul & Odabaşı, 2013)

Factor	Content
Design	Teacher competency in designing enriched learning environments by using technological and pedagogical knowledge.
Proficiency	Teacher competency in employing technology in order to pursue the designated teaching process and to assess its effectiveness.
Ethics	Teacher competency in employing technology in accordance with technological and professional ethical principles.
Exertion	Teacher competency in leading the environment by using field knowledge and problem solving skills for issues faced in the teaching process and competency in using technology and content knowledge.

Preservice teacher training programs are one of the most critical ways to facilitate teachers' acquisition of technopedagogical education competency. TPACK acquisition, especially for preservice teachers to be employed in preschools and primary schools, is of particular educational interest since such education is considered to compose the basis of all further education. Helping learners adapt to technologically supported learning environments and enabling them to access information through technologies are associated with teacher TPACK competencies. In the literature, it is mentioned that e-stories, educative computer games, and the integration of technologically rich learning environments support the development of early literacy skills in preschools (Belo, McKenney, Voogt, & Bradley, 2016; Verhallen, Bus, & Jong, 2006) and may contribute to technological literacy (McKenney & Voogt, 2017). Again, ICT has been employed in teaching and learning in various early childhood curricula (Wang & Hoot, 2006; Yurt & Cevher-Kalburan, 2011). Research has shown that the use of technology, including computers, might support children's memory development, communication, and problem solving skills (Haugland, 1992) as well as their natural musical abilities (Panagiotakou & Pange, 2010).

With this being said however, several studies (Enochsson & Rizza, 2009; McKenney & Voogt, 2017; Tondeur, Pareja Roblin, Braak, Fisser, & Voogt, 2013) have revealed that preservice teachers do not feel ready to use instructional technology. It has further been observed that educational institutions do not have sufficient technological resources during the preservice teacher training process and that application examples, role models, and motivation for the effective use of technology is lacking (McKenney & Voogt, 2017). Moreover, it has been suggested in the literature that teachers cannot effectively employ ICT unless they are trained (Önkol, Zembat, & Balat, 2011) and therefore they need to be trained in terms of the use and integration of such technologies (Gialamas & Nikolopoulou, 2010; Liang, Chai, Ling Koh, Yang, & Tsai, 2013; McKenney & Voogt, 2017; Yurt & Cevher-Kalburan, 2011). When the increased amount of time in front of screens spent by children is considered, the training of teachers able to employ technology in such a way that children may benefit from it is now much more important than ever. Again, the findings reveal that teachers' increased ICT knowledge increases their feelings of self-efficacy in integrating technology (McKenney & Voogt, 2017), highlighting the need for and the importance of teacher training. It has been suggested that since technology in particular has an influential role in every sphere of daily life and plays an inarguable role in children's life (Liang et al., 2013), teachers need to be able to use technology effectively for educational purposes in order to integrate technology into educational practices (Mishra & Koehler, 2006). All things considered, just as integrating technology into education at the preschool and primary school levels has gained critical importance, so too so too has teachers' acquisition of TPACK, especially in the preservice training process, gained vital significance. Taking into consideration such a need in Turkey, policies for integrating ICT into education have been initiated. Such policies include providing technological infrastructure and updating the education system to meet the contemporary needs and practices (e.g. digital course content development) (Tekin & Polat, 2014). The *FATİH* project (*Movement to Enhancing Opportunities and Improving Technology*) is remarkable it its being the most comprehensive project aiming to integrate technology into education. However, the integration of technology into education means not only technology in classrooms involved in the teaching process but also ensuring the appropriate curriculum, pedagogy, theoretical background, financial support, and teacher competencies (Tinio, 2003). In this context, with renewed teacher training programs, Turkey's Council of Higher Education (1997), also known as YÖK in Turkish, introduced curriculum including *Instructional Technology and Material Development* (ITMD) courses during the 1998-1999 academic year and was renamed *Instructional Technology and Material Design* in 2006 in the restructured curriculum that structured course content (course definition) within the framework of theoretical and practical integrity (e.g. the theoretical basis of instructional technology, the use of instructional technology for educational purposes, the definition of technological needs, 2D/3D and computer based material development, educational software reviews and assessment, and distance education) (Yükseköğretim Kurulu [YÖK], 2007). In the curriculum guideline, the Council of Higher Education highlights the fact that those who are supposed to carry out ITMD courses need to be specialized in instructional technology (YÖK, 2007) and in a sense, defines competencies of the instructors in charge. However, with regard to today's technology, it must be understood that many teachers do not feel ready to employ technology in classrooms and that because there is no single technological resolution appropriate for every teacher, course, or teaching approach, it is not surprising that they do not consider the contributions of instructional technologies to teaching and learning significant. However, teachers' abilities to flexibly sift through fields defined by content, pedagogy, and technology and to provide complex interactions between these in certain contexts might beget solutions. Disregarding the peculiar complexity of every piece of information or complex relationships between components may cause simplified resolutions or failure. For this reason, teachers need to develop cognitive flexibility not only in each of the key disciplines (Technology, Pedagogy and Content) but also in grasping how these fields and contextual parameters are inter-connected so that they may be able to come up with efficient resolutions. As a result, there is no "best way" to integrate technology into curricula. Contrarily, the attempts for integrity need to be creatively designed or structured for specific issues at particular class levels and in classroom environments (Koehler & Mishra, 2009). When considered in this context, it could be suggested that since ITMD courses not only establish relationships between technology, pedagogy, and content but also facilitate the development of content specific teaching strategies and outcome oriented content, they bear a prominent role in preservice teacher training programs aiming for to help future teachers acquire TPACK competencies.

Upon review of the literature, it is clear that certain issues have been addressed both in the ITMD course applications in accordance with course objectives and in the implementation of the FATİH project. For example, the following facts have been observed: the environmental aspect of instructional technology during ITMD courses has become prominent and practices are rather performed on the basis of material development (Alım, 2007; Kolburan Geçer, 2010; Yaman, 2007) and the technopedagogical aspect has, at least in the past, been lacking (Çoklar, Kılıçer, & Odabaşı, 2007), teachers are unable to use technologies in accordance with objectives although learning environments are gradually becoming technologically equipped (Akıncı, Kurtoğlu, & Seferoğlu, 2012; Akgün, Yılmaz, & Seferoğlu, 2011; Ekici & Yılmaz, 2013; Kayaduman, Sırakaya, & Seferoğlu, 2011; Pamuk, Çakır, Ergun, Yılmaz, & Ayas, 2013), they do not have the basic competencies necessary to integrate technology into education nor do they display enthusiastic attitudes in employing technologies (Collis & Moonen, 2008). In terms of content, ITMD seems to be a course in which technopedagogical education competencies could be acquired. Nonetheless, there no tangible data has been collected on the effect of ITMD courses on technopedagogical education competency acquisition under the current course description. Thus, under the current course description, these two questions have remained unanswered: (i) "What effects do ITMD courses have on technopedagogical education competency acquisition?" and (ii) "Do the following variables of department, personal computer ownership, ownership period and daily computer use, Internet usage time, ICT training background, and the use of web 2.0 tools predict such an influence, if there is any?" For this reason, the current study has been designed to determine whether ITMD courses have an effect on technopedagogical education competency acquisition under the current course description and to explore its predictors.

Purpose

The general purpose of the study is to show the effect of the ITMD courses included in the professional teaching knowledge courses of education faculties on technopedagogical competency acquisition. While keeping this main purpose in mind, answers to the following questions have been sought:

i. In the pre-course and post-course periods,

   a. Do technopedagogical education competency levels of those who attend ITMD courses vary significantly?

   b. Are there significant differences between the technopedagogical education competency factors?

ii. Do the independent variables of the study (i.e. department, personal computer ownership, length of ownership and daily computer usage time, time spent on the Internet, computer training, the use of e-mail, social networking, blogs and web site ownership) predict technopedagogical education competency acquisition when these same variables as well as technopedagogical education competencies of those who attend ITMD courses are considered for each factor?

Method

The current study employs the casual comparative method, one of the survey methods, as it aims to explore the effect of ITMD courses in-line with the Council of Higher Education's course description on technopedagogical education competency acquisition and its predictors (YÖK, 2007). The casual comparative method attempts to determine the reasons and outcomes for differences between groups without any interventions with conditions and participants (Büyüköztürk, Kılıç, Akgün, Karadeniz, & Demirel, 2009).

Research Group

The research was conducted with those who attended ITMD courses in Adnan Menderes University's Faculty of Education during the spring semester. The main criteria used to define the research group were (i) accessibility and (ii) courses sharing similar content and systematic proceedings in terms of theoretical and practical integrity. Another significant reason for defining the research group in this way was the critical importance and need for preschool and primary school teachers to be competent in technopedagogical educational areas, as these levels constitute the very foundation of the educational process. Therefore, the study was conducted with a total of four sections (N = 186) consisting of preservice teachers from the Department of Preschool Teaching (n = 42, %22.6) and from the Department of Classroom Teaching (n = 144, %77.4) who had taken ITMD courses during the same semester under the supervision of the author preservice. All of the students who had taken and regularly attended the ITMD courses during the semester in question were included in the research process.

Data Gathering Instrument

The five-point Likert type *Technopedagogical Education Competencies Scale* (TPACK-deep) developed by Kabakci Yurdakul et al. (2012) was to collect data gathering in the current study with the consent of the researchers. Composed of four factors related to technopedagogical competencies (i.e. Design, Proficiency, Exertion, and Ethics) and composed of 33 items, the internal reliability coefficient scale was found to be .95.

Data Collection

The TPACK-deep Scale was distributed to preservice teachers at the beginning of the course. Following the course description published by the Council of Higher Education (YÖK, 2007), the course consisted of one two-hour theoretical segment and one two-hour practical segment that were carried out by the current researcher as part of the content scheduled to be taught. Due to laboratory restrictions however, the practical part of the course was completed in classrooms. During the course, the technologies to be employed in learning environments were introduced to the students in consideration with the field specific qualities of the departments in which they were studying.. The related technologies were modeled by the instructor in classroom settings using tablet PCs, interactive boards, and students' own mobile phones. At the end of the course, the students were assigned tasks in which they were to design instructional materials to be employed for the content area of their choice that took into consideration their prospective educational levels, student levels, and probable student qualities. The tasks assigned were completed either individually or in groups depending on the features of the related technologies and content scope. Tasks included in the practical segment were assigned concerning the available technological changes. In this context, current technologies, such as web 2.0, were employed for material design and production because innovative web based technologies (e.g. Web 2.0 tools) could be applied in different teaching contexts by developing interactive communications supporting teacher-student learning communities, shareable educational resources, and constructivist collaborative learning approaches (Purdy, 2010). With such approaches, not only students were more actively involved in the search for related sources, cognitive structure constructions, the exchange of information, and access to feedback, they were able to perform tasks in collaboration (Chai et al.). The development of 3D

Table 3

ITMD Course Syllabus

Week	Theory	Practice	Task	Type of work
I	Basic concepts of instructional technology, historical process, trends in educational technology	TPACK-DEEP / Introduction of Learning Management System (LMS) (Whiteboard)	Whiteboard membership of students	
II	Instructional technology, Communication and Instructional Analysis.	LMS experience, Lesson plan development	File downloading through LMS, file uploading, writing messages, lesson plan development	Team work
III	Learning situations; The role and importance of equipment in the teaching-learning process, selection and effective usage of equipment.	Interactive board, Document camera	Effective use of interactive board and document camera	Hands on practice during courses in a group setting
IV	Learning situations; The role and importance of equipment in the teaching-learning process, selection and effective usage of equipment.	Camera, Video camera, Projection devices	Video camera recorded instructional material design	Team work
V	Audio-visual materials design, development and evaluation.	PowerPoint, Emaze, Powtoon	Presentation design	Individual work
VI	Audio-visual materials design, development and evaluation	Inspiration, Pooplet, Padled	Concept mapping (Inspiration), knowledge mapping and mind mapping (Pooplet), Wallboard design (Padled)	Team work
VII	Audio-visual materials design, development and evaluation	Webquest	Webquest design	Team work
VIII	Audio-visual materials design, development and evaluation	Video editoruse (Moviemaker)	Video based study case/ Digital story design	Team work
IX	Audio-visual materials design, development and evaluation	Programmed instruction	Programmed instructional material design	Team work
X	*Internet and distance education*	Social networking and blog starting	Blog starting	Individual work
XI	*Internet and distance education*	Online classroom	Course participation in online classrooms	Individual work
XII	*Course Evaluation*	TPACK-DEEP		

materials based on manual skills, however, was not included. Theoretical and practical issues discussed during the course, the tasks assigned to students, and the ways these tasks were performed are listed in Table 3. Since an ethical aspect was not covered in the ITMD course description, it was not mentioned as a main topic in the research process, although it was briefly explained in necessary cases.

Data Analysis

Both the Kolmogorov-Smirnov and Shapiro-Wilk tests were incorporatedly employed to examine the normal distribution in the data analysis. As a result of the Kolmogorov-Smirnov test, the values were calculated to be $p > .05$ for the pre-test and $p > .05$ for the post-test. The Shapiro-Wilk test revealed normal distribution of the data with the following values: $p > .05$for the pre-test and $p > .05$ for the post-test.

Kabakci Yurdakul et al. (2012) suggest the following criteria for the evaluation of scores obtained from the Technopedagogical Education Competency Scale (TPACK-deep): (i) a general mean score between 1.00-2.33 is considered low level, (ii) between 2.34-3.67 is considered moderate level, and between 3.68-5.00 is considered high level.

A paired sample *t*-test was employed to determine whether a significant difference existed between preservice teachers' views before and after the course, resulting in a .05 level of significance. In the study, a CHAID (Chi-squared Automatic Interaction Detection) analysis was used to define predictor variables that influenced preservice teachers' views about technopedagogical education competencies and the type of hierarchical structure that was built by the variables according to the level of significance. A CHAID analysis is a technique that repeatedly splits distributions into clusters or subclasses (Kayri & Boysan, 2007; Zırhlıoğlu, 2011). This method splits the target into detailed homogenous subclasses in a fashion best able to explain the data set of categorical variables and the dependent variable. These subclasses consist of smaller predictive subgroups. For optimum estimation, initial variables are independently re-categorized (Zırhlıoğlu, 2011).

Findings

In this section, the data obtained from the study in accordance with the research aims have been transformed into findings, placed into tables, and interpreted.

As seen in Table 4, participants' TPACK education competency levels prior to the course were $x = 3.59$, increasing to $x = 3.74$ at the end of the course. The applied paired sample t-test revealed the difference to be statistically significant in favor of the post-test. Examination of the table reveals that there is a statistically significant difference in favor of the post-test for three (i.e. *design*, *proficiency*, and *exertion*)

Table 4
Paired Sample t-Test Results of TPACK Education Competency Levels: Pre/Post Course Periods

	X	N	ss	df	*t*
Design (pre)	3.70	186	.483	185	-5.594*
Design (post)	3.87	186	.463		
Proficiency (pre)	3.,58	186	.504	185	-3.988*
Proficiency (post)	3.71	186	.472		
Ethics (pre)	3.37	186	.570	185	-.067
Ethics (post)	3.37	186	.569		
Exertion (pre)	3.68	186	.568	185	-7.064*
Exertion (post)	3.97	186	.515		
Pre course	3.59	186	.465	185	-4.972*
Post course	3.74	186	.448		

**p* <.05.

of the four factors on the TPACK-deep Scale. For the forth favor, *ethics*, the mean scores were similar both prior to and following the course, suggesting that the course did not have any effect on ethics.

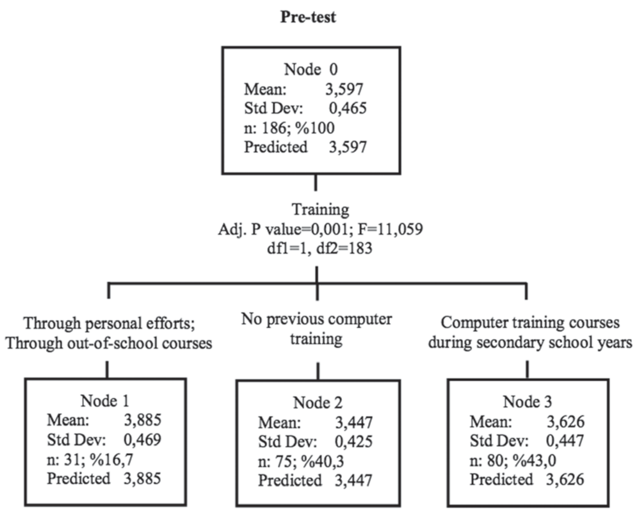

Figure 2. CHAID analysis results of predictor variables of TPACK education competencies: Pre-course.

Figure 2 illustrates that the technopedagogical education competencies of those who had received ICT training as a result of their own personal efforts in addition to higher education and out-of-school courses before attending ITMD courses were higher (x = 3.88) than those who had not, whereas the mean scores of those without any training were lower (x = 3.44). Thus, it could be concluded that computer training before attending ITMD courses seems to be a significant predictor variable of technopedagogical education competencies. Figure 3 reveals that the time one spends using a computer was the most significant predictor for those who attended ITMD

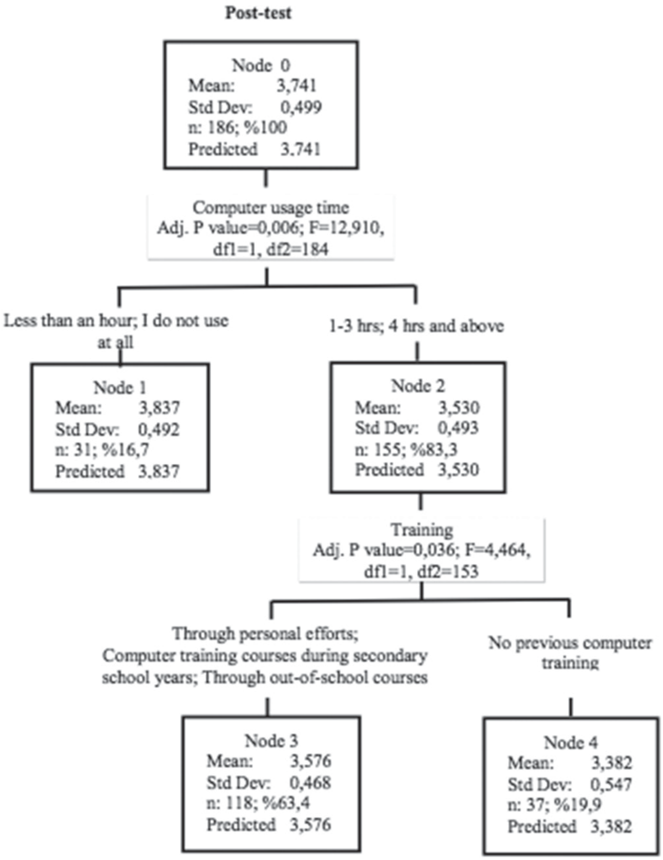

Figure 3. CHAID analysis results of predictor variables of TPACK education competencies: Post-course.

courses. At this point, daily ICT usage for more than an hour was the most influential factor on post-test scores. Again, in the scores of those who used ICT for more than

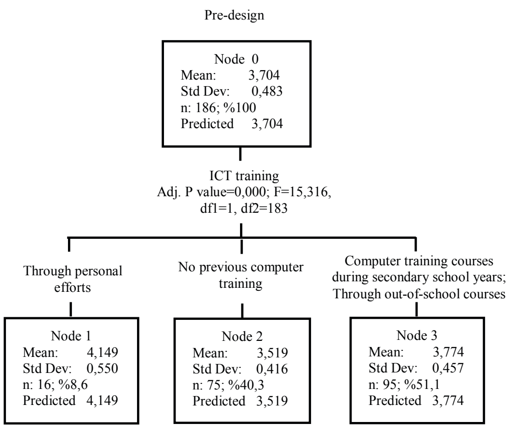

Figure 4. Predictors of TPACK education competencies in the "Design" factor: Pre-course.

an hour, ICT training was found to be a significant predictor variable. ICT training background appeared to be a significant predictor variable in more ICT usage.

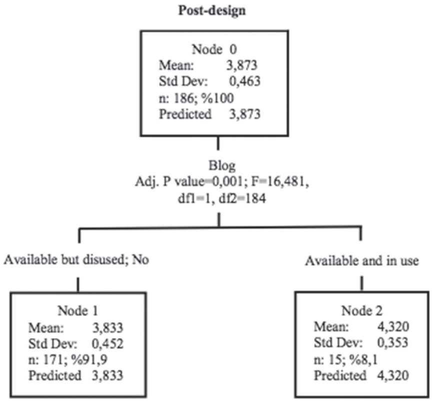

Figure 5. Predictors of TPACK education competencies in the “Design” factor: Post-course.

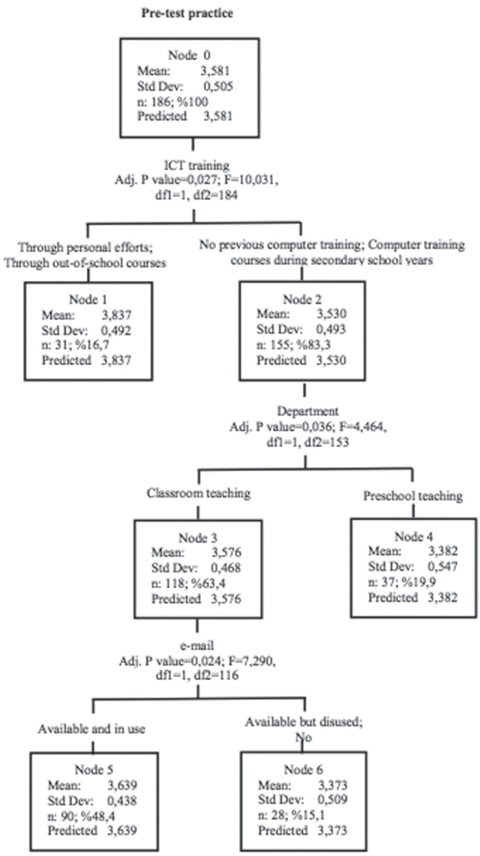

Figure 6. Predictors of TPACK education competencies in the “Proficiency” factor: Pre-course.

Examination of Figures 4 and 5 above reveals that previous ICT training was the most significant variable predicting preservice teachers' mean scores for the TPACK-deep *design* factor prior to attending ITMD courses (Figure 4). Nevertheless, after attending ITMD courses, blog use was found to be the most significant predictor variable for the TPACK-deep *design* factor (Figure 5).

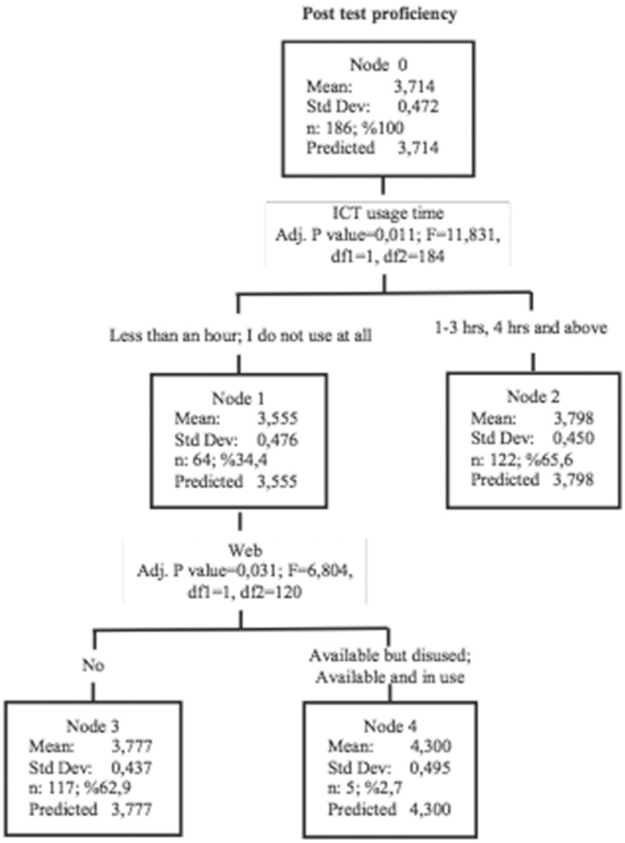

Figure 7. Predictors of TPACK education competencies in the "Proficiency" factor: Post-course.

The most significant predictor variable for the TPACK-deep *proficiency* factor was found to be having received ICT training as a result of one's personal efforts and out-of-school courses ($x = 3.83$) before attending ITMD courses. Whereas one's field of study (i.e. department) was a significant predictor variable in the mean scores of those who had not previously received ICT training and of those who had received computer training courses during secondary school (Figure 6), e-mail use was found to be a significant variable affecting the mean scores of those who were studying to be classroom teachers (Figure 6). For the TPACK-deep *proficiency* factor, the high amount of daily ICT usage appeared to be a significant predictor variable influencing the mean scores of the *proficiency* factor after attending ITMD courses. Webpage ownership and active use of webpages ($x = 4{,}30$) was found more significant predictor variable (Figure 7) for the mean scores of those using ICT for more than an hour per day for the TPACK-deep *proficiency* factor,.

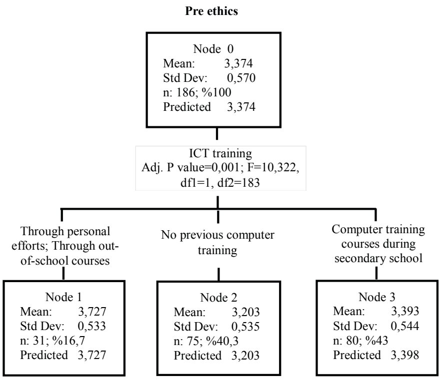

Figure 8. Predictors of TPACK education competencies in the “Ethics” factor: Pre-course.

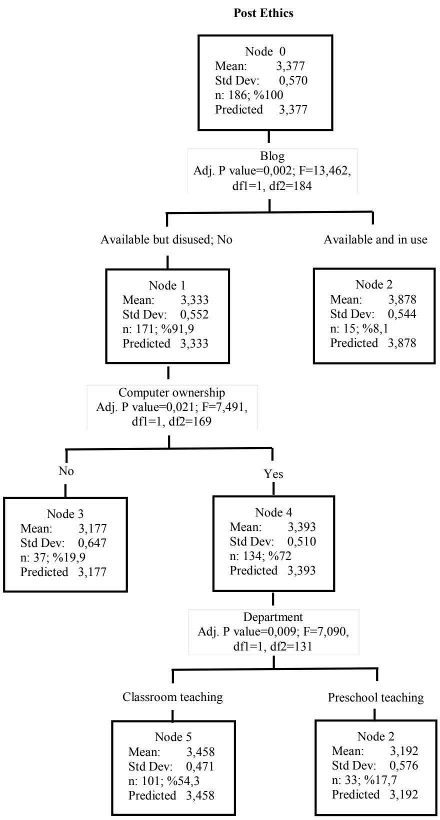

Figure 9. Predictors of TPACK education competencies in the “Ethics” factor: Post-course.

Whether or not one had received ICT training as a result of his personal efforts and out-of-school courses predicted preservice teachers' mean scores (Figure 8) for the TPACK-deep *ethics* factor prior to attending ITMD courses. After attending the ITMD courses (Figure 9), blog use was found to be a significant predictor variable for the mean scores of the *ethics* factor. However, computer ownership was a more significant variable (x = 3.39) for the mean scores of both those with active but non-updated blogs and those without blogs. Participants' field of study (i.e. department) appeared to be a significant predictor variable for the mean scores of computer owners for the *ethics* factor, whereas the mean scores of those who studying in the classroom teaching department were found to be higher (x = 3.45).

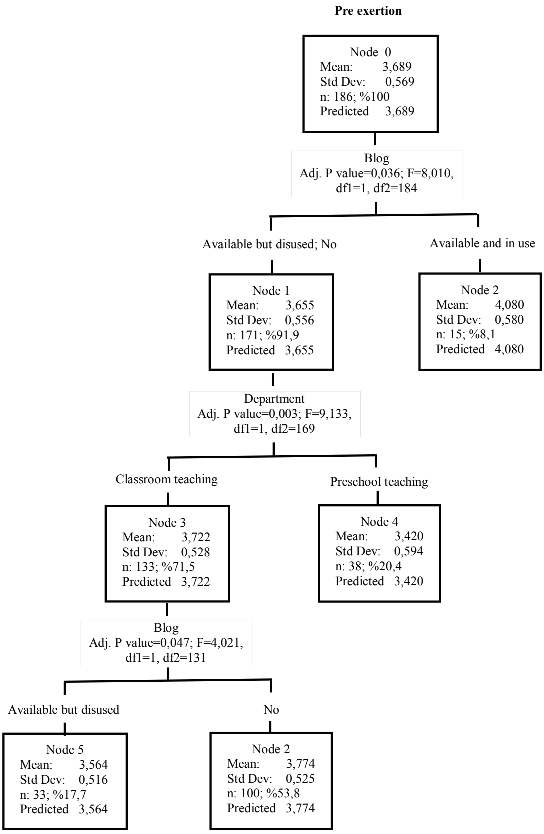

Figure 10. Predictors of TPACK education competencies in the "Exertion" factor: Pre-course.

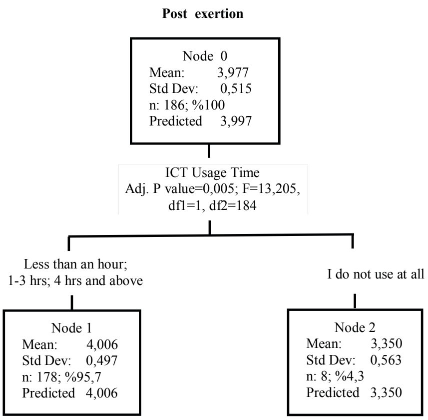

Figure 11. Predictors of TPACK education competencies in the "Exertion" factor: Post-course.

Blog use (x = 4.08) was found to be the most significant variable influencing preservice teachers' mean scores for the TPACK-deep *exertion* factor (Figure 10) prior to participating in the ITMD courses. Participants' department of study was a significant predictor variable for the mean scores of those individuals who either had never used a blog or who although owning a blog did not use it for the TPACK-deep *exertion* factor. The mean score of those who were studying in the classroom teaching department was x = 3.72, whereas that of the preservice teachers studying in the preschool teaching department was x = 3.42. ICT usage was found to be a significant variable influencing the post-test mean scores for the TPACK-deep *exertion* factor (Figure 10) after participating ITMD courses.

Discussion

The gradual active role and spread of ICT in the learning process has led to the need for technology to be integrated into schools throughout Turkey. However, the integration of technology does not mean to overload schools with technology. Beyond this, technology needs to be employed on a pedagogical basis in the following aspects: (i) design, (ii) practice, and (iii) evaluation of the instructional process. Since technological literacy competencies have become an indispensable part of teacher training and since TPACK ensures an infrastructure for the effective and meaningful integration of technology into classrooms on behalf of teachers, it is necessary that teachers develop competencies in technopedagogical education. For such competency acquisition, ITMD courses have been included in preservice training programs for teachers. ITMD courses, due to their theoretical content and practical aspect, seem to contribute the most to training those who will be in the position of supporting the integration of technology into the teaching-learning process. In their study, Gündüz and Odabaşı (2004) also highlighted the significance of the courses in this context.

However, in the current practices, ITMD is largely perceived to be restricted to *material development*. Conducted taking into consideration the latest technologies following the Council of Higher Education's description for ITMD, the current study found that the applied instructional process was influential on technopedagogical education competency acquisition, with the sole exception of the TPACK-deep *ethics* factor. Since the course description by the Council of Higher Education mentions no topics or units on ethical aspects (YÖK, 2007), ethics was not covered as a main topic during the course. It was however occasionally mentioned in the context of other subjects. Yet, such mention was insufficient for competency acquisition in the area of. Nevertheless, as a result of an experimental application of technopedagogical education for preservice teachers by Ersoy, Kabakçı, Yurdakul, and Ceylan (2016), it was seen that competencies for all of the TPACK-deep factors increased. It could be suggested that a specific experimental structure for TPACK-deep competency acquisition in the study definitely led to such a result. Unlike the study by Ersoy et al. (2016), the current research did not employ a special experimental fiction, focusing instead on the pre-defined content of the course. Nevertheless, the latest technologies and technological opportunities were all covered in the applications.

As a result of the CHAID analysis conducted to explore the significance range of the predictors of the TPACK-deep factors, having received prior ICT training was found to be the most significant variable predicting preservice teachers' TPACK-deep levels prior to attending the ITMD courses. In this context, ICT training through one's personal efforts and out-of-school courses was the primary predictor variable, whereas training during secondary school years was next. It was found that the most significant predictor variable influencing preservice teachers' TPACK-deep competencies after attending the ITMD courses was computer use. TPACK-deep increased as the time preservice teachers spent using computers increased. However, it was concluded that preservice teachers' competencies for all of the TPACK-deep factors increased following the experimental application of the technopedagogical education by Ersoy et al. (2016).

During the study, when the four factors included in the TPACK-deep scale (i.e. design, proficiency, ethics, and exertion) were considered separately and the predictor variables included in the study were examined, it was seen that the predictor variables for each factor partially varied.

Concerning the *design* factor, results revealed that prior ICT training was the most significant variable predicting competency acquisition during the pre-test whereas blog ownership and use was the most important predictor variable during the post-test. The difference is thought to be a result of the effective blog starting practices gained during the course. Jang and Chen (2010) suggested that TPACK based technology usage and experience was important in improving TPACK competencies. It was concluded that those able to use ICT efficiently were more successful in technology supported activities (Polly, 2008; 2014).

On the other hand, prior ICT training before attending the ITMD courses was found to be the most significant predictor variable for the *exertion* factor of the TPACK-deep scale. While examining the predictors of ICT training methods in a hierarchical structure, it was found that ICT training through one's personal efforts and out-of-school courses constituted the most significant predictor variable. One's area of study (i.e. department) was the most significant predictor variable for those who had not received prior ICT training and for those who had ICT training during secondary school. Ownership of an e-mail account was an important predictor among the preservice teachers who were studying in the classroom teaching department. The TPACK-deep competencies of those who had and actively used an e-mail account were found to be higher. However, daily time spent using ICT was the most significant predictor variable for preservice teachers' TPACK-deep competencies after attending the ITMD courses, with preservice teachers' TPACK-deep levels increasing as their time spent using ICT increased. The most significant predictor of TPACK-deep for those who spend more than one house per day using ICT was webpage membership. The TPACK-deep levels of preservice teachers who had and used webpages were higher than those who did not have and use them. The results obtained from the *exertion* factor clearly reveal that one's personal efforts in seeking computer training and out-of-school courses played a crucial role in preservice teachers' acquisition of technopedagogical skills. This case might have been caused both by preservice teachers' voluntary participation and by their belief that ICT was an essential aspect both in daily life and in terms of their professional skills. In other words, it could be suggested that the preservice teachers' high levels of intrinsic motivation were a significant predictor of TPACK-deep competency acquisition. The importance of ICT competency levels in technopedagogical education competency acquisition was also emphasized in the studies conducted by Chai, Ng, Li, Hong, and Koh (2013) and Koh, Chai, and Tsai (2013). Again, in their study, Kabakci Yurdagul, and Coklar (2014) concluded that time spent using ICTs positively influenced TPACK competencies. What is more is that the literature contains research findings showing that ICT skills are influential on preservice teachers' teaching practices (Inan, Lowther, Ross, & Strahl, 2010; Khan, 2011; Orlando, 2009). In studies conducted by Lee and Tsai (2010) and Jang and Tsai (2012), preservice teachers' TPACKs varied significantly according to teaching experience. Lee and Tsai (2010) concluded not only that TPACK competencies of those who had more web experience were higher compared to those with less experience, but that they had attitudes toward using web tools were generally more positive.

The CHAID analysis of the TPACK-deep *ethics* factor found, that previous computer training was the most significant predictor variable during the pre-test phase. Furthermore, it was seen that training through one's personal efforts and out-of-school courses constituted a more significant predictor variable than other types of prior ICT training upon examination of the hierarchical structure. Nonetheless, during the post-test phase, blog ownership and managing an active blog were found to be a more significant predictor variable. An examination of the resulting hierarchical structure revealed that personal computer ownership appeared to be a more significant predictor variable for those who had started and who continued to actively use blogs. The TPACK-deep levels of computer owners were higher, for whom field of study (i.e. department) was found to be the most significant predictor variable. The TPACK-deep levels of those studying in the classroom teaching department were found to be higher. This change was thought to be a result of the courses' mention of copyrights in regard to content development in blog and website design. In a study conducted with preservice teachers in which the low number of studies on ethics in Turkey was emphasized, Beycioglu (2009) studied views on non-ethical computer usage in Turkey, concluding that although individuals were not concerned about the issue of ethics, they were sensitive to the ethical usage of computers.

On the other hand, while daily time spent using ICT was the most significant predictor variable during the post-test phase, blog ownership and use was the most significant during the pre-test phase for the *exertion* factor of TPACK-deep prior to attending the ITMD courses. It is obvious that work needs to be given exertion in certain matters. When considered in this context, experience using ICT and an increase in time spent using were found to be a significant predictor variable for acquiring competency for areas in the TPACK-deep *exertion* factor. In their experimental application of technopedagogical education with preservice teachers, Ersoy et al. (2016) concluded that TPACK competency levels increased as their use of ICT increased. In addition to higher education, the time preservice teachers spent using ICT and their prior ICT training were the most significant variables influencing TPACK-deep competency acquisition. Having received prior computer training through one's personal efforts and out-of-school courses played a crucial role in technopedagogical education competency acquisition and was thought to be a result of preservice teachers' voluntary participation in the process, their belief that ICT was indispensable in both their daily and profession lives, and their intrinsic motivations. The importance of ICT competency levels in technopedagogical education competency acquisition was also emphasized in the studies conducted by Chai et al. (2013) and by Koh et al. (2013). Again, in their study, Kabakci Yurdakul, and Coklar (2014) concluded that ICT usage levels positively influenced TPACK competencies.

The accelerated integration of technology into schools, as part of the *FATİH* Project in particular, entailed a strong need for digital content development. While the Ministry of Education (MoNE) has been trying to meet the need via its Education

Information Network (EBA), it expects teachers to support the system since the system is open to digital contents prepared by teachers. It is essential to carry out ITMD courses, included in professional teaching knowledge courses, on the basis of technopedagogical education in order to meet these expectations in the long term. The results of the project implemented by Kabakçı Yurdakul, Çoklar, Birinci, and Kılıçer (2012) have also supported this finding (as cited in Kabakçı Yurdakul & Odabaşı, 2013). Again, Ersoy et al. (2016) have highlighted that teacher training programs need to be updated, suggesting not only a new format that supports learner skills with the rearrangement of ITMD course content included in the curricula used by the departments that make up Turkey's Faculties of Education but also a review of the content of particular technology based courses and applications based on TPACK.

Technopedagogical education competency acquisition during preservice training and in-service training programs for teachers has become increasingly crucial due to the development of ICT and its integration into education. It is obvious that teacher training programs need to be renewed to ensure competency acquisition, particularly in the preservice training period. Moreover, great importance has been given to ICT competency acquisition before higher education and, in this context, the exploration and integration of intrinsic motivation supporting units in learning environments. It is thought that carrying out ICT courses during preservice training programs will contribute greatly to technopedagogical education competency acquisition. This is considered especially true for curricula supporting the scheduled ITMD practices. Again, designing special learning environments for ITMD courses is considered significant in that it will lead to more effective and productive proceedings during in-class practices.

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