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Factors Associated with Technology Integration to Improve Instructional Abilities: A Path Model

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Abstract: Today, students are expected to access, analyse and synthesise information, and work cooperatively. Their learning environment, therefore, should be equipped with appropriate tools and materials, and teachers should have instructional abilities to use them effectively. This study aims to propose a model to improve teachers' instructional abilities through technology integration. To this end, data on variables that affect technology integration were collected from 600 teachers and analysed by using path analysis. The results revealed an acceptable fit between the model and the data. Technological Pedagogical Content Knowledge, attitude towards technology use in education, gender, frequency of computer use, seniority, duration of computer use, technical support, and individual innovativeness have direct or indirect effects on technology integration. The developed model can be considered original because it includes the variable of individual innovativeness. Based on the developed path model, some suggestions were presented to support the instructional abilities of teachers.

Keywords: Instructional abilities, learner-centered education, technology integration, path analysis

Introduction

Among the most important tasks in guiding learning is to plan learning experience and organise the environment, to encourage the individual to interact with his/her environment and to accomplish the intended change. During the process of organising the environment, teachers need to use certain educational equipment as required by the lesson (Ertürk 1991). Teachers can decide which educational equipment to use and how to use them by taking learning objectives, the learner's characteristics and available facilities into consideration. Today, learning objectives are expected to be oriented towards abilities that involve learner-centred access to information, sharing and collaboration rather than teacher-centred lecturing and transfer of information (Ornstein, Pajak, & Ornstein, 2015). Learner-centered objectives, accordingly, require the renewal of conventional methods of instruction, as well as the proficient use of information technologies. In this respect, teachers face the responsibility of carrying out effective instruction by considering multiple variables, including the curriculum, student characteristics, information technologies, subject area, classroom environment, and so forth. How to support instructional abilities regarding this responsibility has become a subject of inquiry in educational research. The aim of the present study is to apply a model to explain certain variables which have been reported in the literature to affect technology integration and to introduce a hypothetical model that includes suggestions for improving instructional abilities in line with this model.

Learner-Centered Education and Technology

The abilities students are expected to have in the twenty-first century may be listed as content knowledge, learning and innovation skills; information, media and technology skills; life and career skills (P21, 2002). The use of technology can support the twenty-first-century skills by way of dynamic content presentation, access to information, creation and sharing, and interaction/reflection (Pheeraphan, 2013). Dynamic content presentation includes the use of knowledge and information and communication technologies to encourage learners to be more active. Access to information refers to the research, construction, understanding, analysis, and synthesis of information. In this way, students will be able to reorganise their ideas, choose convenient information and evaluate and structure this information. Creation and sharing are the processes in which students form and share learning products in and outside the classroom using knowledge and information technologies. Learning products may include articles, presentations, videos, blogs, wikis, or portfolios. In this way, students can give feedback to the products of their peers and become evaluators too. Interaction and reflection are the processes of supporting student-teacher interaction through the use of technology. Instructional technologies can diversify and support this interaction in multiple ways. The use of technology in learner-centred activities requires teachers to have technological knowledge, as well as pedagogical and content knowledge, and to understand the interactions between these three areas of knowledge (Mishra & Koehler, 2006). It is, therefore, of great importance to take Technological Pedagogical Content Knowledge TPACK into consideration in the process of technology integration. Teachers can facilitate the learning process and make it more productive by using technology to support pedagogical strategies they use for transferring content information (Mazman & Usluel, 2011).

According to some studies in the literature, there is a relationship between teachers' pedagogical perspectives and their use of technology (Hixon & Buckenmeyer, 2009; Inan, Lowther, Ross, & Strahl, 2010). While teachers with an orientation of teacher-centered education tend to use instructor- and skill-oriented software programs, teachers with an orientation of learner-centered education encourage students to use "open-ended software" such as word processor or presentation programs that would support students' active participation, productive skills, and structuring of information (Inan et al., 2010).Teachers, who focus more on learner-centred methods like group work, individualised learning and project work, and who are prepared better for efficient use of these methods, are observed to be more willing to use technology (OECD, 2015). So, supporting teachers in the use of technology in education through appropriate ways will help them apply learner-centred activities more efficiently.

In parallel with investments in educational technologies, teachers are expected to integrate information and communication technologies into the learning environment (Huxley, 2014; MEB, 2009; Serrado Bayes, 2010). The presence of required equipment in schools, however, does not necessarily mean that teachers will integrate these technologies into the learning environment (Hennessy, Ruthven, & Brindley, 2005; Law, Pelgrum, & Plomp, 2008).Teachers' access to technology, even their regular use of technology in daily life, does not guarantee the use of technology in the learning environment with the purpose of supporting learner-centred applications (Hixon & Buckenmeyer, 2009). In some cases, teachers may fail to integrate technology into the education environment even though they use it for individual purposes (Demiraslan & Usluel, 2005; Yıldırım, 2007). In some cases, the use of technology in the classroom may not increase student learning as intended (Mama & Hennessy, 2010; Tondeur, van Braak, & Valcke, 2007). Teachers might use interactive boards only for presenting reading materials, not for supporting students' interactive learning and increasing their ability to discover and structure information (Mama & Hennessy, 2010). In several cases, innovative technology use, such as advanced thinking skills and learner-centred technology, appears to be problematic (OECD, 2015; Sanchez, Marcos, Gonzalez, & He, 2012; Yıldırım, 2007). This situation and its results are noted in the OECD report (2015) as follows:

> *No positive effect of technology was observed especially in the areas of reading comprehension, mathematics and science. An important conclusion to be drawn from these findings is that teacher-student interaction is a must for improving in-depth comprehension and advanced thinking skills, and technology in some cases can interrupt this interaction. Also, we have not been able to develop and employ pedagogical applications for the best possible use of technology. Using twenty-first-century technologies through twentieth-century pedagogical applications disrupt the efficacy of education. Students will not get smarter by using their smart phones, only for copying and pasting information. If we want our students to be smarter than their smart phones, we need to be more careful about the pedagogies we use in learning environments (OECD, 2015, s.3-4).*

Teachers should accept change so that they can apply instruction technologies and replace teacher-centred applications with learner-centred ones. Such change in the instructional approaches of teachers is a nonlinear and highly complicated process full of uncertainties (Fullan, 1993). During this demanding process, teachers are expected to be open to change and have skills like risk-taking, openness to experience, creativity and opinion leadership to be able to embrace change. Nevertheless, individuals may differ in these skills, and therefore they accept change at different speeds (Kılıçer & Odabaşı, 2010). Understanding teachers' levels of individual innovativeness will provide us with valuable ideas about their prospective speed of accepting change. In this way, significant evidence can be obtained for planning follow-up and support studies for teachers.

In order to improve learner-centred applications and to use technology in this process, it is important to give appropriate pre-service education to teachers and to organise professional development programs with a particular focus on the skills mentioned above. In pre-service education, teachers' knowledge of pedagogy, content and technology, as well as the interactions of these areas, should be supported through suitable approaches. Professional development programs should increase teachers' knowledge and abilities of how to use learner-centred applications with the help of technology. However, several studies in the literature show that professional development programs do not always provide the desired contribution to teachers (Brinkerhoff, 2006; Bümen, Ateş, Çakar, Ural, & Acar, 2012; Fragkouli & Hammond, 2007; Glazer, Hannafin, Polly, & Rich, 2009). Professional development programs may fail to be effective because they are not given a chance of application, lack follow-up and feedback and are conducted centrally (Bümen, 2009; Bümen et al., 2012). It is reported that sometimes, needs assessment is not appropriately conducted in professional development programs, and applications are carried out as theory-based and decontextualised presentations without follow-up and feedback (Bümen et al., 2012). Such programs will be successfully applied only when the needs of teachers are taken into consideration in the planning process (Bümen et al., 2012; Guskey, 2000). In this respect, studies on the understanding of teachers' current states regarding technology integration may contribute to the generation of ideas for a more effective application of professional development programs. Accordingly, this study aims to contribute to evidence-based decisions, taken during the process of planning and implementation of professional development programs, by way of understanding teachers' current technology integration situations and variables affecting technology integration.

Literature on Technology Integration

Today, instructional technologies are important tools that can support active learning. Teachers are expected to integrate these technologies into the learning environment. Technology integration, however, cannot be realised on a moment's notice and involves a process that includes certain stages (Hixon & Buckenmeyer, 2009; Mills & Tincher, 2003). During the first stage, teachers do not believe the benefit of technology for themselves or the class. At the second stage, teachers begin to use technology for personal purposes (Hixon & Buckenmeyer, 2009). When teachers begin using technology for educational purposes in the initial stages, they tend to use it for teacher-centred activities to support traditional instructional applications (Hixon & Buckenmeyer, 2009; Mills & Tincher, 2003; Yıldırım, 2007). Teachers use learner-centered strategies generally towards the final stages. At these stages, technology integration into the learning environment enables learning to become more learner-centred, interdisciplinary and project-based, contributing to an increase in peer-teaching and individual learning (Hixon & Buckenmeyer, 2009; Mills & Tincher, 2003). Multiple variables affect technology integration. These variables include gender, professional seniority, and duration of computer use, technical support, technological pedagogical content knowledge (TPACK), individual innovativeness and attitude.

Several studies show that gender is a variable that affects technology use in education (Hao & Lee, 2015; Lin, Tsai, Chai, & Lee, 2012; Summak, Baglibel, & Samancioglu, 2010). While some researchers report that in-class technology use is lower among women compared to men (Hermans, Tondeur, van Braak, & Valcke, 2008; Tondeur, Valcke, & Van Braak, 2008); Lin, Huang, & Chen (2014) state that women are more willing to spare time for additional studies necessary for adapting technology to the learning environment. Nevertheless, there are publications which report no significant relationship between technology use and gender in education (Area-Moreira, Hernandez-Rivero, & Sosa-Alonso, 2016; Rahimi & Yadollahi, 2011; Shi et al., 2013).

Besides gender, professional seniority is one of the variables which is reported to affect technology integration in education (Area-Moreira et al., 2016; Gomez, Rodriguez, & Igado, 2010; Karaca, Can, & Yildirim, 2013). Mostly, technology integration decreases with the rise in professional seniority (Baek, Jung, & Kim, 2008; Rahimi & Yadollahi, 2011). Some researchers, on the other hand, consider professional seniority as an ineffective variable regarding technology integration (Shi et al., 2013). Age, which can be considered parallel with professional seniority, is also effective on technology integration (Lin et al., 2014; Lin et al., 2012). On the other hand, Summak et al. (2010) do not consider age an effective variable in technology integration. Another effective variable in technology integration is the duration of computer use (Karaca et al., 2013). Technology integration increases with the increase in the duration of computer use

(Tondeur et al., 2008). Besides duration of computer use, the frequency of use also affects technology integration (Area-Moreira et al., 2016).

Another important variable affecting technology integration is teachers' attitudes towards technology as well as its use in education. Several researchers have reported that the possibility of achieving technology integration is higher among teachers with positive attitudes (Baya'a, Daher, & Ieee, 2012; Chikasha, Ntuli, Sundarjee, & Chikasha, 2014; Karaca et al., 2013). Sanchez et al. (2012), on the other hand, note that teachers' levels of in-class technology use may be low despite their positive attitudes. To enable technology integration in education, teachers should have immediate access to technical support whenever they need it. Inadequate technical support is an important obstacle to technology integration (Inan & Lowther, 2010; Lin et al., 2014; Yıldırım, 2007).

Individual innovativeness also affects technology integration, as well as the variables affecting technology integration (Çuhadar, Bülbül, & Ilgaz, 2013; Tondeur et al., 2008; Yilmaz & Bayraktar, 2014). According to Tondeur et al. (2008), teachers' level of openness to change which can be interpreted as innovativeness is effective on computer use and appears to be the mediating variable in attitudes towards computers. Some researchers have not found any significant relationship between individual innovativeness and computer use (Korucu & Olpak, 2015). Yet, there is a positive correlation between individual innovativeness and technological pedagogical education competence of teacher candidates (Çuhadar et al., 2013). Individual innovativeness is reported to have a significant relationship with attitudes towards computer use (Örün, Orhan, Dönmez, & Kurt, 2015; Yilmaz & Bayraktar, 2014).

Literature includes several models in which variables affecting technology integration are explained in relation to one another (Hsu & Kuan, 2013; Inan & Lowther, 2010; Karaca et al., 2013). Variables affecting technology integration are classified at school and teacher levels. Variables at school level may be listed as the school's openness to change, technology use planning in education, facilities and equipment, technical support, executive support and colleague support (Chen, 2010; Hsu & Kuan, 2013; Karaca et al., 2013; Tondeur et al., 2008). Variables at teacher level include gender, technology competence, attitude, experience, duration of computer use, openness to change, constructivist teacher beliefs, and TPACK (Inan & Lowther, 2010; Karaca et al., 2013; Yücel, Acun, Tarman, & Mete, 2010). However, none of the models about technology integration includes individual innovativeness as a variable in the path models. So, including individual innovativeness is one of the authenticity parts of this study.

As seen in the discussion above, integrating technology into the learning environment is a complex process. Recognizing and explaining the variables affecting teachers' technology uses may be useful for a better understanding of the process of technology integration. The present study aims to apply a model to explain certain variables which have been reported in the literature to affect technology integration, and to introduce a hypothetical model that includes suggestions for improving instructional abilities in line with this model. When the available research studies on variables affecting technology integration are examined, it is observed that TPACK, attitude towards technology use in education, individual innovativeness, gender, professional seniority, duration of computer use, frequency of computer use and technical support have direct or indirect effects on technology integration. Although the effects of these variables on technology integration have been analysed from different aspects, their contribution to technology integration as a whole has not been studied. Explaining how these variables affect technology integration may provide significant contributions to literature and practical implementations. Although there are studies on the effects of individual innovativeness on technology use (Çuhadar et al., 2013; Korucu & Olpak, 2015; Örün et al., 2015), no study has been found in the literature that examines the effects of individual innovativeness on technology integration on a model. The present study is expected to contribute to the literature in this respect. With the model created as a result of the path analysis and the hypothetical model developed for supporting instructing abilities at the end of the literature survey, this study is expected to make significant contributions to the interventions implemented for supporting instructing abilities.

Method

A survey was set up to gather data about the variables that affect technology integration. Participants were selected by purposeful sampling method to provide maximum diversity. Schools were selected from metropole and rural areas. Gender, seniority and subject-matter triangulation of teachers were also considered. For anonymity, teachers did not write their names on the questionnaires, and the research report was written without certain information about participant schools and teachers. While 330 of 600 teachers who participated in the research worked at schools in the metropolitan area, 270 of them worked in towns in suburban areas. The number of female and male teachers is 383 and 217, respectively. While 162 of the teachers had access to technical support, 279 of them had partial access, and 70 of them had no access to technical support. The teachers' professional experiences, duration and frequency of computer uses are presented in Table 1.

Professional Experience (Year)	n*	Duration of Computer Use (Year)	n*	Frequency of Computer Use	n*
1-5	62	1-5	125	Every day	341
6-10	48	6-10	243	5-6 days a week	81
11-15	144	11-15	172	3-4 days a week	98
16-20	162	16-25	60	1-2 days a week	62
21-25	102			Once in a few weeks	18
26+	82				

*Number of teachers

Table 1: Professional Experience (Year), Duration of Computer Use (Year) and Frequency of Computer Use

Data Collection Tools

Research data were obtained by using personal information form, TPACK scale, attitude scale for technology integration in education, individual innovativeness scale and scale for technology integration in education.

TPACK scale

TPACK scale was developed by Mumcu & Usluel (2010); confirmatory factor analysis showed that factor structure and data fit were within acceptable limits (RMSEA:.075, NNFI:.99, CFI:.99, GFI:.92, AGFI:.87). It consisted of four factors, including technological knowledge, technological content knowledge, pedagogical knowledge and technological pedagogical content knowledge. Cronbach α reliability coefficient for the entire scale was calculated to be .96, and the reliability coefficient for the dimensions was calculated as .86, .85, .93 and .91, respectively.

Attitude Scale

Attitude scale for technology use in education was developed by Cavas, Cavas, Karaoglan, & Kisla (2009). At the end of the explanatory factor analysis, a two-factor structure was obtained, explaining 40% of total variance. The scale with 31 items has two factors, including the effects of technology on learning-teaching and obstacles to applications of technology. Reliability coefficients for the first and second factors were calculated as .92 and .79, respectively.

Individual Innovativeness Scale

The original form of the individual innovativeness scale was developed by H. Thomas Hurt, Katherine Joseph and Chester. D. Cook in 1977 in English (Kılıçer & Odabaşı, 2010). The original scale was adapted to Turkish by Kılıçer & Odabaşı (2010).The scale with 20 items has a four-factor structure. Factor analysis was applied to the scale, and internal validity coefficient and test-retest reliability coefficient were calculated. Internal validity coefficient is .82, and test-retest reliability coefficient is .87.

Technology Integration Scale

Technology integration scale developed by Uslu (2013) consists of five factors and explains 56% of total variance. The factors include in-class computer use and preparation, ethics, encouragement of technology use, technology use for communicating with students and written material preparation. Cronbach α reliability coefficient for each factor is .86, .87, .78, .70 and .74, respectively. Fit indices obtained at the end of the confirmatory factor analysis were within acceptable limits (RMSEA .055, NNFI .96 CFI .96, GFI .93, AGFI .92).

Data Analysis

The correlation between all the variables was examined with the help of path analysis which can be used to examine the direct causal contribution of one variable to another (Jöreskog & Sörbom, 1993). So the literature-based model over the variables was tested by using path analysis. Gender, seniority, duration of computer use, frequency of computer use and technical support were assigned as exogenous variables which mean they affect other variables. Technology integration was assigned as an endogenous variable, which means it is affected by other variables, while technological pedagogical content knowledge, attitude and individual innovativeness were assigned as both exogenous and endogenous variables. Direct and indirect effects of these exogenous variables on technology integration were examined. Analyses were carried out by using Lisrell 8.7 program, and fit indices and error values were examined to determine the fit rate between the model and the data.

Hypotheses

As SEM can be considered as the application of multilinear regression, the premises of multilinear regression were checked (Çokluk, Şekercioğlu, & Büyüköztürk, 2012). Skewness values were examined to test normal distribution, and skewness values for all variables were observed to be below the interval of -1/+1. Accordingly, it means that variables were normally distributed (Leech, Barrett, & Morgan, 2014). The correlation between dependent and independent variables was examined to test whether a linearity hypothesis was fulfilled, and a linear correlation was observed. Tolerance values were examined to test the multicollinearity problem, and these values were found to be higher than $1\text{-}R^2$ for the independent variables. Accordingly, the absence of multicollinearity problem was confirmed (Leech et al., 2014).

Findings

The graphic obtained from the path analysis, which was performed to examine the direct and indirect effects of the determined variables on technology integration, is given in Figure 1. After fit indices and error values obtained from path analysis are explained, data on regression equations are presented.

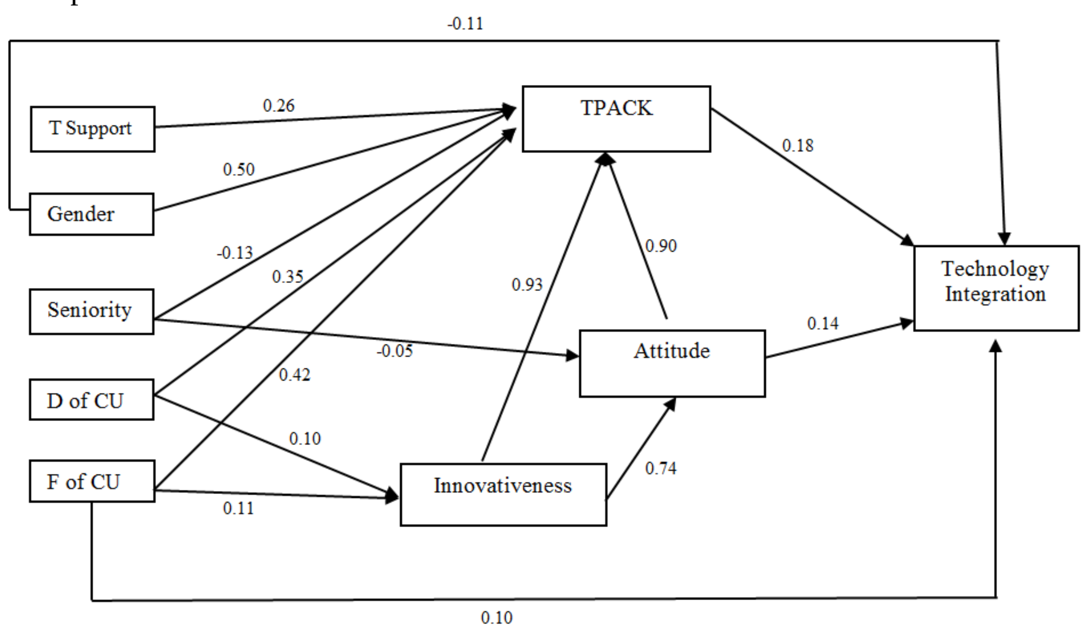

Figure 1: Presentation of variables accounting for technology integration (non-standardized results)

Various fit indices and error values were examined to determine the fit between the established model and the data. Fit indices were close to one and error values were close to zero, showing an adequate model-data fit (Hu & Bentler, 1999; Jöreskog & Sörbom, 1993). Fit indices obtained for the model are as follows: chi-square:15,60, df:11, chi-square/df < 2, GFI:.99, AGFI:.98, NNFI:.99, CFI:1, SRMR:.024, RMSI:.027. Accordingly, the model-data fit was found to be adequate.

Variables with direct or indirect effect on technology integration account for 55% of total variance. Direct effects of technological pedagogical content knowledge (Beta=.18), attitude towards technology use in education (Beta=.14), gender (Beta=-.11) and frequency of use of information and communication technologies (Beta=.10) were found to be significant. For technological pedagogical content knowledge, seven exogenous variables account for 47% of the total variance; while two of the exogenous variables account for 34% of the total variance concerning attitude. Fourteen percent of the variance concerning individual innovativeness is explained by two exogenous variables included in the model. Regression equations are given below.

TB = 0.18*TPACK + 0.14*Attitude - 0.11*Gender+ 0.096*BT Frequency of Use, Error.= 0.18 , $R^2 = 0.55$

Individual innovativeness = 0.096*Duration of Computer Use+ 0.11*Frequency of Computer Use, Error.= 0.20 , $R^2 = 0.14$

TPACK= 0.93*Individual Innovativeness+ 0.90*Attitude + 0.50*Gender+ 0.13*Seniority + 0.35*Duration of Computer Use - 0.42*Frequency of Computer Use+ 0.26*Technical Support, Error.= 2.20 , $R^2 = 0.47$

Attitude = 0.74*Individual Innovativeness- 0.045*Seniority, Error.= 0.26 , $R^2 = 0.34$

Direct effects of exogenous variables (Gender, Seniority, Duration of Computer Use, Frequency of Computer Use, Technical Support, TPACK, Individual Innovativeness, Attitude) on endogenous variables (TPACK, Individual Innovativeness, Attitude, Technology Integration) are presented in Table 2. When direct effects were examined, it was observed that technological pedagogical content knowledge had the greatest direct effect on technology integration. It is followed by attitude, gender, and frequency of computer use.

Exogenous (Independent) Variables	Endogenous (Dependent)Variables TPACK	Individual Innovativeness	Attitude	Technology Integration
Gender	.50*	-	-	-.11
Seniority	-.13*	-	-.05	-
Duration of Computer Use	.35*	.10*	-	-
Frequency of Computer Use	.42*	.11*	-	.10
Technological Support	.26*	-	-	-
TPACK	-	-	-	.18
Individual Innovativeness	.93*	-	.74	-
Attitude	.90*	-	-	.14
R2	.47	.14	.34	.55

Table 2: Direct effects of the factors affecting technology integration (non-standardized coefficients)

Besides the direct effects, the indirect effects of exogenous variables on technology integration were also examined. Absolute magnitudes of indirect effects of exogenous variables vary between .04 and .39. Values related to indirect effects are presented in Table 3.

Independent variable	Mediating variable	Dependent variable	Indirect effect	Direct effect	Total
Gender	→TPACK→	TB	.09*	-.11*	-.02*
Seniority	→ TPACK→ →Attitude→TPACK→	TB	.04*		.04*
Duration Computer of Use	→TPACK→ →Individual In.→TPACK→ → Individual In.→Attitude→	TB	.10*		.10*
Frequency of Computer Use	→TPACK→ →Individual In.→TPACK → → Individual In.→Attitude→	TB	.12*	.10*	.22*

Technical Support	→TPACK→	TB	.05*		.05*
TPACK				.18*	.18*
Individual Innovativeness	→TPACK→ →Attitude→ →Attitude→TPACK→	TB	.39*		.39*
Attitude	→TPACK→	TB	.16*	.14*	.30*

Table 3: Direct, indirect and total effects of independent variables on technology integration (calculated by multiplying over the model)

When the indirect effects were examined, it was observed that all independent variables had an indirect effect on technology integration. Individual innovativeness had the most powerful effect; and it is followed by attitude, frequency of computer use, duration of computer use, gender, technical support and seniority, respectively. When total effects were examined, individual innovativeness is shown to have the greatest effect. It is followed by attitude, frequency of computer use, TPACK, duration of computer use, technical support, and seniority. The total effect of all these variables is significant. When men are taken as a reference in the gender variable, technology integration scale scores of women decrease by 11%, while their TPACK scale scores increase by 50%. Both direct and indirect total effects of gender on technology integration are significant.

Conclusion, Discussion and Suggestions

Today, learner-centred activities are encouraged in instructional activities, and students are expected to be individuals who access information, work in collaboration, solve authentic problems, generate learning products and share and criticise these products (Ornstein et al., 2015). In this respect, learning environments should be equipped with appropriate tools and teachers should be able to use these to support students' processes of learning. Technology is one of the important tools that can support students in becoming active learners. It is, therefore, of importance that learning environments are equipped with information technology that would support information access, communication and collaboration. However, the inclusion of technology as an educational tool for learning environments in schools does not necessarily guarantee its use for supporting learner-centred education (Hennessy et al., 2005; Law et al., 2008). To be able to use technology for supporting learner-centred applications, teachers should have appropriate pedagogical, content and technological knowledge, and understand the interaction between these areas. It is important that teachers improve their teaching abilities to carry out learner-centred education applications and support these applications with technology. Teachers should be supported with pre-service educational and professional development programs to be able to improve their instructional abilities. The variables affecting technology integration should be understood to take evidence-based decisions during the planning of educational activities. So, we can understand teachers' current states better, lead to a better planning based on educational, scientific data and enable a more effective evaluation of the results of education. In the present study, the variables affecting teachers' technology integrations are explained on a path model which was established in the light of the literature. It was observed that the fit between the data and the model was within acceptable limits. In line with the statistical model obtained at the end of the path analysis, some suggestions are introduced for improving instructional abilities.

The analysis of the path model shows that TPACK is the most effective variable within teachers' technology integration processes. Several studies in the literature also report TPACK to be effective on technology integration in education (Mishra & Koehler, 2006; Opfer & Pedder, 2011). Similarly, the significance of the use of pedagogical knowledge along with technology is emphasised in the OECD report (2015), and it is noted that technology use in education may have negative effects if it is not supported with adequate pedagogical knowledge. To encourage technology integration, teachers' technological, content and pedagogical knowledge should be improved, and teachers should understand how these areas of knowledge interact.

Attitude towards technology use in education is another important variable that has a direct effect on technology integration in the path model. The literature also includes several studies which report the effect of attitude on technology integration (Baya'a et al., 2012; Chikasha et al., 2014; Karaca et al., 2013). While some researchers note the necessity of positive attitude for using technology for educational purposes (Ertmer & Ottenbreit-Leftwich, 2010), some researchers report that teachers begin to develop positive attitudes towards a method or material after they try them first and observe their convenience and positive effects on students (Guskey, 2000; Pierce & Ball, 2009; Uslu & Bümen, 2012). To encourage teachers to develop positive attitudes, they should be shown how to use new and successful applications, and their positive effects on student achievement should be demonstrated. Teachers should be encouraged to consider change and recognise its positive contributions to students' future success.

Gender is another variable that has a direct effect on technology integration in the path model. When men are taken as a reference, technology integration scores of women tend to decrease to some extent. There are studies in the literature that similarly report a higher proportion of technology use and technology integration in men compared to women (Hermans et al., 2008; Tondeur et al., 2008). On the other hand, an increase is observed in the technological pedagogical content knowledge of women when men are taken as a reference. As Lin et al. (2014) also note, this may be because women spare more time to additional work required for the use of technology in learning environments. However, some studies report that gender does not have any effect on technology use in education (Hao & Lee, 2015; Lin et al., 2012; Summak et al., 2010).

Besides gender, the frequency of computer use is also observed to have a direct effect on technology integration on the model. Similarly, Area-Moreira et al. (2016) report the effect of frequency of computer use on the use of technology in education. The frequency of computer use has a direct effect also on individual innovativeness and TPACK. Therefore, teachers should be appropriately encouraged to increase their use of technology in daily life. Considering that technology use in daily life would not suffice for desired technology integration (Hixon & Buckenmeyer, 2009), teachers' knowledge and abilities should be improved in terms of technology integration, such as preparing materials through the use of technology, using technology in communication with students and in-class technology use (Uslu, 2013).

Although teachers' professional seniority has no direct effect on technology integration on the model, it has a considerable indirect effect through attitude and TPACK. The effect of seniority on technology integration through attitude and TPACK was found to be significant. Teachers' technology integrations decrease with the rise in professional seniority. As observed in the present study, although there are studies reporting a direct or indirect effect of professional seniority on technology integration (Area-Moreira et al., 2016; Gomez et al., 2010; Karaca et al., 2013), some studies report the opposite, showing that professional seniority does not affect technological integration (Shi et al., 2013). Based on the obtained findings, it may be stated that the sooner teachers begin to work on the use and integration of technology in learning environments, the more successful they will be in their applications. In this respect, adequate integration of technology into the learning environment by teachers during pre-service teaching education will be helpful for setting an example for prospective teachers. Also, supporting the TPACK of teacher candidates will enable them to integrate with technology in early stages of their career. To this end, professional development programs, follow-up and support studies should be conducted to enable teachers to integrate technology into learning environments especially in the first years of their career.

While technical support does not have a direct effect on technology integration in this model, it has an indirect effect through TPACK. Several studies in the literature also report the necessity of technical support for technology integration (Inan & Lowther, 2010; Lin et al., 2014; Yıldırım, 2007). Therefore, providing immediate and accessible technical support is an important requirement for increasing technology integration in schools.

Individual innovativeness does also not have a direct effect on technology integration on this path model. However, it has an indirect effect through both TPACK and attitude. According to the calculation of the total effect, individual innovativeness is the variable with the greatest effect on technology integration. There are other studies which also report the effect of individual innovativeness and characteristics related to change on teachers' technology integration (Tondeur et al., 2008).Some studies show that individual innovativeness is effective on both TPACK and attitude towards technology use in education (Çuhadar et al., 2013; Örün et al., 2015; Yilmaz & Bayraktar, 2014). It is, therefore, highly important to take teachers' levels of individual innovativeness into consideration in studies on technology integration. Possible differences in teachers' states of individual innovativeness should be determined carefully, and necessary support should be planned and provided in accordance with these differences (Kılıçer & Odabaşı, 2010). Furthermore, theories of change should be taken into account and applied when appropriate, in the process of supporting technology integration to improve teachers' innovativeness.

This study is expected to contribute to the understanding and improvement of the teaching process. Based on the path model established within the scope of the research, and the data obtained from the literature, the hypothetical model suggested for the improvement of instructional abilities is presented in Figure 2.

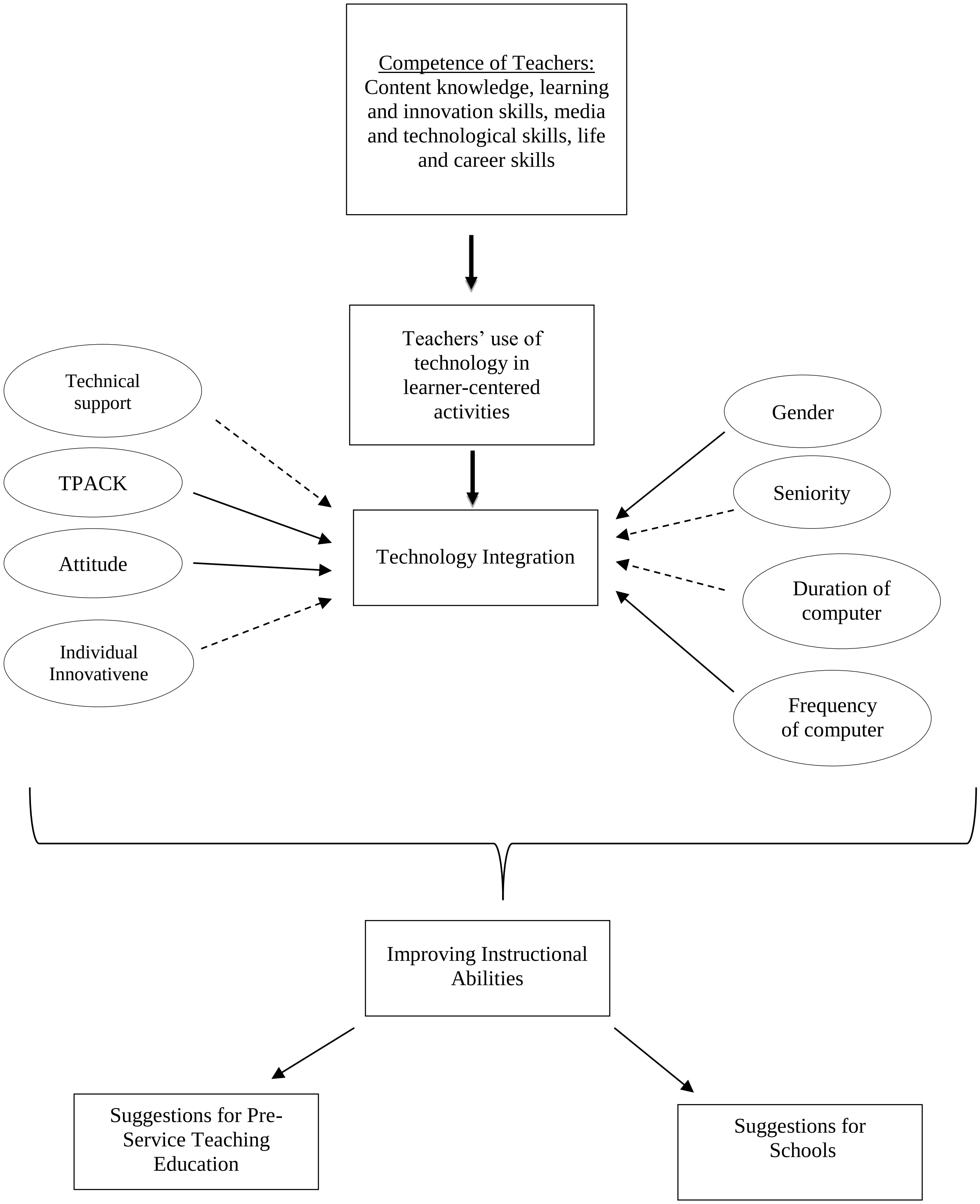

Figure 2: A hypothetical model suggestion for the improvement of instructional abilities through technology integration

As can be seen in Figure 2, focusing on the activities of accessing information, questioning, working in collaboration, product generation and publication will contribute to the improvement of students' twenty-first-century abilities during the learning process. Therefore, teachers' uses of technology by integrating it into pedagogical and content knowledge in the learning process can support learner-centred activities. According to the findings; gender, seniority, duration and frequency of computer use, technical support, TPACK, attitude, and individual innovativeness are effective on technological integration. Direct effects are shown with straight lines, and indirect ones are shown with dashed lines. Based on the model obtained at the end of the path analysis, the following suggestions are introduced for the improvement of instructional abilities:

1. According to the findings, teachers' states of technology integration improve with the increase in their duration of computer use. Therefore, teachers' technology uses should be supported as early as possible. In pre-service teaching education, studies should be conducted to enable teacher candidates to use technology more frequently in theoretical and applied courses.
2. Technology integration is negatively affected by the rise in seniority. Therefore, in pre-service education, learning activities requiring technology use should be planned for teacher candidates, and instructors should set an example by using learner-centered technology applications. Also, follow-up and support studies should be conducted through appropriate professional development programs in the first years of the profession. Professional development programs should be carried out specifically for senior teachers to improve their technology integration abilities. Professional development models like holding training courses, observation/assessment and action research can be preferred for these programs, and branch-based grouping or model combinations can be developed.
3. Findings show that teachers' state of technology integration improves with the increase in the frequency of computer use. Therefore, teachers should be encouraged to use technology in daily life and to plan and conduct learner-centred activities. They should be taught how to do planning for technology use in education, how to collect educational materials from the internet in line with the learning goals, and how to use Internet technologies to support learner-centered applications. To this end, applied studies with lesser theoretical load should be carried out both in pre-service teaching education and in professional development programs.
4. Providing immediate technical support is highly important for improving teachers' states of technology integration. In this respect, schools should accommodate specialists who will provide teachers with immediate technical support when they experience difficulties in using technology.
5. TPACK is one of the important variables that have a direct effect on technology integration. Increasing technological knowledge should not be the only target in studies on improving technology integration in education; knowledge and skills for a better understanding of the interaction between technology, pedagogy and content should be supported as from pre-service teaching education. In this respect, activities, assignments and projects should be planned for the theoretical understanding and application of TPACK in courses like Teaching Principles and Methods, Teaching Technologies and Material Development, and Special Teaching Methods in pre-service teaching education. Necessary activities should be planned to enable teachers to understand the interaction

between technology, pedagogy and content knowledge, and make applications through school-based, long-term and applied for professional development programs.

6. According to the findings, individual innovativeness has an important indirect effect on technology integration through TPACK and attitude. Innovativeness is defined as willingness to change and involves concepts like risk-taking, openness to experience, creativity and opinion leadership (Kılıçer & Odabaşı, 2010). It is important to encourage teacher candidates to take risks in flexible learning environments to improve the innovativeness of them. Also, learning activities should be meticulously planned and conducted to improve teacher candidates' creativity skills by encouraging them to define and re-describe problems, tolerate uncertainties, say their opinions without fear of being criticised, be patient and have the intrinsic motivation (Sternberg & Lubart, 2016). For teachers, the principles of increasing innovativeness should be implemented in professional development programs, and their creativity and risk-taking skills should be supported in in-class applications by increasing their autonomy.
7. Attitude is an important variable affecting technology integration. Sample applications should be presented and how these samples affect student success should be explained to enable teachers to develop positive attitudes. Also, teachers should be encouraged to try recommended applications and observe their effects on student success.
8. Gender is observed to be an important variable in technology integration. When men are taken as a reference, women's levels of technology integration decrease and their TPACK increases. There are also studies in the literature reporting that women's technology uses are lower (Hermans et al., 2008; Tondeur et al., 2008), yet they are more willing to spare the required time for planning technology (Lin et al., 2014). In this respect, the efficiency of applications can be increased by encouraging female teachers for technology integration and motivating male teachers for sparing more time for planning activities integrated with technology.

Although the results of this study introduce significant information on teachers' technology integration, some limitations of the study should be noted. Firstly, research sample was limited to 600 teachers working in high schools in the city of Izmir, Turkey. Therefore, the model can be re-tested by collecting data from other cultures also. All variables were measured through methods based on self-report. The method can be re-tested by measuring the variables included in the research through methods other than self-report. The importance of school culture in technology integration has been emphasised by many researchers (Ertmer, 1999; Mitchell, Gagné, Beaudry, & Dyer, 2012). In the present study, "technical support" was examined as one of the variables that can be considered as the reflection of school culture. Qualitative studies can be carried out to perform a detailed research on the effect of school culture on technology integration. Using technology for educational purposes may not always include learner-centred activities (Hixon & Buckenmeyer, 2009). Collecting qualitative data, such as through observation, may be useful for obtaining in-depth data on whether the applications in technology integration studies are learner-centred. Inappropriate use of technology in the learning environment may have negative effects on student learning (OECD, 2015). Therefore, how technology integration efforts affect students should also be examined.

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