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Curriculum Content Proposal for Integration of Technology in Education

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Abstract

This study focuses on the content of technology-related courses offered by teacher training institutions to determine the factors that will avoid technology integration in teacher education/training. Two methods are combined in the research. As a first step, the integration of technology in education/teaching models literature was analyzed, synthesized, and categories were created based on the critics. Next, technology-related courses in teacher training curricula were defined, the content of those courses was analyzed, and some content and suggestions were proposed for better technology-integrated courses. Even though literature indicates the most critical barriers to technology integration in education are hardware problems and the lack of technical infrastructure, one of the underlying factors is the teachers' inadequacy in ICT, the usage of technology in education, and technology integration literacy. These inadequacies are the result of the training curriculum deficiencies. There are three suggestions based on the findings and for further studies. The first one is to add courses and contents to the teacher-training curriculum as discussed in interpretation and discussion. Secondly, instructional technology courses should have specific content related to the content area. The syllabus should be developed with the cooperation of the content area teacher trainer for each subject area. Finally, as a part of curriculum development, these proposed courses and their content should be reevaluated for further studies.

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Introduction

Integrating technology in education can only create an engagement between technology and the learning-teaching process. The teacher is critical for integrating technology in education/teaching, and the initial point is teacher-training institutions. Although teachers and teacher trainers must be technology literate to ensure technology integration in education/teaching, more is needed to be ICT literate to use this literacy effectively in teaching activities. It should be remembered that a person's technology qualifications and the ability to use technology in teaching require different competencies.

Some research indicates that even though teachers have some ICT skills, they do not have specified skills to transfer those skills to educational settings (Kim, Kim, Lee, Spector & DeMeester, 2013; Llorens, Salanova, & Grau, 2002; Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010). Other studies emphasize that pre-service teachers born in the digital age can use essential information technologies daily (Kennedy, Judd, Churchward, Gray, & Krause, 2008). However, their knowledge and skills could be more extensive in subjects that require higher level skills, such as blogs, wiki, and Web 2.0 technologies (Jones, Ramanau, Cross, & Healing, 2010; Marganyan, Littlejohn, & Vojt, 2011). Similarly, many studies report those teacher trainers, who already have basic technological skills and have a positive attitude toward using technology in teaching, have minimal technology experience and do not use technology enough in their lessons (Carroll & Morrell, 2006; Dinçer & Yeşilpınar-Uyar, 2016; Drent & Meelissen, 2008; Instefjord & Munthe, 2017; O'Brien, Aguinaga, Hines, & Hartshorne, 2011).

The teacher trainers, as role models for pre-service teachers, and the pre-service teacher should know and use instructional technology in classroom settings to eliminate those limitations (Carroll & Morrell, 2006; Groth, Dunlap, & Kidd, 2007; Matthew, Stephens, Callaway, Letendre, & Kimbell-Lopez, 2002; Uerz, Volman, & Kral, 2018). For example, Drent and Meelissen (2008) underline that teachers gain experience in ICT by using it. Therefore, they suggest that teacher trainers increase their competencies by using ICT in classroom settings and be models to pre-service teachers. Therefore, pre-service teachers should first be trained in ICT literacy (Agyei & Voogt, 2011; Drent & Meelissen, 2008; Sang, Valcke, Braak & Tondeur, 2010) and then focus on how to use ICT in their subject area's teaching (Angeli & Valanides, 2005). Despite these requirements, many countries' teacher training curricula do not include enough ICT literacy and ICT integration in the subject area of teaching (Gudmundsdottir & Hatlevik, 2018; Instefjord & Munthe, 2017; Tømte, Enochsson, Buskqvist, & Kårstein, 2015; Tondeur, et al., 2012).

One of the many reasons to engage more with ICT training is the interchangeable usage of ICT in teaching and ICT integration in the teacher training curriculum. Even though there are several ICT literacy definitions and standards created by many organizations (ACER, 2008; ISTE, 2021; OECD, 2005; 2013), these definitions and standards focus on the usage of ICT in instruction (ACER, 2008; ISTE, 2021; OECD, 2013). Dinçer (2021a) points out that using ICT in instruction is about using ICT technologies in the instruction process, and it does not include any detail-oriented activity. However, integrating technology in education/teaching sets up technology as the main component of instruction. Using a smartboard instead of a blackboard is a specific example of using ICT in instruction. It facilitates instruction. However, the aim of using the material could be more innovative; that is, using a blackboard instead of a

smartboard does not create any significant change in the system. Considering smartboards as a part of the curricula, saving activities and making them available online through learning management systems can be considered ICT integration in education/teaching. Technology plays a critical role in this scenario as a well-defined part of curricula, supporting learning opportunities at out-of-school times; the absence of technology may result in a learning loss. Teacher training curricula have some elements of the basic skills of ICT, such as introductory ICT literacy courses and the usage of ICT in instruction. However, as mentioned above, the usage of ICT in instruction and the technological pedagogical usage of ICT are very different concepts, and the second requires better-fitted curricula and models for integration.

Mishra and Koehler (2006) underline the importance of the intersection of content knowledge and ICT literacy through their Technological Pedagogical Content Knowledge [TPACK] framework. Technology, pedagogy, and content knowledge are described as three individual components of teaching, and technology integration in education is possible only by creating an intersection among them.

They define the components

and the variables related to TPACK (Rodríguez Moreno, Agreda Montoro, & Ortiz Colón, 2019). In the recent TPACK literature, establishing a theoretical framework or TPACK's relationship with different content area teacher training curricula is looked into (Chaipidech, Kajonmanee, Chaipah, Panjaburee & Srisawasdi, 2021; Tzavara & Komis, 2015). However, they focus on the theoretical component of the model or the case studies instead of using specific models. Also, empirical studies have conducted research with self-report scales instead of knowledge or skill tests (Dinçer, 2018; Dinçer & Doğanay, 2015; Dinçer & Doğanay, 2017; Hohlfeld, Ritzhaupt, Barron, & Kemker, 2008).

In summary, the TPACK model is essential for integrating technology into education. However, there are gaps in the literature about how this model fits different content area teaching, how appropriate curricula will develop for the intersection of technology, pedagogy, and content knowledge, and how the model should be assessed. TPACK model requires a specific teacher training curriculum for different content areas to integrate technology so that teachers may use technology effectively for different content areas in their classroom practice. For example, the integration of technology in education/teaching may vary between content like social science or science teaching. However, how this integration will occur in those different content areas is still being determined.

Teacher qualifications should be revised according to the usage of technology and the technology-integrated instruction to apply the TPACK model and to have better technology integration to teacher training curricula (Drent & Meelissen, 2008; ISTE, 2021; Tondeur, Aesaert, Pynoo, van Braak, Fraeyman, & Erstad, 2017; Uerz et al., 2018). Like many other countries, Turkey has some technology-related courses in its teacher training curriculum; however, those courses are limited to basic ICT literacy skills. Having courses limited to ICT literacy skills is one of the most critical barriers to integrating technology into education. It is necessary to understand the other barriers to the integration of technology in education in the Turkey context and propose some courses to teacher training institutions.

This research aims to suggest the content of technology-related courses in teacher training institutions by determining the factors preventing technology integration in education/training. For this purpose, answers to the following questions were sought:

1) What are the main factors hindering technology integration in education/training?
2) What is the content of the technology-related courses of teacher training institutions in Turkey?
3) How can the curriculum be developed to fully integrate technology into education in teacher training institutions in Turkey?

Method

Research Model

Developing a model for instruction goes far beginning of the teaching act. It progresses by either revising the former model or proposing a model from scratch. For example, Halloun (2007) states that developing a model can occur by "analyzing the data from the field" or "doing a critical review of the literature and creating a synthesis."

In this study, both methods are combined. As a first step, the literature about the integration of technology in education/teaching models literature was analyzed, synthesized, and categories were created based on the critics. Next, technology-related courses in teacher training curricula were defined, the content of those courses was analyzed, and some content and suggestions were proposed for better technology-integrated courses.

Data Collection and Analysis

There were two steps for data collection. First, the literature about technology integration in education/teaching models (2016-2020) was coded for synthesis by the document analysis method. Second, technology-related courses in teacher training curricula were examined, and the course's aims and content were coded.

There were 42 studies as a result of a search with the keywords of "integration of technology in education/teaching," "technology integration in education/teaching," "education/teaching with technology," and "barriers/limitations." In parallel with the research question, the results of the studies in the literature were grouped and coded according to the main factors that prevent technology integration in education/training.

Results

The categories of barriers to technology integration in education are summarized below in Table 1. As Table 1 indicates, the significant barrier to integrating technology in education is the lack of infrastructure, such as computers, and the internet connection pace (f=43). The other barriers, by order, are teachers' and students' ICT literacy level (f=42), insufficient content (f=17), and teachers' and students' literacy level of integration of technology in education/teaching (f=4).

Literature regarding technology integration in education/teaching indicates that studies focus on TPACK Model for technology integration. There was no critical perspective toward the

TPACK model; however, there are limitations due to ambiguous knowledge about integrating pedagogical content knowledge with technology.

The studies focus on teachers' and pre-services teachers' ICT usage, or integration, which has severe critics and points out some significant limitations. Those limitations and critics can summarize as "the inappropriate assessment tools" (f=22), "the ambiguous models especially for different content areas' specific nature" (f=15), and "the lack of prescription about applying technology in specific content knowledge" (f=13). Most studies are based on self-report tools and measure attitudes, neither knowledge nor skills.

Table 1. *The barriers to technology integration in education are mentioned in the literature.*

Categories	*f*
The lack of the infrastructure	43
Teachers' ICT literacy level	24
Students' ICT literacy level	18
Insufficient content	17
Teachers' literacy level of integration of technology in education/teaching	2
Students ' literacy level of integration of technology in education/teaching	2

Turkish Higher Education Council's (YÖK, 2018) curriculum for the faculty of education is examined to review to what extent teacher training curricula are adapted to technology-integrated teaching. There are two standard courses in all teacher training curricula. One of those courses is three hours per week, and the other is two hours per week courses (ICT, instructional technologies). Those courses' content is described below:

Information Technologies: Information and communication technologies and computational thinking; the concepts and approaches to problem-solving; algorithms and flow diagrams; computer systems; the basic concepts about the hardware and the software; the basics of operating systems; up-to-date operating systems; file management; utility programs (third party software); word-processing software; computing/tabling/graphic software; presentation software; desktop publishing; database management systems; web design; the usage of internet in education; communication and cooperation technologies; internet security; communication and technology ethics and copyright issues; the effects of computer and internet on children/teenagers.

Instructional Technologies: Information technologies in education; the teaching process and the classification of instructional technologies; the theoretical approaches towards instructional technologies; the instructional technologies as a tool and a material; the instructional technology design; to design a thematic instructional technology; to create an object warehouse to the specific subject area; the criteria to assess an instructional material.

Discussion, Conclusion, and Implications

With the development of technology, teaching materials change, which requires the revision of teacher competencies (Drent & Meelissen, 2008; ISTE, 2016; 2017; Tondeur et al., 2017; Uerz

et al., 2018). For integrating technology in education/teaching, technology literacy and the use of technology in education must be taught in teacher education. There are many studies in the literature on the technology literacy of teachers and pre-service teachers (Aldunate & Nussbaum, 2013; Uerz et al., 2018; Webb & Cox, 2004). However, only some of these studies examine the variables of technology integration in education (Drent & Meelissen, 2008; Groth et al., 2007; Mishra & Koehler, 2006; Uerz et al., 2018). Most of the studies focus on the instruction-technologies relationship with different variables to investigate the effect of instructional material on students' achievement; the skills of teachers or prospective teachers need to be examined in depth. It is a fact that teachers must first be technology literate in order to use them, especially technology-related materials. Dinçer (2021b) indicates that ICT literacy is insufficient to use those technologies as material or for any other purpose in the instruction process. ICT literacy does not necessarily mean teachers have the skill set to use technology in instruction. Teachers should have the skills to use these technologies in their teaching activities as well as the skills to use these technologies in their teaching activities.

In order to fully understand the situation, as mentioned earlier, it is necessary to understand the difference between technology use and integration in education/training. The use of technology in education or teaching and integrating technology in education/teaching represent two different situations. The use of technology in education/teaching refers to the direct use of the elements/factors expressed by technology in education or teaching activities; in other words, there is no complicated situation regarding the use of these technologies. However, it states that integrating technology in education/teaching has become one of the teaching activities' main factors/elements. For example, using the interactive whiteboard instead of the blackboard in teaching activities is the use of technology. It provides convenience in teaching activities but will not provide any innovation or severe convenience in terms of its intended use. In other words, bringing the blackboard instead of removing the interactive whiteboard from the teaching environment will not make a meaningful difference. They are learning management systems by including the interactive whiteboard in the curriculum and recording their use. Making it accessible to students with applications can be an example of integrating technology in education/teaching. The critical role here is for the learners to use this element in their extracurricular activities by clearly specifying the material in the curriculum; Using the interactive whiteboard may help the teaching activities.

Table 1 indicates that at first sight, the most critical barrier is hardware and infrastructure; however, the underlying barriers are teachers' limited technology usage and low literacy in using ICT. Dotong, De Castro, Dolot, and Prenda's (2016) study support this perspective, especially in under-developed and developing countries. As a result, teacher-training curricula should be updated to facilitate teachers' technology usage in instruction and their ICT-integrated teaching. Those updated curricula should include three dimensions ICT literacy, the usage of technology in education, and the integration of technology in education/teaching. Research indicates that even ICT-literate teachers may not use technology in educational settings (Georgina & Olson, 2008; Uerz, etc., 2018). As a result, having these three dimensions is the bare minimum for technology integration in education.

In Turkey, teacher training curriculum, there are only two courses related to technology, and their content is so limited. As a piece of evidence, the Turkish Higher Education Council (YOK, 2018) announced that those two courses' syllabi' are the same for all different content areas,

which is contrasted with the perspective of the recently discussed technology integration model, TPACK. The TPACK model indicates that different content areas use different pedagogical methods and technologies. "The Methods and Principles of Teaching" course in the teaching training curriculum can be considered as creating an intersection for different content areas, pedagogy, and technology integration. However, this course also has a standard description, aim, and content for all content areas, suggesting otherwise.

The discussions so far can be summarized as the teacher training curriculum in Turkey requires an update on technology-related courses from both the number and the content perspective. This update may constitute as such: After taking "The information and Communication Technologies" course, there can be a course for three credits (Theory: 2 hours, Practice: 1 hour) "The usage of technology in education and instruction." This course should focus on the relationship between the related content area and its pedagogical practices instead of broad and narrow content related to technology. The proposed courses' goals and content are described below:

The information and communication technologies content: The up-to-date operating systems; file management; internet search; ICT security and ethics; social media literacy; word-processing software; computing/tabling/graphic software; presentation software; database management systems.

The information and communication technologies goals:

Students,

• be able to describe operating systems and software,

• be able to achieve files based on a system,

• be able to open different file types with appropriate software,

• be able to use advanced search engines to reach out for specific information,

• be able to question the information source and use reliable sources,

• willing to follow up on ethical codes about information and communication technologies,

• be able to create a formatted document with word-processing software,

• be able to create a formula by computing/tabling/graphic software,

• be able to create a presentation with presentation software.

The usage of technology in education and instruction content: Teaching management systems, cloud services, searching information, communication technologies, digital typography, the practice of third-party digital tools (projection, smart board), the necessity of technology in education.

The usage of technology in education and instruction goals:

Students;

• be able to list learning management systems' goals,

• be able to use learning management systems,

• be able to share the file through cloud systems,

- be able to use the proper sources to reach out for information,
- be able to create and manage groups through communication technologies (forum, e-mail, mobile phone applications)
- be able to typeset by word-processing software,
- be able to set up third-party digital tools,
- be able to use third-party digital tools in education,
- be able to use proper technology,
- be able to assess a chosen technology from a cost-effective perspective.

The content of the instructional technologies course should be changed for the pre-service teachers who have gained basic literacy on the use of technology, and it should be added to the content of technology integration in education. However, these contents are different in all fields. The ones related to the use and integration of field-specific technology are added to the curriculum as a five-hours (Theory: 3 hours, Practice: 2 hours) practical course. In this context, it is suggested to determine the course content and achievements as follows:

Instructional technologies course content: Teaching process and classification of instructional technologies; theoretical approaches to instructional technologies; the relationship between pedagogy and technology; application of instructional technologies in instructional design; material design processes; designing site-specific materials; technology integration in education/training; domain-specific measurement and evaluation using technology.

Instructional technologies course goals:

Students,

- be able to classify instructional technology,
- be able to explain theoretical approaches related to instructional technologies,
- be able to List the material design processes,
- be able to design material specific to the field,
- be able to use instructional strategies that combine content, technologies, and instruction
- be able to develop course content (instructional software, educational games) by using technology in teaching;
- be able to develop assessment tools through technology.

Conclusion and Suggestions

Even though literature indicates the most critical barriers to technology integration in education are hardware problems and the lack of technical infrastructure, one of the underlying factors is the teachers' inadequacy in ICT, the usage of technology in education, and technology integration literacy. These inadequacies are the result of the teacher training curriculum's deficiency.

It is suggested,

- To add courses and contents to the teacher training curriculum as discussed in interpretation and discussion.
- Instructional technology courses should have specific content related to the content area. The syllabus should be developed with the cooperation of the content area teacher trainer for each subject area.
- As a part of curriculum development, these proposed courses and their content should be reevaluated for further studies.

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TÜRKÇE GENİŞ ÖZET

Eğitimde Teknoloji Entegrasyonu İçin Öğretim Programı İçerik Önerisi

Giriş

TPACK Modeli teknoloji entegrasyonunda önemli bir aşamadır; ancak modelde, özellikle farklı disiplinlerde, teknoloji pedagoji ve alan bilgisi kesişimlerini içeren öğretimlerin nasıl yapılabileceğine ilişkin uygun bir öğretim programı önerilmemiş; model çıktılarının nasıl ölçülmesi gerektiği ve modele ilişkin öğretim programlarına yer verilmemiştir. Öğretmenlerin öğretim faaliyetlerinde teknolojiyi etkin kullanabilmeleri için öğretmen eğitimi sırasında teknolojiyi alanlarına göre entegre edebilmelerini sağlayacak öğretim programına ihtiyaçları vardır ki bu durumun nasıl sağlanacağı TPACK Modeli'nde açık olarak belirtilmemiştir.

TPACK Modeli'nin uygulanabilmesi ve teknoloji entegrasyonunun sağlanması teknoloji kullanımı ve entegrasyonu içerikli öğretmen yeterliklerinin revize edilmesini gerektirmekte (Drent ve Meelissen, 2008), öğretmen yetiştiren kurumların öğretim programlarının buna göre tasarlanması gerekmektedir. Türkiye'deki eğitim fakültelerinde bilgisayar ve teknoloji içerikli öğretim programların içeriği bulunmasına rağmen bu programlar temel bilgisayar okuryazarlığı seviyesinde sınırlı kalmaktadır. Eğitimde teknoloji entegrasyonunun önündeki en büyük problemlerden birisi de budur. Bu problem durumunu aşmak için eğitimde teknoloji entegrasyonuna engel teşkil edecek diğer faktörlerin de belirlenerek öğretmen yetiştiren kurumların teknoloji ile ilgili derslerine ilişkin öğretim programı geliştirilmesi gerekmektedir.

Yukarıda değinilen sorunlar göz önüne alınarak bu araştırmada eğitimde/öğretimde teknoloji entegrasyonuna engel teşkil edecek faktörler belirlenerek öğretmen yetiştiren kurumların teknoloji ile ilgili derslerine ilişkin içerik önerilmesi amaçlanmıştır.

Yöntem

Halloun (2007) model geliştirmenin "araştırma sürecinde elde edilen verilerin analizi ile" ya da "literatürdeki belirtmelerin eleştirel bir biçimde analiz edilmesi ve sentezlenmesi" ile yapılabileceğini belirtmiştir. Bu araştırmanın yöntemi ise iki yaklaşımın sentezlenmesi ile kurgulanmıştır. Öncelikle teknoloji entegrasyon modelleri ile ilgili literatürdeki çalışma sonuçları analiz edilerek sentezlenmiş, eleştiriler kategorilendirilmiştir. Daha sonra teknoloji içerikli dersler belirlenerek ders içerikleri analiz edilmiş, eğitimde teknoloji entegrasyonunun sağlanabilmesi için içerik ve öneriler sunulmuştur.

Bulgular

Son beş yıldaki ilgili literatür taranmış, incelenen 42 çalışmada belirtilen teknolojinin eğitimde entegrasyonu önündeki engeller kategorileştirilmiştir. Tablo 1'de de görüldüğü üzere engellerin başında bilgisayar, internet hızı vb. teknik ekipmanların yetersiz olduğu (f=43)

bulgusu elde edilmiştir. Diğer engeller ise sırasıyla öğretmen ve öğrencilerin teknoloji okuryazarlıklarının yeterli düzeyde olmaması (f=42), içerik yetersizliği (f=17) ve öğretmen-öğrencilerin eğitimde teknoloji entegrasyonu okuryazarlık düzeylerinin düşük olması (f=4), olarak belirlenmiştir.

Öğretmenlerin ya da öğretmen adaylarının eğitimde teknoloji kullanımı ya da entegrasyonunu inceleyen çalışmalarda ise ciddi eleştirilerin ve sınırlılıkların olduğu tespiti yapılmıştır. Bu eleştiri ve sınırlılıklar "ölçme araçlarının uygun olmaması" (f=22), "modellerin özellikle alanların farklı durumlarına özgü yapı kullanımının net olmaması" (f=15), "teknolojinin alan bilgisine özgü yönerge içermemesi" (f=13) şeklinde sıralanmıştır. Çalışmaların hemen hepsinde ölçmenin öz değerlendirme şeklinde yapıldığı, bilgi ya da beceriyi değil algıyı ölçtüğü bulgusuna erişilmiştir.

Tartışma, Sonuç ve Öneriler

Öğretimde teknoloji entegrasyonu için bu bağlamda teknoloji okuryazarlığının ve teknolojinin eğitimde kullanımına ilişkin öğretimlerin, öğretmen eğitiminde verilmesi önemlidir. Literatürde öğretmenlerin ya da öğretmen adaylarının teknoloji okuryazarlıkları ile ilgili çok sayıda çalışma mevcuttur (Aldunate ve Nussbaum, 2013; Uerz vd., 2018; Webb ve Cox, 2004). Ancak bu çalışmaların az bir kısmı eğitimde teknolojinin entegrasyonunun değişkenlerini incelemektedir (Drent ve Meelissen, 2008; Groth ve diğ., 2007; Mishra ve Koehler, 2006; Uerz vd., 2018). Literatürdeki eğitim-teknoloji ilişkisini araştıran çalışmalar incelendiğinde çalışmaların genellikle dijital materyallerin öğrencilerin akademik başarılarına etkisini inceleme boyutunda kaldığı, öğretmenlerin ya da öğretmen adaylarının bunları kullanma becerilerinin derinlemesine incelenmediği görülmektedir. Başta teknoloji ile ilişkili materyaller olmak üzere, bunları kullanmak için öğretmenlerin öncelikle teknoloji okuryazarı olması gerektiği bir gerçektir. Dinçer (2021a) ister materyal boyutunda olsun ister diğer boyutlarda olsun, teknolojinin öğretimde kullanılabilmesi için sadece teknoloji okuryazarı olunmasının yeterli olmadığı sonucuna erişmiştir. Öğretmenlerin teknoloji okuryazarı olma gereklilikleri gibi bu teknolojileri öğretim faaliyetlerinde kullanabilecekleri becerilerinin de olması gerekmektedir.

Eğitimde/öğretimde teknoloji kullanımı ve entegrasyonunun farkının anlaşılması gerekmektedir. Öğretimde teknoloji kullanımı ve öğretimde teknoloji entegrasyonu iki farklı durumu ifade etmektedir. Öğretimde teknoloji kullanımı, teknoloji ile ifade edilen unsurların öğretim faaliyetlerinde doğrudan kullanılmasını ifade eder; yani bu teknolojilerin kullanımı açısından ayrıntılı bir durum söz konusu değildir. Ancak öğretimde teknoloji entegrasyonu kullanılan teknolojinin öğretim faaliyetlerinin ana unsurlarından biri haline gelmesini belirtmektedir. Örneğin etkileşimli tahtanın öğretim faaliyetlerinde sadece kara tahtanın yerine kullanılması öğretimde teknolojinin kullanılmasıdır. Bu durumun öğretim faaliyetlerinde bir kolaylık sağlayacağı açıktır, ancak kullanım amacı açısından bir yenilik ya da ciddi bir kolaylık sağlamayacağı ortadadır. Etkileşimli tahtanın öğretim ortamından kaldırılması yerine kara tahtanın getirilmesi anlamlı bir farklılığa yol açmayacaktır. Etkileşimli tahtanın öğretim programı içerisine dahil edilip, kullanımlarının kaydedilerek öğrenme yönetim sistemleri vb. uygulamalar ile erişimine açılması ise teknolojinin öğretime entegrasyonuna örnek verilebilir. Buradaki kilit rol materyalin öğretim programında net bir şekilde belirtilerek öğrenenlerin okul dışı etkinliklerinde bu unsuru kullanmaları gerekliliğidir; diğer bir değişle etkileşimli tahta kullanılmaması öğretim faaliyetlerini aksatabileceğidir.

Tablo 1'de ilk sırada verilen sınırlılık, donanım ve alt yapı olarak görülse de ana engelin öğretmenlerin teknoloji kullanımı/entegrasyonu okuryazarlıklarının düşük olması olduğu düşünülmektedir. Dotong, De Castro, Dolot ve Prenda (2016) tarafından yapılan çalışmada da benzer bulgular bu düşünceyi destekler niteliktedir. Bu nedenle teknoloji kullanımı ve teknoloji entegrasyonuna yönelik öğretmen yetiştiren kurumlardaki programların güncellenmesi gerektiği anlaşılmaktadır. Bu programların teknoloji okuryazarlığı, öğretimde teknoloji kullanımı ve teknoloji entegrasyonu okuryazarlığı kapsamında üç boyutlu olarak ele alınması gerektiği düşünülmektedir. Bu düşünce bazı çalışmalarda teknoloji okuryazarı olunsa da öğretim faaliyetlerinde teknolojinin tam kullanılmadığı bulgusuyla da desteklenmiştir (Georgina ve Olson, 2008).

Ulusal anlamda eğitim fakültelerinin programlarında belirtilen teknoloji içerikli derslerin iki tane olduğu bilinmekte ve içeriklerinin oldukça sınırlı olduğu düşünülmektedir. Örneğin tüm programlarda ders içerikleri YOK (2018) tarafından aynı şekilde verilmiştir ki bu literatürde TPACK Modeli olarak benimsenen modelin TCK yani teknoloji alan bilgisi alt bileşeni ile tezat bir yapı oluşturduğu şeklinde yorumlanmıştır. TCK her alanda farklı teknoloji kullanım bilgi ve becerisi gerektirdiği gibi bu bilgi ve becerinin öğretiminin de farklı olması gerektiği düşünülmektedir. "Öğretim İlke ve Yöntemleri" dersinin öğretim programında oluşu, bu düşüncenin karşısında olabileceği şeklinde yorumlanabilir; ancak, bu dersin de tüm programlarda aynı içerikle sunulması ve tüm yaklaşımları içermesi nedeniyle bu karşı düşüncenin geçerli olmayacağı düşünülmektedir.

Eğitim fakültesi lisans programlarının teknoloji ile ilgili derslerinin güncellenmesi gerekmektedir. Bu güncellemenin eğitim-öğretimde teknoloji kullanımı ve teknoloji entegrasyonu başlıklarında iki farklı şekilde ele alınması gerektiği düşünülmektedir. Programda yer alan "Bilişim Teknolojileri" dersine ek olarak ikinci dönem de "Eğitim-Öğretimde Teknoloji Kullanımı" dersinin uygulamalı olarak üç saat şeklinde programa eklenmesi önerilmektedir. Teknoloji kullanımına ilişkin temel okuryazarlık kazanmış öğretmen adaylarına öğretim teknolojileri dersinin kapsamında değişiklik yapılıp, ek olarak eğitimde teknoloji entegrasyonuna yönelik içeriklerinde eklenmesi önerilmektedir. Ancak içeriklerin tüm alanlarda aynı olmayıp, alana özgü teknoloji kullanımı ve entegrasyonuna ilişkin içeriklerin de eklenerek dersin uygulamalı olarak beş saat olarak programa eklenmesi önerilmiştir.