Successful Implementation of TPACK in Teacher Preparation Programs

Barbara Martin

Illinois State University, United States

Abstract

Today's teacher education programs should be providing pre-service teachers with ample preparation in shifting instructional approaches enriched with innovative educational technologies. In fact as Lambert & Gong (2010) stated "We have entered a crucial time when the technological preparation of teachers has become an urgent problem we can no longer afford to marginalize" (p. 55). This review of literature examines recent publications on the topic of technology in teacher preparation through the theoretical lens of Technology, Pedagogy and Content Knowledge (TPACK) which has shown potential to emphasize a teacher's understanding of how technologies can be used effectively as a pedagogical tool.

1.INTRODUCTION

Today's teacher preparation students are considered to be part of the population called "digital natives" (Prensky, 2001). "Digital natives" have been using technologies in their daily lives for as long as they can remember. Students are frequently comfortable and savvy with various types of media and can navigate through various technology obstacles unfazed. However, a recent study suggests that perhaps education students are not as prepared for 21st century technology integration as one might expect. Lei (2009) found that although "digital natives" as pre-service teachers use technology extensively, their use of technology has been mainly focused on and related to their social-communication activities and their learning activities as students. As pre-service teachers, they lack the knowledge, skills, and experiences to integrate technology into classrooms to help them teach and to help their students learn, even though they fully recognize the importance of doing so.

With the integration of technology into the daily lives of educators and students it is vital that teacher preparation programs across the nation respond (Kyei-Blankson, Keengwe & Blankson, 2009). In fact, the National Research Council (2005, 2010) recognizes this need to address technology integration in both content (e.g., undergraduate science and math courses) and instructional pedagogy courses. Teacher preparation programs need embrace the shift from skill focused technology courses to technology infused pedagogy curriculum. Today's teacher education programs should provide pre-service teachers with ample preparation in shifting instructional approaches enriched with innovative educational technologies.

DOI :10.5121/ijite.2015.4102

In a meta-analysis of the value and use of technology in K–12 education (Valdez, McNabb, Foertsch et al., 2004), the North Central Regional Laboratory found that "technology innovations are increasing the demand for reforms in teaching and learning approaches that, in turn, are having a significant impact on technology use expectations" (p. iii). New teacher education graduates should be as literate as the "digital natives" they are intending to teach and should be confident in embracing the ever-changing world of technology in education as this will play an integral role in their future classrooms.

In response to this need, the International Society for Technology in Education (ISTE) created standards for administrators and educators regarding the use of technology in the classroom. These needs include such things as inspiring student learning, model digital age work and develop authentic learning experiences for students. These ISTE standards emphasize the importance of the teacher as a facilitator of knowledge construction and aim to foster continued improvement in the field of education.

To successfully integrate digital technologies into instructional practices, pre-service teachers must be trained throughout their undergraduate experiences on technology implementation resources and strategies (Williams, Foulger, & Wetzel, 2009). The National Educational Technology Standards for Teachers (NETS.T) were created by ISTE to provide this instructional support in technology integration. The following concentration areas are covered:

1. Facilitate and inspire student learning and creativity
2. Design and develop digital age learning experiences and assessments
3. Model digital age work and learning
4. Promote and model digital citizenship and responsibility
5. Engage in professional growth and leadership (www.iste.org)

The NETS.T framework for teacher candidates communicates goals for teacher education curriculum and articulates objectives for successful technology implementation. With this framework in mind, schools across the country are developing and delivering curriculum embedded with technology. Institutions of higher education are aligning teacher certification, promotion, and tenure requirements with a corresponding set of professional standards (Cohen& Tally, 2004; Richardson, 2012). Most recently the Council for Accreditation of Educator Preparation (CAEP formerly known as NCATE), the governing body solely in charge of accreditation of teacher preparations across the nation, has begun vocalizing the importance of technology integration across teacher preparation curricula. In the most recent revision of teacher preparation standards, CAEP has articulated that "technology is a critical area that will require new learning and substantial innovation by preparation providers" (CAEP, 2014). The organization also emphasized the importance of technology integration be "imbedded in every aspect of educator preparation" and chose to recognize it throughout the recommended standards as opposed to providing an isolated section for technology standards (CAEP, 2014).

Nationally educators agree that there is vital importance in pre-service teachers developing 21st century technology skills (Pellegrino, Goldman, Bertenthal, &Lawless, 2007). "We have entered a crucial time when fundamental shifts in the economy, changing nature of the workforce, demographic shifts, educational competitiveness, globalization of society, and computerization of

the workplace make the technological preparation of teachers an urgent problem we can no longer afford to marginalize" (Lambert& Gong, 2010, p. 55). While it seems that most teacher preparation programs would agree with this argument, many are still operating under an older, skill-oriented framework that provides technology instruction in a stand-alone course (Parette, Quesenberry.,& Blum, 2010). Moreover, many programs have not taken the time to rigorously evaluate if the students are successfully being technologically prepared (Williams et al., 2009).

2.What is TPACK?

Educators interested in successful technology implementation and integration into K-12 classroom as well as teacher education programs have become familiar with the TPACK framework (Technology Pedagogy and Content Knowledge model). TPACK is a framework for describing and understanding the goals for technology use. The model introduces the relationships and overlapping between all three basic components of knowledge (technology, pedagogy, and content) (Koehler & Mishra, 2009). TPACK emphasizes a teacher's understanding of how technologies can be used effectively as a pedagogical tool and illustrates the rich overlap among the pedagogy, content and technology knowledge bases (see Figure 1).

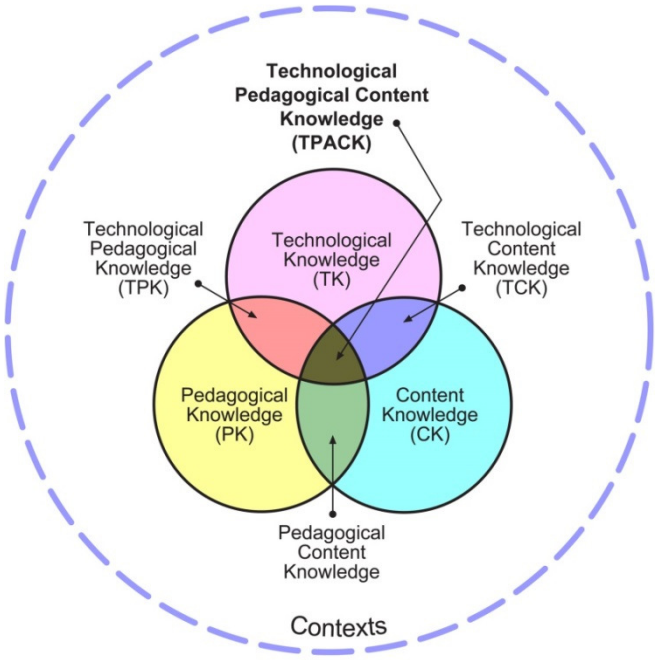

*Figure 1:*TPACK framework (Koehler & Rosenberg, 2014)

TPACK is based on the work of Shulman (1986) which suggested the combination of pedagogy, content and knowledge (PCK) as the key to effective teaching practices. Rather than providing information on content and knowledge separately, Shulman illustrated strength in the overlap between the two constructs. To address a growing need for guidance in technology integration, Koehler and Mishra (2009) expanded Shulman's PCK model by adding an additional dimension,

technology (Figure 1). At the core of TPACK, technology, pedagogy and content combine to illustrate the optimal goal of technology infused curricula as suggested by ISTE NETS technology standards as well as the accreditation body CAEP. This meeting point at the core of TPACK clearly articulates the utopian goal for both classroom teachers and higher education instructors. Thus, the creation of the TPACK model emerged to become a very valuable tool in examining how integrated technology can seamlessly strengthen instructional strategies as well as content knowledge in curricula (Brantley, Kinuthia, Shoffner, et al., 2007; Cox & Graham, 2009; Hu& Fyfe, 2010; Hsu, 2012; Koelher& Mishra, 2008; Schmidt, 2009).

Through the TPACK lens, researchers examine strategies for successful technology integration. In this review of 35recent professional journal articles on TPACK, several reoccurring themes emerged: Student technology confidence, Leadership and modeling of technology integration, and assessment/evaluation of technology integration. This paper will examine and synthesize these suggestions for successful technology integration in teacher preparation in an effort to articulate key supported considerations for implementation.

3.Student Confidence

Much of the research and literature published on the topic of TPACK is based on the building and assessment of student confidence in technology integration (Gao,Choy, Wong, & Wu, 2009; Hersh, 2013; Mayo,Kajs,&Tanguma,2005). One might hypothesize that this theme is so prominent due to the difficulty of quantifying technology integration and the relative ease of obtaining student perception via survey responses. On the other hand, it is important to note that student confidence in technology integration does play a significant role in continued use of technological tools and strategies (Mayo et al., 2005).

In fact, a recent publication Gao et al. (2009) stated “failure to raise the teachers’ competence during pre-service education may result in the pre-service teachers quickly forsaking the use of instructional computer technology in practice” (pg. 725). Similar research by Hersh (2013) suggests that for successful implementation, the use of technology should be embedded in content-specific and methods coursework to increase teacher confidence. Finally, Mayo et al. (2005) concluded that increased use of educational technologies resulted in increased self-efficacy of technology integration. These findings all suggest that the first step to building TPACK in teacher preparation is through building confidence through exposure.

4.Leadership and Modeling of Technology Integration

While exposure to technology learning opportunities was often cited in TPACK literature, exposure to technology modeling was equally emphasized as an integral factor of successful technology integration. In fact, TPACK literature frequently cited education instructors as vital components in technology learning as they play an important part of technology role models for pre-service teachers (Koch,Heo, & Kush, 2012; Kopcha, 2010; Thomas, Herrring, Redmond & Smaldino, 2013).

In another recent publication, Goktas, Yildirim, andYildirim, (2009) articulate how important it is for teacher educators to act as role models for prospective teachers by using technologies in their own teaching. The authors illustrates how specifically instructor competency and willingness to

use technologies in teaching will enrich their courses in the technology-integration process while modeling best practices for pre-service teachers. This sentiment was echoed in another article by Hsu (2012) that stated "modeling from course instructors is a critical component" of technology in teacher preparation (p. 198).

This point was even further supported by recent research by Kovalik, Kuo, and Karpinski. (2013).Results from the study indicated that teacher candidate observations of technology-rich elementary classrooms significantly increased pre-service teacher technology knowledge in all five standard areas of the NETS technology standards for teachers. Similarly, Koch et al. (2012) published a study that showed that technology modeling and program design within a teacher education program can have a significant impact on pre-service teachers, thus improving their perceptions about their ability to integrate technology. This professional goal may seem easier said than done as Gronseth, Brush and Ottenbreit - Leftwich, et al. (2010) suggest "Many methods faculty fail to provide appropriate modeling, as they themselves struggle with keeping up with best practices in current technologies" (pg. 30).

While these findings articulated the profound influence that instructor modeling can have on teacher candidates, Thomas et al. (2013) extended this concept by stating "Leaders, deans and department heads must be an integral part of the change process for successful technology integration to take place"(pg. 55). These recent publications illustrate the importance of modeling technology integration not only by education instructors but also by university leadership and administrators as these individuals articulate the expectations by which the students model their own efforts.

However, building confidence through exposure and modeling are just two of the many ways that TPACK can be established in teacher preparation programs. As Gao et al.(2009) suggest, building TPACK in teacher preparation programs takes a multifaceted effort. The authors illustrate this concept particularly well in their recent publication by stating the following:Teacher education programs need to adopt various strategies to nurture a sophisticated, constructivist view of technology integration. For example, teacher education programs need to challenge pre-service teachers by involving them in critical reflection upon their own practice, providing on going guidance, modelling and collaboration (p. 726).

In fact in many recent publications researchers cited reflection as a suggested integral part of building and evaluating successful TPACK in teacher preparation programs (Goktas et al. 2009; Pierson & Borthwick, 2010).

5.Assessment/Evaluation of Technology Integration

Over the past ten years, the field of technology in education has really struggled with ways to quantify progress toward technology standards. For example, Coffman (2013) describes how the only measure of whether pre-service teachers possess the technology capabilities to satisfy the ISTE NETS•T standards at Kent State University relied on whether or not they successfully completed the one Educational Technology course required. This shows the concern for how programs are evaluating technology standards.

Due to this concern, researchers have recently been dedicated to developing reliable assessment approaches for measuring TPACK and its constructs(Abbitt, 2011; Koehler & Mishra, 2009; Schmidt, 2009).The goal of this effort is to better understand which areas of strengths and weaknesses as well as which professional development approaches do increase teachers' technology knowledge.

In a recent publication Kyie-Blankson et al. (2009) articulated this effort well by stating "Monitoring and examining students' expectations and evaluation of faculty use of technology in instruction is necessary to provide valuable feedback to educators and administrators regarding effective technology integration in teaching and learning" (p. 211). It's clear that researchers and educators are beginning to see the need for systematic design, evaluation, reflection and redesign is essential in building a strong TPACK foundation (Goktas et al., 2009).

In fact to support and define this need further Pierson & Borthwick (2010) created a model for meaningful assessment and reflection with TPACK at the core (see Figure 2). This model illustrates how effective and meaningful assessment of educational technology professional development (ETPD) requires that educators design in-service learning activities that can be measured using methods consistent with teaching and learning. The authors importantly note that reflection and evaluation is an inseparable component of ongoing teacher action and growth.

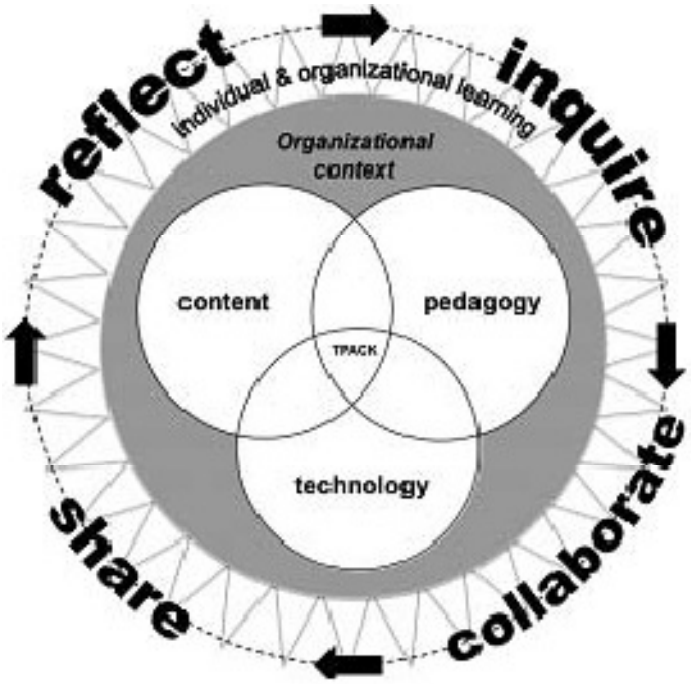

Figure 2: Assessment of educational technology based on a contextually-situated TPACK model

6.Integrated Technology in Teacher Preparation

The final theme that became evident through the review of literature on TPACK was in the delivery of information to pre-service teachers. According to a 2006 Educational Technology in Teacher Education Programs for Initial Licensure study, 100% of all teacher preparation programs in the United States provide instruction on technology integration (Kleiner, Thomas, Lewis, & Greene, 2007). While standards have consistently provided a guideline for what students need to know, universities have chosen the delivery of technology in teacher preparation courses in two separate ways (Kay 2006; Teclehaimanot, Mentzer,& Hickman, 2011; Torre, 2013; Wentzler, 2008) the traditional, stand-alone and the nontraditional, integrated approach.
More recent research in teacher preparation has encouraged instructors to incorporate technologies into their courses to strengthen student confidence, build contextual knowledge and model technology integration (Wetzel, Foulger, & Williams, 2008). However because many universities have not moved to full technology integration, there is a heavy reliance upon the traditional, stand-alone technology courses to provide all of the technology knowledge needed by pre-service teachers.

In fact, in a national study by Gronseth et al. (2010), eighty percent of faculty members responsible for technology experiences indicated all or some of their programs required a standalone educational technology course. In the same study when asked to describe changes they would make in their programs, more than half of the educational technology faculty expressed a desire to have more systemic technology integration, particularly in field experiences and methods courses. Similarly, Mouza& Klein (2013) mentioned "Often, pre-service teachers learn about technology, content, and pedagogy in separate course work, giving them an incomplete picture of how technology can support student learning"(pg. 149).

In a recent study that analyzed technology perceptions in teacher preparation programs, students communicated a disconnect between their technology training and the rest of their program courses. Sutton (2011) shared that students articulated a misalignment with the program expectations of technology integration into course work. However, paradoxically students noticed a lack of emphasis on technology training outside the one required technology course. So frequently noticed is this phenomena that it has created its own name: Techno centric. A term that Seymour Papert (1987) coined to identify overemphasis on the tools of the technologies rather than the learning that they can support, techno centrism defines the stand alone traditional technology courses that are stifling the depth suggested by the TPACK model.

As an alternative to more traditional stand-alone courses, Hersh(2013) suggests that the use of technology should be embedded in content-specific and methods coursework to increase teacher candidate confidence in their technology implementation skills. Collier, Weinburgh and Rivera(2004) echoed the same sediment when it stated that "a key recommendation for teacher educators is to consider that technology literacy no longer be acquired through a series of discrete, perhaps isolated courses, but integrated in and across the curriculum content" (p.466). Hsu (2012) examined the impact of educational technology courses on pre-service teachers' development of knowledge of technology integration in a teacher preparation program and recommended the following:

- First, although it is important to introduce technology knowledge (TK) early in a teacher education program, professional development activities might be offered regularly to pre-service teachers to keep them updated on emerging technology and technology commonly available in their placement schools.
- Second, it is essential that educational technology faculty, methods course faculty and school teachers collaborate to develop technology-integrated teacher education curricula that help pre-service teachers to develop technology content knowledge (TCK).

Another suggestion from recent literature by Kovaliket al. (2013) found that when teacher preparation courses were redesigned with all five standard areas of NETS-T in mind, pre-service teachers made significant progress in technology knowledge. To support the previously mentioned Pierson & Borthwick model, the importance of student reflection for technology growth was again cited this time in the form of student work. Specifically Mouza& Klein (2013) suggest projects such as case studies that allow pre-service teachers to engage in reflection on their own practice have the potential to help participants begin to notice the interacting connections that form the ultimate goal of successful TPACK integration.

Hu & Fyfe (2010) recently shared another illustration when their teacher preparation program recently updated the curriculum. The more modern integrated approach to technology instruction shared how students quickly began to show evidence of TPACK development. In the study Hu & Fyfe (2010) shared findings that suggested the new curriculum helped boost the pre-service teacher's confidence in their abilities in choosing the right technology tools to enhance the teaching approaches for a lesson and students' learning.

7.Conclusion

Through the review of TPACK literature, it is evident that many teacher preparation programs are relying on out-of-date technology models and are in need of redesign. Suggested improvements have focused on building confidence through exposure, instructor and administrative modeling, effective evaluations and technology embedded curriculum. All of these strategies have potential to strengthen teacher education programs and prepare pre-service teachers for 21st century instruction. Perhaps Gaoetal. (2009) illustrated the complexity of improving technology integration in teacher preparation best when they stated "The development of technology based pedagogy is an active, on-going process situated in multiple contexts. It is therefore imperative for teacher education programs to adopt various strategies to guide, model and support pre-service teachers' development of technology based pedagogy, until it becomes an integral part of their professional growth" (p. 727).

Perhaps what educators should consider is how we can expect students to grow when we have not grown ourselves as instructors? We cannot teach with 19th century skills and expect our students to be prepared in the 21st century. What should our 21st century teacher preparation courses look like?

References

1] Abbitt, J. (2011). Measuring technological pedagogical content knowledge in preservice teacher education: A review of current methods and instruments.Journal of Research on Technology in Education, 43(4), 281-300.

2] Brantley-Dias, L., Kinuthia, W., Shoffner, M. B., De Castro, C., &Rigole, N. J. (2007).Developing pedagogical technology integration content knowledge in preservice teachers: A case study approach.Journal of Computing in Teacher Education, 23(4), 143-150.

3] Coffman, V. G. (2013). The perceived technology proficiency of students in a teacher education program. (Order No. 3617732, Kent State University). ProQuest Dissertations and Theses, , 229. Retrieved from http://search.proquest.com/docview/1531329184?accountid=11578. (1531329184).

4] Cohen, M., & Tally, B. (2004). New maps for technology in teacher education: After standards, then what?. Journal of computing in teacher education, 21(1), 5-9.

5] Collier, S., Weinburgh, M. H. & Rivera, M. (2004). Infusing technology skills into a teacher education program: Change in students' knowledge about and use of technology. Journal of Technology & Teacher Education, 12(3), 447-468.

6] Cox, S., & Graham, C. R. (2009). Diagramming TPCK in Practice: Using and elaborated model of the TPCK framework to analyze and depict teacher knowledge.TechTrends, 53(5), 60-69.

7] Gao, P., Choy, D., Wong, A. F. L., & Wu, J. (2009). Developing a better understanding of technology-based pedagogy.Australasian Journal of Educational Technology, 25(5), 714-730.

8] Goktas, Y., Yildirim, S. &Yildirim, Z. (2009).Main barriers and possible enablers of ICT integration into preservice teacher education programs.Educational Technology & Society, 12(1), 193-204.

9] Gronseth, S., Brush, T., Ottenbreit-Leftwich, A., Strycker, J., Abaci, S., Easterling, W., & ... van Leusen, P. (2010). Equipping the next generation of teachers: Technology preparation and practice.Journal of Digital Learning In Teacher Education, 27(1), 30-36.

10] Hersh, E. C. (2013). Change and challenge: The influence of technology integration in teacher preparation programs.

11] Hu, C., & Fyfe, V. (2010).Impact of a new curriculum on pre-service teachers'Technical, Pedagogical and Content Knowledge (TPACK).Curriculum,Technology& Transformation for an Unknown Future. Proceedings ascilite Sydney 2010.

12] Hsu, P. (2012). Examining the impact of educational technology courses on pre-service teachers' development of technological pedagogical content knowledge.Teaching Education, 23(2), 195-213.

13] ISTE National Educational Technology Standards. (2014). Retrieved from http://www.iste.org

14] Kay, R. (2006). Evaluating strategies used to incorporate technology into preservice education: A review of the literature. Journal of Research on Technology in Education, 38, 383–408.

15] Kleiner, B., Thomas, N., Lewis, L., & Greene, B. (2007, December).Educational technology in teacher education programs for initial licensure (NCES 2008-040). National Centerfor Education Statistics, Institute of EducationSciences, U.S. Department of Education.Washington, DC.

16] Koch, A., Heo, M., & Kush, J. (2012).Technology integration into pre-service teacher training.International journal of information & communication technology education, 8(1), 1-14.doi:10.4018/j icte.2012010101

17] Koehler, M. J. & Rosenberg, J. (2014) [Graphic image of TPACK framework].Retrieved from http://www.TPACK.org.

18] Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)?.Contemporary Issues in Technology and Teacher Education, 9(1), 60-70.

19] Kopcha, T. J. (2010). A systems-based approach to technology integration using mentoring and communities of practice. Educational Technology and Research Development, 58, 1042–1629. DOI:10.1007/s11423-008-9095-4

20] Kovalik,C., Kuo,C.L. &Karpinski.A. (2013). Assessing pre-service teachers' information and communication technologies knowledge.Journal of technology and teacher education, 21(2)179-202.

21] Kyei-Blankson, L., Keengwe, J., &Blankson, J. (2009).Faculty Use and Integration of Technology in Higher Education.AACE Journal, 17(3), 199-213.
22] Lambert, J., & Gong, Y. (2010).21st Century paradigms for pre-service teacher technology preparation.Computers in the Schools, 27(1), 54-70.
23] Lei, J. (2009). Digital natives as preservice teachers: What technology preparation is needed? Journal of Computing in Teacher Education, 25(3), 87-97.
24] Mayo, N. B., Kajs, L.T., &Tanguma, J. (2005).Longitudinal study of technology training to prepare future teachers.Educational Research Quarterly, 29(1), 3-15.
25] Parette, H. P., Quesenberry, A. C., & Blum, C. (2010). Missing the boat with technology usage in early childhood settings: A 21st century view of developmentally appropriate practice. Early Childhood Education Journal, 37(5), 335-343.
26] Pellegrino, J., Goldman, S., Bertenthal, M., & Lawless, K. (2007). Teacher education and technology: Initial results from the "what works and why" project. Yearbook of the NationalSociety for the Study of Education, 106(2), 52–86.
27] Pierson, M., &Borthwick, A. (2010).Framing the assessment of educational technology professional development in a culture of learning.Journal of Digital Learning inTeacher Education, 26(4), 126-131.
28] Prensky, M. (2001). Digital natives, digital immigrants part 1. On the horizon, 9(5), 1-6.
29] Richardson, J. D. (2012). NETS*A Scholarship: A review of published literature. Journal of research on technology in education (International Society for Technology in Education), 45(2), 131.
30] Schmidt, D. S. (2009). Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. Journal of research on technology in education (International Society For Technology In Education), 42(2), 123.
31] Sutton, S. R. (2011). The preservice technology training experiences of novice teachers. Journal of digital learning in teacher education (International Society for Technology in Education), 28(1), 39.
32] Teclehaimanot, B., Mentzer, G., & Hickman, T. (2011).A mixed methods comparison of teacher education faculty perceptions of the integration of technology into their courses and student feedback on technology proficiency. Journal of Technology and Teacher Education, 19, 5–21. Retrieved from http://www.aace.org/pubs/jtate/
33] Thomas, T., Herrring, M., Redmond, P., &Smaldino, S. (2013). Leading change and innovation in teacher preparation: A blueprint for developing TPACK ready teacher candidates. Techtrends, 57(5), 55-63.
34] Torre J. (2013) Instructional predictors of students' technology standards.International journal of educational research & technology.4(3):37. Ipswich, MA.
35] Valdez, G., McNabb, M., Foertsch, M., Anderson, M., Hawkes, M., &Raack, L. (2004). Computer-based technology and learning: Evolving uses and expectations. North Central Regional Educational Laboratory.
36] Wetzel, K., Foulger, T. S., & Williams, M. K. (2008).The evolution of the required educational technology course.Journal of Computing in Teacher Education, 25(2), 67–71.
37] Williams, M. K., Foulger, T. S. & Wetzel, K. (2009).Preparing preservice teachers for 21st century classrooms: Transforming attitudes and behaviors about innovative technology.Journal of Technology & Teacher Education, 17(3), 393-418.