European Journal of Education Studies
ISSN: 2501 - 1111
ISSN-L: 2501 - 1111
Available on-line at: www.oapub.org/edu

10.5281/zenodo.165861 Volume 2 | Issue 9 | 2016

THE OPINIONS OF PRE-SERVICE BIOLOGY TEACHERS' ABOUT THE CONTEXT OF TEACHERS' SKILLS IN TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE[i]

Tugba Tafli[1*ii], Tahir Atici[2]
[1,2]Faculty of Education, Gazi University,
Department of Biology Education, 06500, Ankara, Turkey

Abstract:
In recent years, the concept of Technological Pedagogical Content Knowledge has emerged as a result of changes taking place in the process of teaching by the introduction of technological tools and equipment. The idea of this was described by Mishra and Koehler and builds on the core of Shulman's Pedagogical Content Knowledge through the inclusion of technology. The framework negotiates the relationships between technology, pedagogy and content. Accordingly, the purpose of this study is to describe the opinions of pre-service biology teachers' about the context of teachers' skills in technological pedagogical content knowledge. It is very important that teachers understand how content, pedagogy and technology interrelate with each other and create a new form of knowledge in our 21st century. Qualitative research method was applied in this study. The data were collected via semi-structured interview form from 60 pre-service teachers and analyzed by utilizing the NVivo 9.0 package program employing the content analysis. As a result of this analysis the data were organized by these groups: Technological Knowledge, Content Knowledge, Pedagogical Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge and Technological Pedagogical Knowledge.

Keywords: pre-service teachers, opinions, technological pedagogical content knowledge

[i] Correspondence: email tugbatafli@gazi.edu.tr

[ii] This study was presented in the 1st Eurasian Educational Research Congress, Turkey

Introduction

In the teaching and learning process, one important thing is the teachers' qualifications. Teachers have to be creative, innovative, conscious, and qualified in their special fields to meet the requirements of the educational system. It is very necessary and important for teachers to be this kind of qualified person before they graduated from the education program, because later success depends on the teachers' continuous individually improvement efforts with their awareness of the advents and the new developments. Pedagogical content knowledge is playing an effective role in this period process. The developments of new digital technologies have dramatically changed practices in most of human life. In the process of teaching and learning, it is becoming more important to benefit from new educational technologies too. As a result of this the concept of technological pedagogical content knowledge (TPACK) has emerged because of changes taking place in the process of teaching by the introduction of technological tools and equipment. The idea of TPACK was described by Mishra and Koehler builds on the core of PCK through the inclusion of technology. In terms of finding new approaches, it will bring us a bright future.

In 1986, Lee Shulman introduced a new term: "*Pedagogical Content Knowledge.*" It was suggested as component of teaching expertise in addition to the teachers' content knowledge and general knowledge of instructional methods. Shulman (1986) defined PCK as discipline-specific content knowledge for teaching such as one's knowledge of curriculum, assessment, subject-specific misconceptions, and techniques to promote content learning. Pedagogical content knowledge is a type of knowledge that is unique to teachers, and is based on the manner in which teachers relate their pedagogical knowledge to their subject matter knowledge (Cochran, 1997). As a part of getting the importance of the technology in the 21st century, researchers proposed to include technological knowledge about education for teachers. The notion of technological pedagogical content knowledge (TPACK) formally used it for a teacher's technology integration (Pierson, 2001) and emerged in the literature of education journal in 2003 (Lundeberg, Bergland, Klyczek, & Hoffman, 2003). Since 2005 just as the interaction of pedagogical knowledge and content knowledge gave rise to PCK, Mishra and Koehler proposed that the inclusion of technological knowledge derived from other forms of knowledge be included in teacher training as technological content knowledge (Koh, Chai and Tay, 2014). TPACK has been a burgeoning focus of research especially among teacher educators who are working or interested in the field of educational technology (Chai et al, 2013).

The purpose of TPACK is to integrate educational technology tools into the classroom teaching and learning via the synthesized form of knowledge. The

composition knowledge of TPACK consists of three core constituents: These are content knowledge (CK), pedagogical knowledge (PK), and the technological knowledge (TK). The interaction of these three forms of core knowledge gives rise to pedagogical content knowledge (PCK), technological content knowledge (TCK), technological content knowledge (TPK) and the TPACK (Figure 1).

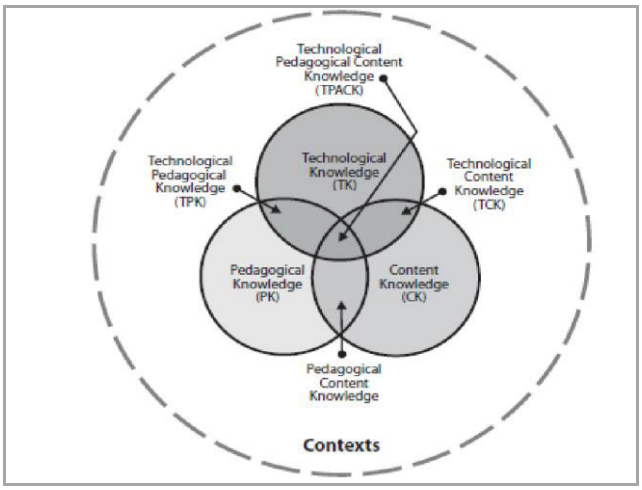

Figure 1: TPACK Frame (Image from http://tpack.org)

Technological knowledge (TK) is knowledge about both standard technologies like books or blackboard and more advanced technologies like as the internet and digital tools. This involves the skills required to operate particular technologies.TK includes an understanding of how to use computer software and hardware, presentation tools such as document presenters and projects, and other technologies used in educational contexts. Most importantly, TK covers the ability to adapt to and learn new technologies (Holsti, 1968). Pedagogical knowledge (PK) is deep knowledge about the processes and practices or methods of teaching and learning and how it encompasses, among other things, overall educational purposes, values, and aims (Mishra and Koehler, 2006). This knowledge involves, but is not limited to; an understanding of the role of student motivation, classroom management activities, assessment and evaluation of learning and lesson plan development and implementation (Koehler et al, 2013). Content knowledge is a knowledge or specific nature of a discipline or subject matter. It is about the actual subject matter that is to be learned or taught (Mishra and Koehler, 2006). Teachers must know and understand the subjects that they teach. They have to know about knowledge of central facts, theories, concepts and procedures within a given field; knowledge of explanatory frameworks that organize and connect ideas and knowledge of the rules of evidence and proof (Shulman, 1986). Pedagogical Content Knowledge (PCK) as a knowledge that concerned with the representation of

concepts, pedagogical techniques, knowledge of what makes concepts difficult or easy to learn, knowledge of students' prior knowledge, and theories of epistemology. It includes knowing what teaching approaches fit the content, and likewise, knowing how elements of the content can be arranged for better teaching (Mishra and Koehler, 2006). PCK refers to knowledge about how to teach certain content to specific groups of students (Cox and Graham 2009). Technological Pedagogical Knowledge (TPK) is knowledge of the components, existence and capabilities of various technologies as they are used in teaching and learning process and conversely knowing and understanding how teaching could change as the result of using some Technologies (Mishra and Koehler, 2006). Teachers, who have this knowledge, could know what technology is appropriate for certain pedagogic goals and to select the most appropriate tool based on the specific pedagogical approach. Technological Content Knowledge (TCK) is knowledge of the reciprocal relationship between technology and content. Teachers need to know not just the subject matter they teach but also the manner in which the subject matter can be changed by the application of technology (Koehler and Mishra, 2008).

The purpose of this study is to describe the opinions of the pre-service biology teachers' about the context of teachers' skills for the six sub-dimensions in technological pedagogical content knowledge.

2. Method

In this study, qualitative research method was applied. The data were collected via semi-structured interview from 60 pre-service teachers and were submitted to content analysis through NVivo 9.0 package program using. Content analysis is any technique for making inferences by systematically and objectively identifying special characteristics of messages (Holsti, 1968). The basic goal of content analysis is to take a verbal, non-quantitative document and transform it into quantitative data (Bailey, 1978). It is a process by which the 'many words of texts are classified into much fewer categories (Weber, 1990). By doing content analysis, it takes texts and analyses, reduces and interrogates them into summary form through the use of both pre-existing categories and emergent themes in order to generate or test a theory (Cohen et al, 2007). As a result of this data the data were coded separately by the sub-dimensions of TPACK. After gathering the same codes of the data, it was arranged by the aspects in a common way and the results were interpreted.

3. Results

As a result of the data, the opinions about the sub-dimensions of TPACK are as below:

3.1 Technological Knowledge (TK)

In this section it is asked to the pre-service teachers that what are the required skills in the process of teaching in TPACK and the summary of the related items frequency showed in Table 1.

Table 1: The Summary of the Related Items about the Technological Knowledge Skills

Technological Knowledge	**N**	**Frequency%**
To have the ability of how to use educational technologies (such as smart board, computer, projectors, microscope etc.)	56	93
To follow the emerging technological developments	16	27
To be open to the new technological innovations	15	25
To have the ability to use the technological tools in accordance with the objectives of the lesson	7	12
To know how to use the internet effectively	7	12
To be interested in learning the technology	1	2
To take measures against the failures if any problem occurs in a technological tools	1	2
To know how to easily access to technological information.	1	2

93% of the pre-service teachers who participated in the survey stated that the teacher must have the ability of how to use educational technologies such as smart board, computer, projectors, microscope etc. 27% of the pre-service teachers specified that the teacher must follow the emerging technological developments and %25 of them told that the teacher have to be open to the new technological innovations. %12 of stated that the teacher must have the ability to use the technological tools in accordance with the objectives of the lesson and know how to use the internet effectively. 1% of them specified that the teacher have to be interested in learning the technology, be able to take measures against the failures if any problem occurs in technological tools and know how to easily access to technological information.

Here are some examples of the pre-service biology teachers' opinions:

Student 3 (Senior): *"…Teachers have the ability of keeping face with the required qualifications and the innovations by the era and to know information about the technology. They applied educational technology equipment and programs in the classrooms."*

Student 31 (Junior): *"…A good teacher is a person who can use the technology easily in the lessons. If she doesn't have chance to reach or use them, she also has to know what they are and what do they used for…"*

Student 33 (Sophomore): *"…Technology is an equipment that makes the humans life easy and everybody has to know them. Especially the biology teachers must use educational technologies such as computers, projection, smart board and microscope. As a result of this they*

have to follow the emerging technological developments and innovations and interested in trying them."

3.2. Pedagogical Knowledge (PK)

In this section it is asked to the pre-service biology teachers that what are the required skills in the process of teaching about pedagogical knowledge in TPACK and the summary of the related items and the frequency% showed in Table 2.

Table 2: The Summary of the Related Items about the Pedagogical Knowledge Skills

Pedagogical Knowledge	**N**	**Frequency%**
To organize the lesson according to students' age level and the level of the development.	55	92
To know the educational methods and the techniques	15	25
To know how to communicate to the students	9	15
To know the classroom management	9	15
To provide guidance	8	13
To solve the encountered problems to the students	8	13
To motivate the students into the course	5	8
To act as equal to all of the students	4	7
To develop itself continuously	4	7
To know about the assessment and evaluation techniques	4	7
To prepare a good material about the subject matter	1	2
To know the empathy	1	2
To be an exemplary human to the students.	1	2

92% of the pre-service teachers' who are participated in the survey emphasized that the teacher has the ability of organizing the lesson according to students' age level and the level of the development. 25% of them stated that the teacher has to know the educational methods and the techniques and 15% told that the teacher has to be able to have to be able to provide guidance and to solve the encountered problems to the students and know how to manage the classroom best. 13% of the pre-service teachers specified that the teachers have to be able to provide guidance and to solve the encountered problems to the students. 8% of them stated that the teachers have the capable of motivating students into the course, 7% of said that the teachers have to be able to act as equal to all of the students, should develops by herself continuously and have the information about the assessment and evaluation techniques. 1% of them specified that the teacher has to know how to prepare a good material about the subject matter has to know the empathy and has to be an exemplary human to the students.

Here are some examples of the pre-service biology teachers' opinions:

Student 5 (Senior): *"…The teacher has to know the pedagogical level of the student and arrange the requirement skills such as the objectives for the lesson or the behaviors to them.*

Furthermore, she has to know the educational strategies and the methods, assessment and evaluation techniques and know how to motivate the students."

Student 10 (Senior): *"…The teacher has to know the properties of the students' development. She has to arrange the lesson in an appropriate form and do the exercise for their age level. She also has to know the classroom management and be a guide for the students…'*

Student 23 (Junior): *"…The teacher must know how to bring the acquisition of cognitive, affective and psychomotor skills to the student's development in an appropriate level and also has the information about the assessment and evaluation techniques."*

Student 24 (Junior): *"…The teacher has to know about the classroom management, how to prepare good materials for the subject matter, can organize a lesson plan, react to the students in a friendly and equally. She also knows the properties of the student's age level."*

Student 34 (Sophomore): "…The teacher has the capacity of how to act the students and how to organize the lesson according to students' age level. She also has to be able to provide guidance and to solve the encountered problems to the students. She has to know the classroom."

3.3 Content Knowledge (CK)

In this section, it is asked to the pre-service biology teachers what are the required skills in the process of teaching about content knowledge in TPACK and the summary of the related items which were analyzed showed in Table 3.

Table 3: The Summary of the Related Items about the Content Knowledge Skills

Content Knowledge	N	Frequency %
To be well-equipped subject matter about their specific area.	48	80
To update their knowledge and the new information about their field.	24	40
To answer the questions easily when the students asked to them.	8	13
To teach the subject matter by getting attention of the students.	6	10
To make detailed research about the specific area when it is needed.	5	8
To make the connection of the relationship between the subject matter and the daily life.	3	5
To do some experiments about their area.	2	3
To explain the basic concepts easily.	2	3
To make drawings while they are explaining the issues.	1	2

According to the table 80% of the pre-service biology teachers' indicated about the content knowledge that the teachers must be well-equipped subject matter about their specific area. 40% of them stated that the teachers have to update their knowledge and the new information about their field. 13% of the participant of the pre-service teachers specified that they have to answer the questions easily when the students asked to them. 10% of them told that the teachers have to know how to teach the subject matter by getting attention of the students. 8% of the pre-service teachers said that the teacher

must know how to make detailed research when it is needed. 5% of them stated that the teacher has to be able to make the connection of the relationship between the subject matter and the daily life. %3 of the pre-service teachers specified that the teachers have the ability of doing some experiments about their area and can easily explained the basic concepts and 2% reported that teachers could make drawings while they are explaining the issues.

Here are some examples of the pre-service biology teachers about the content knowledge skills:

Student 57 (Sophomore): *"…Every teacher should have a well-equipped knowledge of the area. They have to follow the new information about their field and update their subject matter in their specific area. The other important thing is when the student asked questions, they must answer them easily."*

Student 28 (Senior): *"…The teacher must know all of the subject matter and the issues of their area. They can easily explain the basic concepts and teach them clearly. I think the most important thing is not only the knowledge level of the teacher but also to teach perfectly to the students. The teacher has to answer the questions in a clear way according to the students' level."*

Student 46 (Junior) *"…The teachers have to be well trained in their special area by themselves. They have to answer the questions easily and do the connections of the relationship between the issue and the daily. They have to update their information and do some research about their special fields..."*

3.4. Technological Pedagogical Knowledge (TPK)

In this section it is asked to the pre-service biology teachers that what are the required skills in the process of teaching about technological pedagogical knowledge in TPACK and the summary of the related items which were analyzed showed in Table 4.

Table 4: The Summary of the Related Items about Technological Pedagogical Knowledge Skills

Technological Pedagogical Knowledge	N	Frequency %
To use the technological tools in the process of the education	30	50
To choose the appropriate technological tools for the students' age level.	21	35
To have the opportunity to attract the student's interest.	13	22
To prepare educational methods by integrating technology to the lessons.	7	12
To manage the classroom while she is using the technological tools	5	8
To follow the new educational technologies and the technological tools	4	7

According to the results of the analysis 50 % of pre-service biology teachers emphasized that the teacher must use the technological tools in the process of the education. 35% of stated that the teacher has to choose the appropriate technological tools for the students' age level. 22% of them specified that the teacher should have the opportunity

to attract the student's interest. 12% of the pre-service teachers have the ability of to prepare educational methods by integrating technology to the lessons. 8% reported that the teacher should be able to manage the classroom while she is using the technological tools and 7% of stated that the teacher should follow the new educational technologies and the technological tools.

Some examples of the pre-service biology teachers about the content knowledge skills:

Student 4 (Senior): *"…Teachers should be able to choose the appropriate technology for the student's age in the classroom. If the students are in the level of primary and the teacher use difficult technological tools as for the elementary, students cannot understand or use them."*

Student 58 (Sophomore): *"…Teachers have to use the educational technology effectively in the teaching process. They should create good opportunity for students to get in touch with the process and they should plan the methods by using technology. Therefore the students more interested in the issues and they can learn easily."*

Student 34 (Junior): *"Teachers have to use and choose the appropriate technological tools for the students' age level. Because it is important that also the students can use them in an active way of the process. Teachers also have the ability of the classroom management while they are using technology…"*

3.5 Technological Content Knowledge (TCK)

In this section it is asked to the pre-service biology teachers that what are the required skills in the process of teaching about Technological Content Knowledge in TPACK and the summary of the related items which were analyzed showed in Table 5.

Table 5: The Summary of the Related Items about Technological Content Knowledge Skills

Technological Content Knowledge	N	Frequency %
To use technological tools in the lessons to be more understandable the issues by the students.	32	44
To use digital tools effectively while they are teaching.	19	32
To know and choose the best technology for aim of the lesson.	8	13
To integrate the educational technology tools to the concept of the lesson	5	8
To make a good video, animation or simulation about the lesson.	5	8
To use some electronically tools which are related their field	3	5
To follow the new development of the related technologies for being updated.	2	3

According to the results of the analysis, the 32% of pre-service biology teachers reported that teachers have the ability to use technological tools in the lessons to be more understandable the issues by the students. While they are teaching the subject matter and 32% of them stated that they should know how to use digital tools effectively while they are teaching. 13 % of emphasized that teaches must know and choose the best

technology for aim of the lesson. 8% of them specified that teachers should integrate the educational technology tools to the concept of the lesson and should know how to make a good video, animation or simulation about the lesson. 5% of them told that they must also use some electronically tools which are related to their field and 3% of expressed that teachers should follow the new development of the related technologies for being updated.

Some opinions about the pre-service biology teachers are as below:

Student 53 (Sophomore): *"…The teacher has to know all about the subject matter in her area and to be more understandable the issues by the students she has to use and integrate the educational technology tools to the classroom. It is required in the process of teaching. The teacher also knows how to use or how to prepare a good video or animation about the subject matter."*

Student 37 (Junior): *"…Teachers should benefit from the digital technologies while they are teaching an issue. So that they can provide to students to understand the subjects better. For example, let's think about a biology teacher who is teaching about DNA. If she uses some materials such as an animation or video it will be an effective way to see clearly the events occurring in DNA by the students and as a result of integrating these technologies to the lessons the subjects become more permanent learning."*

Student 19 (Senior): *"A teacher must know about the related technological tools for her special area and always update herself by following the new developments. Because the era of today requires people to use and benefit from them to make our life easy. In the process of the educational it is very important that the teacher should integrate these Technologies to the aim of the lesson…"*

3.6. Pedagogical Content Knowledge (PCK)

In this section it is asked to the pre-service biology teachers that what are the required skills in the process of teaching about pedagogical content knowledge in TPACK and the summary of the related items which were analyzed showed in Table 6.

Table 6: The Summary of the Related Items about Pedagogical Content Knowledge Skills

Pedagogical Content Knowledge	N	Frequency %
To be well-known about their subject matter and they should teach the subject according to the student's level	41	69
To plan the activities to the related issue for student's level.	17	29
To integrate content knowledge to the pedagogical knowledge	10	19
To know all about the educational methods and techniques which is more effective and appropriate for the subject matter	11	18
To get interested in the lesson while teaching the subject.	7	12
To use more materials according to the subject.	7	12
To know about the assessment and evaluation methods for the subject	5	8

Within the scope of the results of the analysis for the pedagogical content knowledge, 69% of the pre-service biology teachers stated that teachers should well-known about their subject matter and they should teach the subject according to the student's level. 29% of reported that they should know how to plan the activities to the related issue for student's level. 19% of pre-service teachers specified that they must know how to integrate content knowledge to the pedagogical knowledge. 18% of emphasized that teachers should know all about the educational methods and techniques which is more effective and appropriate for the subject matter. 12% of stated that teachers know how to get interested in the lesson while teaching the subject and they should use more materials according to the subject. 8% specified that the teacher should know the assessment and evaluation methods for the subject.

Some examples of the pre-service biology teachers about the pedagogical content knowledge skills:

Student 11 (Senior): *"A teacher could do easily combine their pedagogical knowledge and the content knowledge. Because in undergraduate they attended, lessons which are both related with the pedagogy and the special field content. That's why she could be integrating to each other…"*

Student 28 (Junior): *"…Teachers have to plan the lesson before going to the classroom. They must do some activities for the student's level while teaching the issue of the lesson. They must know the best assessment and evaluation methods for the subject"*

Student 5 (Senior): *"…Teachers should set the subjects about the lesson for the student's age level. They should also know which method or the technique is the best for the subject matter. They should use some other materials in the classrooms."*

Student 54 (Sophomore): *"…Teachers know well how to transfer the subject matter to the students for their age levels. Let's think about a primary and a secondary school. Teacher cannot teach the same subject. If she teaches the same subject in a detail to the primary school, the students could not understand the lesson. That's why it is very important to teach the subject matter according to the curriculum and the age level…"*

4. Conclusion

There are number of research studies were carried out to investigate the development of TPACK. Some of them are about the theoretical papers to guideline framework in the area of teachers' acquisition of knowledge for technology integration and TPACK contracts (Koehler & Mishra, 2005; Niess, 2005; Mishra & Koehler, 2006; Angeli and Valanides, 2009; Harris, Mishra, & Koehler, 2009; Cox & Graham, 2009; Hammond and Manfra, 2009; Archambault & Barnett, 2010; Koehler et al, 2011). In these papers the definitions about the notion of TPACK, framework that can be used as a guide for

educators' efforts in the teaching while challenging into the education process were mentioned in a detailed way.

In this study, all of these data were analyzed according to the six dimension of TPACK. The analysis shows that pre-service biology teachers have an idea about TPACK. Some researchers showed us that the teachers could not use technology in the learning and teaching process and they also have challenges while integrating to the lessons (Kurt,2013; Usta and Korkmaz, 2010; Çakır and Yıldırım, 2009; Judson, 2006). Some of them are related the importance of the teachers who are active in the classes by using the technology (Angeli and Valadines, 2009; Graham et al, 2004; Draper et al, 2004). It is very important for the pre-service teachers should be provided opportunities in technology-supported activities and integrate the technologies into the learning process effectively (Kersaint, 2007; Govender and Govender, 2009).

Some studies are about the teachers 'view and use of ICT with related to TPCK such as

Greenhow, Dexter & Hughes, 2008; Banas, 2010. Teachers' knowledge about pedagogy, content and technology is necessary for developing their TPACK. Before being as a teacher in the education faculty the pre-service teachers find opportunity about how these three dimensions interrelate with each other. As a result of this study the findings bring us how much they know about TPACK and what need to do for developing their knowledge more about that subject.

References

1. Angeli,C. , Valanides, N. (2009). Epistemological and Methodological Issues for The Conceptualization, Development and Assessment of ICT-TPCK: Advances in Technological Pedagogical Content Knowledge (TPCK). *Computers & Education*, 52 (1), 154-168.
2. Archambault LM, Barnett JH (2010) Revisiting technological pedagogical content knowledge: exploring the TPACK framework. Computer Education 55(4):1656–1662
3. Bailey, K.D. (1978). Methods for social Research. Basingstoke: Collier Macmillan
4. Banas, J. R. (2010). Teachers' attitudes toward technology: Considerations for designing preservice and practicing teacher instruction. Community & Junior College Libraries, 16(2), 114-127.
5. Chai, C. S., Koh, J. H. L., & Tsai, C. C. (2013). A review of technological pedagogical content knowledge. Educational Technology & Society, 16(2), 31-51.
6. Cochran, K.F. (1997). Pedagogical content knowledge: Teachers' integration of subject matter, pedagogy, students, and learning environments. National Association of Research in Science Teaching: Research Matters- to the Science

Teacher. From https://www.narst.org/publications/research/pck.cfm (Retrieved June 28, 2014)

7. Cohen L., Manion L., Morrison K. (2007). Research Methods in Education (6th ed.). New York, NY: Routledge.
8. Cox, S., Graham, C. R. (2009). Diagramming TPACK in practice: using and elaborated model of the TPACK framework to analyze and depict teacher knowledge. TechTrends, 53(5), 60-69.
9. Çakır R., Yıldırım, S. (2009). Bilgisayar öğretmenleri okullardaki teknoloji entegrasyonu hakkında ne düşünürler? Ilkogretim Online, 8(3), 952-964
10. Draper R. J., Smith L. K., Sabey B. L. (2004). Supporting change in teacher education: using technology as a tool to enhance problem-based learning. In N. Wentworth, R. Earle, M. L. Connell (Ed.). Integrating Information Technology into the Teacher Education Curriculum: Process and Products of Change, New York: Haworth Press, p. 25-42.
11. Graham C., Culatta R., Pratt M., West, R. (2004). Redesigning the teacher education technology course to emphasize integration. Computers in the Schools, 21(1-2), 127-148.
12. Greenhow, C., Dexter, S., Hughes, J. E. (2008). Teacher knowledge about technology integration: An examination of inservice and pre-service teachers' instructional decision-making. Science Education International, 19(1), 9-25. Pierson, M. (2001). Technology integration practice as a function of pedagogical expertise. Journal of Research on Computing in Education, 33(4), 413-430.
13. Govender D., Govender I. (2009). The relationship between information and communication technology (ICT) integration and teachers' self-efficacy beliefs about ICT. Education as Change, 13(1), 153-165.
14. Hammond, T. C., & Manfra, M. (2009b). Giving, prompting, making: Aligning technology and pedagogy within TPACK for social studies instruction. Contemporary Issues in Technology and Teacher Education (CITE Journal), 9(2), 160-185.
15. Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' technology pedagogical content knowledge and learning activity types: curriculum-based technology integration reframed. Journal of Research on Technology in Education, 41(4), 393-416.
16. Holsti O.R. (1968). Content analysis. In G.Lindzey & Aaronson (Eds). The handbook of social psychology. Reading, MA: Addison-Wesley.
17. Judson, E. (2006). How teachers integrate technology and their beliefs about learning. Is there a connection? Journal of Technology and Teacher Education, 14(3), 581-597.

18. Koehler, M., & Mishra, P. (2005). What happens when teachers design educational technology? The development of technological pedagogical content knowledge. Journal of Educational Computing Research, 32(2), 131–152.
19. Kersaint G. (2007). Toward technology integration in mathematics education: a technology integration courses planning assignment. Contemporary Issues in Technology and Teacher Education, 7(4), 256-278.
20. Koehler, M.J., & Mishra, P. (2008). Introducing TPCK. In AACTE Committee on Innovation and Technology (Ed.), The handbook of technological pedagogical content knowledge (TPCK) for educators. New York, NY: Routledge. p.3-30.
21. Koehler, M.J., Mishra, P., Bouck, E. C., DeSchryver, M., Kereluik, K., Shin, T.S., & Wolf, L.G. (2011). Deep-play: Developing TPACK for 21st century teachers. International Journal of Learning Sciences, 6(2), 146–163.
22. Koehler M.J., Mishra P., Akcaoglu M., Rosenberg J.M. (2013). The technological pedagogical content knowledge framework for teachers and teacher educators. Commonwealth Educational Media Center for Asia, p.1-8.
23. Koh, J. H. L., Chai, C. S., & Tay, L. Y. (2014). TPACK-in-Action: Unpacking the contextual influences of teachers' construction of technological pedagogical content knowledge (TPACK). Computers & Education, 78, 20-29.
24. Kurt, S. (2013). Examining Teachers' Use of Computer Based Technologies: A case study. Education and Information Technologies, 18, 557-570.
25. Lundeberg, M., Bergland, M., Klyczek, K., & Hoffman, D. (2003). Using action research to develop preservice teachers' confidence, knowledge and beliefs about technology. The Journal of Interactive Online Learning. 1(4), 1-16
26. Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017-1054.
27. Niess, M. L. (2005). Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. Teaching and Teacher Education, 21(5), 509-523.
28. Shulman, L.S. (1986). Those who understand: Knowledge growth in teaching. Educational Researcher, 15(2), 4-14.
29. Usta, E., Korkmaz, O. (2010). Ögretmen adaylarinin bilgisayar yeterlikleri ve teknoloji kullanımına iliskin algileri ile ogretmenlik meslegine yonelik tutumlari. Uluslararasi İnsan Bilimleri Dergisi, 7(1),1335-1349.
30. Weber R.P. (1990). Basic Content Analysis. Sage Publications, Newburry Park, CA