

Development of Technological Pedagogical Content Knowledge (TPACK) Through Blended Learning for Vocational Teachers Candidates

Nurulita Imansari^{a*}, Amat Mukhadis^b, Syamsul Hadi^c, Hakkun Elmunsyah^d, ^{a,b,c,d}Faculty of Engineering, State University of Malang, Indonesia, Email: ^{a*}nurulita.imansari@gmail.com

The purpose of this research was to develop the syntax of TPACK development through blended learning for Learning Planning course. The development model used was the 4D model that consisted of define, design, development and disseminate. The validity of the product was validated by learning technology experts and lecturers of learning planning course as users. The validation results showed that the syntax of TPACK development through blended learning was included in the excellent category and was feasible to use. This finding shows that this syntax can be used to develop TPACK through blended learning.

Key words: *Development, TPACK, blended learning, vocational teacher candidates*

Introduction

Nawacita President of the Republic of Indonesia has placed vocational education as a top priority in the development of education in Indonesia. Inpres Number 9 of 2016 concerning Vocational School Revitalization in the context of Improving the Quality and Competitiveness of Indonesian Human Resources is the direction of vocational education development going forward. The role of Higher Education is twofold, namely 1) accelerating the provision of vocational teachers of SMK through education, equalization, and recognition, and 2) developing study programs in tertiary institutions to answer the need for vocational teachers.



The definition of a vocational teacher is someone that has trained and has competence in the field of teaching and learning evaluation, as well as ability in their field of expertise, which they continue to develop over their career in terms of knowledge and skills. This is commonly known as lifelong learning. The research conducted by Ismail (2017) showed that a vocational teacher must have social competence, knowledge, and a pedagogy that is in line with current needs. A vocational teacher is certain to have skills, knowledge, and attitudes that are in line with changing technology, the needs of the working world, and the advancement of equipment and machinery.

Efforts to prepare qualified pre-service teachers are often faced with problems related to the students' understanding of knowledge and skills that reflect the development of the current school system such as curriculum changes, changes in teaching materials, the updating of practical tools, and other matters relating to teacher assignments. According to Kompas in March 13, 2018, the abundance of undergraduate education students who were not absorbed into professional teachers was not only due to the lack of a civil-service teacher recruitment quota but was also caused by the inadequate quality of graduates of education. The low quality of LPTK graduates who work as teachers has an impact on the quality of learning in schools. The average number obtained of the UKG results in 2015 was 56.69, including pedagogy and the professional abilities of teaching materials. The impact of teacher quality is also evident in the results of the Indonesian Program for International Student Assessment (PISA) test that ranked 64 out of 72 countries. Ardhi (2013) mentioned the lack of variation and the low teaching skills of teachers may have been caused by the limited ability of prospective teachers/students to think outside the box when studying education at the Institution of Education and Educational Personnel (LPTK).

The 3rd UNESCO Congress in the area of TVET agreed that the vocational education sector would be the main driver of world economic growth. The logical consequence is the need to improve the quality of vocational education. Speaking of increasing vocational education, the role of the Education and Educational Personnel Institution (LPTK) as an institution producing vocational teachers has become very dominant. This is because many vocational teachers come from LPTK. Teacher education institutions have the responsibility of producing professional educators to develop vocational education in Indonesia. The education process (learning) organized by LPTK is an important factor for developing teacher competency (Fauzi, 2016). Tondeur, et al (2017) said that LPTK has the challenge of preparing future teacher candidates who can integrate technology effectively. So, prioritizing LPTK at the operational level in the classroom through learning innovations in preparing prospective teachers becomes strategic (Mukhadis, 2016).

One of the learning innovations that can be applied to prepare prospective teachers by following the times demand is to use technology in the lecture process. Buran (2015)



mentioned that technological developments in the international world have influenced the education system in various countries. Technology integration in the realm of education brings several demands that need to be responded to by the world of education, without any exception including universities (Karakaya, 2017).

To meet the demands, specifically to produce graduates who are competent enough to face life in the 21st-century, modern learning requires 21st-century abilities that involve communication and collaboration skills and the use of information technology in learning. The development of learning by integrating information technology makes a significant contribution to the level of pedagogical practice of students (Brun & Hinostroza, 2014). According to Ismail (2017), knowledge of information technology is also very important for TVET teachers. Through information technology, the teaching and learning process becomes easier and can create an interesting learning environment and help teachers preparing teaching materials and allow teachers to explore new knowledge. Teachers have also demanded IT literacy skills in learning science with a variety of methods and approaches to learning in the classroom (Ottenbreit, et al, 2010).

Hennessey, et al (2005) and Tay, et al (2012) have conducted research and the result was that the use of ICT in the classroom can improve the understanding of teacher knowledge and pedagogical abilities. Such teacher skills must be developed through the integration of ICT in learning (Nazarenko, 2015). The framework of the Partnership for 21st-century Learning stated that learning in the 21st-century involves understanding the material or content, ways of teaching, and the synergistic use of information technology, which is also known as TPACK (Technological Pedagogical Content Knowledge). This is in line with the explanation mentioned by Yildirim & Sensoy (2018), Chai, et al (2017), Bibi & Khan (2017), Yildirim (2018), Yildiz (2017), Baya & Daher, (2015) and Chai et al, (2013). Furthermore, as claimed by Kutaka (2015), TPACK is closely related to creativity, collaboration, and accountability in teaching and learning activities. Considering the importance of TPACK in preparing teachers for the 21st-century, the task of higher education is to equip students with TPACK capabilities that synergize the ability of technology integration with pedagogical abilities that are compatible with learning content.

One of the proper forms of integration to develop TPACK is through blended learning (Alayyar, et al 2012). Blended learning is a combination of online learning and face to face learning (Herloa, (2015) and Hubakova, 2016). Blended learning provides opportunities for greater interaction and access to information for students, increasing the effectiveness and efficiency of the learning process and can expand collaboration with other tertiary institutions (Dewi, 2018). At the tertiary level of higher education especially universities that prepare graduate pre-service teachers, the application of blended learning has a positive influence on improving student pedagogy. Blended learning empowers various other sources of



information. Blended learning also provides many advantages for students by making them active participants in the learning process and responsible for their work (Okaz, 2015). On the other hand, according to Utomo (2015), blended learning has weaknesses related to the costs used to implement blended learning. This, however, can be overcome by using the free Learning Management System (LMS) and thus by applying Edmodo. According to Ainiyah (2015), Edmodo is a platform that can be utilized directly without having to provide special servers and long installations so that its use is easier. Therefore, in this research platform, the mode of blended learning that was used for online learning was Edmodo.

Bibi & Jati (2015) explained that the application of blended learning can give students interest in independent learning because a lot of the latest information can be obtained through the internet. This method is very efficient because the students not only can get face-to-face lectures with lecturers in the classroom but also can access materials that are given online wherever they are. Blended Learning is very useful for developing and instilling student involvement in lectures because students must actively follow the developments that occur on campus. Based on the explanation above, the development of TPACK through blended learning is an appropriate innovation in improving learning to prepare pre-service vocational teachers.

Research conducted by Sari (2014) stated that blended learning is one of the new ways to improve the learning process and learning itself. The application of blended learning is very suitable to face the challenges of Indonesia in the 21st-century and prepare a learning environment for achieving 21st-century competencies as stated by the OECD. Blended learning is also appropriate when applied to LPTK because the challenges of developing 21st-century teacher competencies are related to technology, pedagogy and learning content that are learned or TPACK.

According to Herloa (2015), blended learning is one of the active learning models. In the learning process, students become more responsible and engaged in learning. The impact of using blended learning also has shown an increase in learning outcomes for students. Harandi (2015) mentioned that blended learning has become an important component in learning in higher education. Moreover, technology can offer many new things to create more interesting learning. Various aspects of tertiary institutions must be prepared to utilize technology as a means to achieve learning objectives. Therefore, knowledge about technology and how to teach using technology must be improved because the use of this technology will increase student motivation.

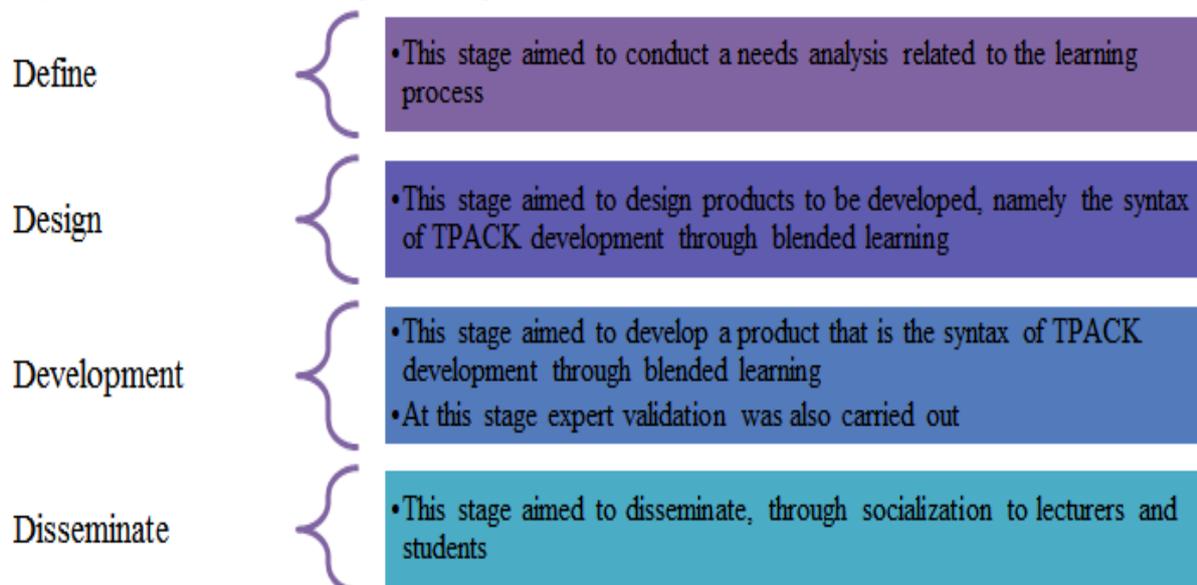
Learning by using blended learning in research combines face-to-face learning with online learning. Specifically, the software used in online learning uses Edmodo where learning is done asynchronously which means learning is not done at the same time and place. TPACK

development is done by developing the contents of CK, PK, and TK as a basis for mastering pedagogical and technological concepts. Developing mastery of collaboration and adaptation of learning content is then emphasized, as well as pedagogy and technology selection according to material conditions. The last phase is to synthesize all the previously developed elements. The TPACK development syntax will be packaged in blended learning and more detail will be translated in the form of learning tools.

Method

The research method used in this development was the 4D model dividing into 4 stages, namely define, design, develop, and disseminate (Thiagarajan, et al., 1974). These stages can be explained as follows:

Figure 1. 4D model development steps



Results and Discussion

Define Stage

To face challenges and improve 21st-century skills, pedagogical abilities and the ability to use ICT in learning are very important factors (Schoen & Fusarelli 2008). In the framework of the Partnership for 21st-century Learning, learning in the 21st-century is focused on the synergy between content, the ways of teaching, and the use of information technology, which

is known as TPACK (Technological Pedagogical Content Knowledge). Yuliati & Wartono (2016) explained that TPACK is a form of knowledge that is complex and very important for pre-service teachers. Yildiz (2017) stated that teachers must have TPACK competence to achieve success in learning. TPACK is the knowledge needed for a pre-service teacher to use the appropriate technology based analysis of material and pedagogy. Bearing in mind the importance of TPACK in 21st-century learning, it is necessary to equip students with TPACK. As mentioned by Allayar (2012), blended learning is an appropriate form of integration for the development of TPACK for teachers. Therefore, this research tried to develop the syntax of TPACK development through blended learning.

Design Stage

In developing TPACK through blended learning, several learning theories were used. Among them were behaviouristic learning theories, cognitive learning theories, and constructivist learning theories. First, one needs the understanding that behaviouristic learning theory is a change in behaviour that occurs as a result of the interaction between stimulus and response (Siregar and Nara, 2015). Someone is considered to have learned something if he shows changes in behaviour. Behavioural principles were emphasized in the determination of specific goals or results-oriented emphasis on students at the end of learning. According to Baruque and Melo (2004), the main focus from the perspective of behaviouristic learning theory is on behaviour and how the learning environment shapes individual behaviour. Thus, the main responsibility in designing blended learning is to identify and sort learning that will help pre-service teacher students to learn.

Cognitive learning theory stated that a person's behaviour is determined by his perception and understanding of situations related to his learning goals (Budiningsih, 2012), because students already know themselves and students build additional knowledge in their way. According to Baruque and Melo (2004), learning is built by complex interactions between students' existing knowledge, social context, and the problems that must be solved. The application of cognitive learning theory must use a variety of technical variations to guide and support the student's process of learning. Furthermore, Gagne et al (2005) suggested that learning events consist of efforts to raise interest and concentration by students, inform learning objectives, stimulate students to recall the knowledge that has been learned, present new knowledge, provide new learning instructions, provide new knowledge, and provide feedback.

Constructivist learning theory stated that learning is a process of the formation (construction) of knowledge by the learning itself (Siregar & Nana, 2015). It means that the knowledge we have is the result of our construction or construction. Learning by constructing concepts results in fundamental changes from prior knowledge. This change can be in the form of a



replacement, the addition or modification of previous knowledge. As claimed by Conrad and Donalson (2004), knowledge is built or constructed from experience, while learning is the result of the interpretation of individual knowledge. Learning is collaborative. Furthermore, Ally (2004) stated that knowledge construction can increase activeness in online learning. Moreover, in blended learning students were encouraged to be able to construct their knowledge gained by student-centred learning so that learning was more meaningful. The product draft intended in this study was the syntax of TPACK development through blended learning. Where blended learning was used is a combination of face to face learning and online learning. TPACK elements that were developed in this study referred to the basic concepts of TPACK proposed by Koehler, et al. (2013), which consist of many elements, namely content knowledge, pedagogical knowledge, technological knowledge, technological pedagogical knowledge, technological content knowledge, and pedagogical content knowledge.

The distribution of the proportion of time in each learning post referred to the statement of Osguthorpe & Graham (2003) that to achieve the quality of learning expected through blended learning is to achieve balance and harmony in the presentation of material. The material taken in this study was Learning Planning material. The blended learning design implemented in this study according to Krres & de Witt (2003) had three didactic components (3C Model), namely (1) content, (2) communication, and (3) construction. These three didactic components in the preparation of blended learning are explained through the following stages:

- 1) Content is a component that makes learning material available to students. In practice, students explored teaching materials through the internet/online media.
- 2) Communication is a component that gives space or the opportunity to interact. The student interacted with the lecturer and with other students.
- 3) Construction is a component that facilitates and guides individual and group activities. Students were expected to solve the problems provided through the student worksheet (LKM).

Development Stage

Table 1: The syntax of TPACK development through blended learning for Learning Planning course

Phase	Face to face		Online	
	Lecturer	Students	Lecturer	Students
Recognizing	<ul style="list-style-type: none"> The lecturer explained the orientation of the lecture plan The lecturer conducted a student's initial ability test The lecturer explained to students how to form study groups 	<ul style="list-style-type: none"> Students understood the orientation and explanation of lecture plans Students worked on the pretest by filling out a questionnaire Students formed study groups 		
Foundation Building			<ul style="list-style-type: none"> Lecturers uploaded teaching materials using Edmodo The lecturer gave an assignment in the form of LKM through uploading on Edmodo 	<ul style="list-style-type: none"> Students downloaded teaching materials using Edmodo Students worked on LKM assignments that were the result of group work
Presentation	<ul style="list-style-type: none"> Lecturers guided students during group presentation activities 	<ul style="list-style-type: none"> Each group of students presented the results of their group work 		

<i>Synthesis</i>	<ul style="list-style-type: none"> • The lecturer gave feedback about the implementation of group presentation tasks • The lecturer confirmed the material that had been learned 	<ul style="list-style-type: none"> • Students provided feedback on the lecturer explanation 		
------------------	--	--	--	--

Expert Validation Results

Based on the results of the validation carried out by four experts consisting of learning technology experts, the following data was obtained:

Table 2. Expert validation Result

Aspects	Items	Category
Learning Syntax	1. The stages of learning were arranged in order and clear	Good
	2. The stages of logical and rational learning	Good
	3. The learning stages clearly contained the activities of lecturers and students	excellent
	4. The description of learning activities at each stage of the learning model reflected the flow of activities that could be carried out by lecturers and students	excellent
	5. Description of learning activities at each stage of the learning model oriented TPACK	good
Social system	1. Description of learning activities showed the interaction of students with students	good
	2. 2. The description of learning activities showed the interaction of students and lecturers	Good
	3. 3. the description of learning activities showed the realization of the prevailing norms	Good
Principles of Reaction	1. The description of learning activities showed that the lecturer provided the learning resources needed by students	excellent

	2. The description of learning activities showed that the lecturer provides a number of activities that stimulated student curiosity and encourage students to explore ideas and communicate scientifically	excellent
	3. The description of learning activities showed that the lecturer gave students the opportunity to ask questions when they were experiencing difficulties in understanding phenomena and concepts	excellent
Supporting System	1. Learning devices arranged according to the steps of the learning model	Good
	2. Learning devices arranged according to learning objectives	Good
Instructional Impacts and Accompaniment Impacts	1. The instructional impact was clearly and logically stated at the learning stages in syntax	excellent
	2. Instructional impact showed the direction of learning objective	Good

Based on the data in the table above, it can be concluded that the syntax of TPACK development through blended learning falls into the very good category so that it is feasible to be used in preparing vocational teacher candidates.

Disseminate Stage

At this stage, the syntax of TPACK development through blended learning was spread to the users, namely lecturers and students at tertiary institutions that have vocational-based study programs, especially in the field of electrical engineering. Dissemination was done through socialization to users.

Conclusion

This study concluded that teacher candidates must be equipped with TPACK, which is a synergy between mastering content, pedagogy, and technology in learning to answer the challenges of teaching in the 21st-century. One model of technology integration for TPACK development was blended learning that combined online learning and face to face. Therefore, a syntax for the development of TPACK was developed through blended learning, which consisted of recognizing, foundation building, instruction tools, and synthesis. The syntax, which consists of four steps, was then validated by learning technology experts and lecturers of Learning Planning courses as users. The validation results obtained indicated that the syntax of TPACK development through blended learning falls into the excellent category and is suitable for use in learning in universities.



REFERENCES

- Ainiyah, Z. 2015. Penggunaan Edmodo Sebagai Media Pembelajaran e-Learning pada Mata Pelajaran Otomatisasi Perkantoran di SMKN 1 Surabaya. *Jurnal Administrasi Perkantoran (JPAP)*, 3(3), 1-13
- Alayyar, G. M., Fisser, P., & Voogt, J. 2012. Developing technological Pedagogical Content Knowledge in Pre-Service Science Teachers: Support from Blended Learning. *Australasian Journal of Educational Technology*, 28 (8), 1298-1316
- Ally, M., 2004. Foundations of educational theory for online learning. *Theory and practice of online learning*, 2, pp.15-44.
- Ardhi, M. W. 2013. Implementasi The Power Of Two Untuk Meningkatkan Kemampuan Mengajar Mahasiswa Dalam Microteaching. *Jurnal Pendidikan*, 19(1). Dari <http://e-journal.unipma.ac.id/index.php/JP/article/view/168>
- Baruque, L. B., & Melo, R. N. (2004). Learning theory and instruction design using learning objects. *Journal of Educational Multimedia and Hypermedia*, 13(4), 343-370.
- Baya'a, N & Daher, W. 2015. The Development of College Instructors' Technological Pedagogical and Content Knowledge. *Procedia - Social and Behavioral Sciences*, 174: 1166-1175
- Bibi, S., & Jati, H. 2015. Efektivitas Model Blended Learning Terhadap Motivasi Dan Tingkat Pemahaman Mahasiswa Mata Kuliah Algoritma Dan Pemrograman. *Jurnal Pendidikan Vokasi*, 5(1), 74-87.
- Bibi, S., & Khan, S. H. 2017. TPACK in action: A Study of a Teacher Educator's Thoughts When Planning to Use ICT. *Australasian Journal of Educational Technology*, 33(4), 70-87
- Brun, M., & Hinostroza, J. E. 2014. Learning to become a teacher in the 21st century: ICT integration in Initial Teacher Education in Chile. *Educational Technology & Society*, 17(3), 222-238.
- Budiningsih, A. (2012). Belajar dan Pembelajaran. Jakarta: PT Rineka Cipta.
- Chai, C. S. Koh, J. H Tsai. 2013. A Review Of Technological Pedagogical Content Knowledge. *Educational technology & society*, 16(2), 31-51.
- Chai, C. S., Tan, L., Deng, F., & Koh, J. H. L. 2017. Examining Pre-service Teachers' Design Capacities For Web-Based 21st Century New Culture of Learning. *Australasian Journal of Educational Technology*, 33(1), 1-20.



- Conrad, R.M., & Donaldson, J.A. 2004. *Engaging the Online Learner Activities*. San Francisco: Jossey-Bass
- Dewi, K. C., Ciptayani, P. I., & Surjono, H. D. 2018. Critical Success Factor for Implementing Vocational Blended Learning. *In Journal of Physics: Conference Series*, 953 (1), 012086
- Fauzi. 2016. Menggagas LPTK Masa Depan : Ikhtiar Mengatasi Problem Pendidikan di Indonesia dari Hulu. *PERSPEKTIF Ilmu Pendidikan*, 30 (1), 59-66
- Fauzi. 2016. Menggagas LPTK Masa Depan : Ikhtiar Mengatasi Problem Pendidikan di Indonesia dari Hulu. *PERSPEKTIF Ilmu Pendidikan*, 30 (1), 59-66
- Gagné, R. M., Wager, W. W., Golas, K. C., & Keller, J. M. 2005. *Principles of instructional design (5th ed.)*. Belmont, CA: Thomson Wadsworth.
- Harandi, S. R. 2015. Effects of e-learning on Students' Motivation. *Procedia-Social and Behavioral Sciences*, 181, 423-430.
- Hennessy, S., Ruthven, K., & Brindley, S. 2005. Teacher Perspectives on Integrating ICT Into Subject Teaching: Commitment, Construction, Caution and Change. *Journal of Curriculum Studies*, 37 (2), 155-192
- Herloa, D. (2015). Improving Efficiency of Learning in Education Master Programs, by Blended Learning. *Procedia-Social and Behavioral Sciences*, 191, 1304-1309.
- Hubackova, S., & Semradova, I. 2016. Evaluation of Blended Learning. *Procedia-Social and Behavioral Sciences*, 217, 551-557.
- Husamah. 2014. *Pembelajaran Bauran (Blended Learning)*. Jakarta: Prestasi Pustaka.
- Ismail, K., Nopiah, Z. M., Rasul, M. S., & Leong, P. C. 2017. Malaysian Teachers' Competency in Technical Vocational Education and Training: A review. *Proceeding of Regionalization and Harmonization in TVET—Abdullah et al.(Eds)*, 59-64
- Koehler, M. J., Mishra, P., Ackaoglu, M., & Rosenberg, J. M. 2013. *The Technological Pedagogical Content Knowledge Framework for Teachers and Teacher Educators*. Commonwealth Educational Media Centre for Asia.
- Kutaka, Kennedy. 2015. A Proposed Model to Increase Creativity, Collaboration and Accountability in The Online Classroom. *International Journal Innovation in Engineering and Technology*, 5 (11), 873-876



- Mukhadis, A. 2016. *Pembelajaran Terintegrasi Model Sa'I Kampus-Sekolah untuk Mengembangkan Teaching Skills dan Teaching Efficacy Mahasiswa Calon Guru*. Makalah disajikan pada Konvensi Nasional Pendidikan Indonesia (KONASPI) VIII Tahun 2016 di Universitas Negeri Jakarta 12-15 Oktober 2016, 379-386
- Nazarenko, A. L. 2015. Blended Learning vs Traditional Learning: What works? (A case study research). *Procedia-Social and Behavioral Sciences*, 200, 77-82.
- Okaz, A. A. 2015. Integrating Blended Learning in Higher Education. *Procedia-Social and Behavioral Sciences*, 186, 600-603.
- Osguthorpe, A & Graham, R. 2003. Blended learning environment: definitions and direction. *The quarterly review of distance education*. 4(3), 227-234
- Ottenbreit-Leftwich, A.T., Glazewski, K. D., Newby, T. J., & Ertmer, P.A. 2010. Teacher Value Beliefs Associated with Using Technology: Addressing Professional and Student Needs. *Computers & Education*, 55, 1321-1335.
- Sari, Milya. 2016. Blended Learning, Model Pembelajaran Abad ke-21 di Perguruan Tinggi. *Ta'dib*, 17 (2), 126-136
- Schoen, L & Fusarelli, L. 2008. Innovation, NCLB and The Fast Factor: The Challenge of Loading Schools in The 21st Century. *Education Policy*. 22 (1), 181-203
- Siregar E., & Nara, H. 2015. *Teori Belajar dan Pembelajaran di Sekolah Dasar*. Jakarta: Prenadmedia Group
- Tay, L., Lim, S.K., Lim, P.c., & Koh, J. 2012. Pedagogical Approach for ICT Integration Into Primary School English and Mathematics: Singapore Case Study. *Australian Journal of Educational Technology*, 28 (4), 740-754
- Thiagarajan, dkk. 1974. *Instruction Development For Training Teachers Of Exceptional Children*. Indiana: Indiana University
- Tondeur, J., Scherer, R., Siddiq, F., & Baran, E. 2017. A comprehensive investigation of TPACK within pre-service teachers' ICT profiles: Mind the gap. *Australasian Journal of Educational Technology*, 33(3), 46-60.
- Utomo, Sumarmi. 2015 Pengembangan Bahan Ajar E-Learning Berbasis Edmodo pada Materi Litosfer Kelas X SMA. *Jurnal Pendidikan Geografi*, 20(2), 1-8



- Vo, H. M., Zhu, C., & Diep, N. A. 2017. The Effect of Blended Learning on Student Performance at Course-Level in Higher Education: A meta-Analysis. *Studies in Educational Evaluation*, 53(2017), 17-28.
- Yildirim, H. I., & Sensoy, O. 2018. Effect of Science Teaching Enriched with Technological Practices on Attitudes of Secondary School 7th Grade Students towards Science Course. *Universal Journal of Educational Research*, 6(5), 947-959
- Yildiz, A. 2017. Reflection From The Lesson Study For The Development of Techno Pedagogical Competencies in Teaching Fractal Geometry. *European Journal of Educational Research*, 6 (1), 41-50