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Instructional Technology: Teacher's Initial Perception of TPACK in Physics Learning

Depi Oktasari[1,a)], Disa Hediansah[2], Jumadi[1,b)], Warsono[1]

[1]*Department of Physics Education, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia*
[2]*Department Technology of Education, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia*
✉: [a)]depi.oktasari12@gmail.com, [b)]jumadi@uny.ac.id

Abstract

The demands of learning in the industrial era 4.0 currently have an impact on innovative learning, learning design with the Technology Pedagogic and Content Knowledge (TPACK) framework provides a useful framework for teachers and researchers to integrate technology in learning activities. The TPACK (Technological Pedagogic Content Knowledge) framework is the latest issue that is relevant to 21st Century learning concepts. This study aims to examine the extent of teacher responses in utilizing learning information sources using TPACK priority scales in encouraging student learning abilities. This study used a quasi-experimental study analytic test of the randomized design with questioner testing. The concept of the approach is through two methods, namely, qualitative and quantitative approaches. The research subjects were carried out randomly with a target sample of physics teachers in the category of new instructors from several provinces in Indonesia, with 33 active respondents in their fields. Based on the results of the study, TPACK is an essential point to give the powerful managing of educational learning and field studies show that the teacher states that some obstacles are experienced when integrating technology in learning physics at school to make sure instructional technology.

Keywords: TPACK, teacher's initial perception, Educational 4.0, instructional technology

INTRODUCTION

Educational literacy that always demands development and innovation is part of the main focus of education practitioners today. The teacher is an important instrument in finding new roles that are more contextual and relevant to the concept of 21st Century learning. The 21st Century learning concept offered requires the professionalism of a teacher in integrating technology, pedagogics, and content knowledge in learning. Current education must be able to describe a better meaning for students as students and teachers as educators. This is inversely proportional to the education situation, which has not been able to become an effective facilitator of the learning process. Dynamically in the social, personal, and personal life, with a background that supports the things that will be needed, in the 21st century, it becomes essential for changes on global (Chalkiadaki 2018).

The learning environment has a very crucial role in one's development. Furthermore, the learners' participation in the process of crafting their environment can empower them, develop community, and increase interest and motivation. To prepare a learning environment that is open, caring, safe, friendly, and respectful is one of the core responsibilities of schools. This ideal environment improves wellbeing. It reflects a positive school philosophy that makes the school an exciting, stimulating, and welcoming

place (Phillips 2014). Furthermore, these preparations of a suitable learning environment, must not only be considered by the school, instead, be coordinated with home, community, and society.

The 2013 curriculum requires the learning process to put more emphasis on the activeness of students in finding concepts that are learned. It is intended that participants can develop their abilities and think more critically, not only in terms of their intelligence but also in their attitude and skill development. The assessment of students in each subject is now no longer only seen in absolute terms from their cognitive competency but also in terms of affective and psychomotor aspects (Learners' achievement and attitude are influenced by many factors, whether extrinsic or intrinsic and there are various ways for a child to learn and develop. The learning process starts even before one enters a formal school. Moreover, when a child attends school, he continues to learn even more. His learning, nonetheless, extends at home and in the community. In this learning process, it is noteworthy to mention that parents play a very critical and delicate role in giving and providing learning opportunities at home and in relating what the child learns at school with what happens in his outside world. The challenge of 21st-century teachers is how to create creative learning innovations for the efficient use of technology in learning activities. Achievements of 21st-century skills expect students not only to have good cognitive skills but also to have good ICT literacy. Furthermore, the role of technology in learning is expected to help students understand the material delivered by the teacher.

Basically, the teaching and learning process between teachers and students is a communication process. Learning objectives that are not achieved at school are the implications that the communication process between teachers and students is lacking or not functioning properly due to the application of erroneous communication. By joining in, and facilitating varied learning experiences and activities outside the formal school, parents become an important factor in a child's overall learning and education (Emerson et al. 2012). Henderson & Berla (1994) mentioned four roles played by parents, which contribute to a child's learning. These are (a) parents as teachers, (b) parents as supporters, (c) parents as advocates, and (d) parents as decision-makers. Moreover, it was reiterated that creating home-school partnerships established for two-way communication boosts parental participation, critical to children's academic accomplishments and achievements (Baker & Piotrkowski 1996).

These integrated forms of knowledge are pedagogical content knowledge, technological content knowledge, technological pedagogical knowledge, and technological pedagogical content knowledge (TPACK). Together with technological knowledge, pedagogical knowledge, and content knowledge, these seven kinds of knowledge make up the TPACK framework (Koh & Lee 2015). The Technological Pedagogic Content Knowledge framework becomes a major terminology of technology, pedagogy, and mastery of material/content that teachers must master when teaching. The development of the TPACK framework arises from the need for a theoretical and conceptual framework that can provide an explanation of how technology can be used in education. The TPACK framework was developed from pedagogical content knowledge as the main core of learning, then developed into Technological Pedagogic Content Knowledge. Framework Technological Pedagogic Content Knowledge added the dimensions of technological knowledge and demonstrated how various kinds of teacher knowledge could be derived from the integration of technological, pedagogical, and content knowledge.

While this framework provides specifications for the kinds of teacher knowledge involved during technology integration, how teachers, educators, and researchers can create more technological pedagogical content knowledge need to be further unpacked (Supriadie & Darmawan 2012). TPACK provides a framework for how teachers can integrate technology into classroom learning. The integration of technology developed must be structured or designed creatively so that it can be used in accordance with specific characteristics specifically (both in material and teaching methods) (at all, 2015). Based on the explanation above, the TPACK framework developed by Mishra & Koehler provides an explanation of how the teacher's pedagogical content knowledge is integrated with TPACK.

Darmawan (2016) states that the use of the TPACK framework has the potential to assist teachers in solving problems by integrating technology in teaching and learning activities in the classroom. The problems faced in the field are the ability of teachers to master the use of technology, and the application of technology in learning that has not been maximized (Masrifah et al. 2018). Preliminary studies conducted by researchers revealed that as many as 82.9% of physics subject respondents said

that Technological Pedagogical and Content Knowledge (TPACK) was the most crucial part that must be possessed by teachers when learning in class takes place. Furthermore, as many as 11.4% of respondents stated that Content Knowledge is the most important part that must be owned by the teacher when learning takes place in class. As many as 5.7% of respondents stated that Pedagogical Knowledge became an essential part of the learning process in the classroom.

In learning, there are components of goals, materials, methods, and evaluations that are interconnected with each other so that learning is said to be a system. "Learning must have a clear purpose. These objectives are described in teaching materials that are conveyed using specific approaches, models, methods, or learning strategies that are deemed appropriate and appropriate to the conditions of students. One of the teacher's tasks is to plan learning activities that inspire all students to engage actively and productively" (Gokdere 2012).

Learners' environment has a consequence on the learner's intellectual and behavioral development and on childhood vulnerability. This is based on the study reported by Ellis (2005). Hence, the physical aspects of one's learning environment must be given due attention and consideration in planning for a child's optimal development. It is probable, then, to deliberate on the essential facets of the physical environment, such as heating, lighting, and acoustics, and also with the overall design of the school, which shall incorporate these aspects. Gutman & Midgley (2000), cited by Henderson & Mapp (2002), and Epstein & Sheldon (2006) explain how the synergistic effects of supporting the quality of the learning environment encourage the relationship between collaborative school learning environments to contribute positively. On the academic achievement of students. Teacher education programs are transforming. Enriched and enhanced modern programs that are coherent, cohesive, and thematic are replacing older traditional program structures of disjointed courses offered without a linking theme or binding overarching theoretical framework (Hechter 2012).

The application of using TPACK provides space for researchers and teachers to develop physics learning tools using the TPACK framework. The development of physics learning tools using the TPACK framework has been widely carried out (Mairisiska, Sutrisno, & Asrial 2014; Apriliani 2017; Rohmitawati 2018). Development of the results of research conducted by Mairisiska et al. (2014) showed positive responses to learning and products developed. Learners' environment has a consequence on the learner's intellectual and behavioral development and on childhood vulnerability. This is based on the study reported by Ellis (2005). Hence, the physical aspects of one's learning environment must be given due attention and consideration in planning for a child's optimal development. It is probable, then, to deliberate on the essential facets of the physical environment, such as heating, lighting, and acoustics, and also with the overall design of the school, which shall incorporate these aspects. Gutman & Midgley (2000), cited by Henderson & Mapp (2002), and Epstein & Sheldon (2006) explain how the synergistic effects of supporting the quality of the learning environment encourage the relationship between collaborative school learning environments to contribute positively. on academic achievement of students

However, on the other hand, the application of learning using technology requires strict supervision by educators. Assumptions that the use of technology is not all positive. A negative side that might happen can be found during the implementation. Learning technology perspective as a process gives an illustration that the role of educators as agents of control is very much needed. Educators act as agents of control to limit the use of technology outside the interests of learning activities. Therefore, the selection of learning models also determines the success of the learning process. Learning is a relatively permanent change in behavior or potential behavior as a result of strengthened experience or training. Learning is a result of the interaction between stimulus and response (Danang 2010). The TPACK Framework explains explicitly what teachers need to integrate technology in learning, but does not explain how the process occurs (Kafyulilo, Fisser & Voogt, 2016). In other words, the teacher must be creative in designing their own desired learning more precisely and in the material and teaching methods that will be carried out using the TPACK framework that has been developed. Planning learning activities must be prepared by the teacher before teaching. The obstacles that teachers face when integrating technology in learning are part of development and planning. Lack of time to create and apply technology in learning. Some teachers feel that they do not understand the use of technology.

METHODS

This study used a quasi-experimental study analytic test of the randomized design with questioner testing. The concept of the approach is through two methods, namely, qualitative and quantitative approaches. Because it uses 2 (two) approaches, it is called the triangulation method, which is combining two methods in one study. The combination method is carried out to make accurate data analysis. Furthermore, it is hoped that through this research approach, it will be able to provide research results to diversify and develop a product.

This study uses qualitative analysis methods. To get a more in-depth and complete picture of the object to be examined by making direct observations in the field. Observation, interview, literature. After the data source at the initial stage is determined purposively and is a snowball, then it is then analyzed through data that has been obtained from interviews, observation, and documentation. Furthermore, to be used as a credible reference from the results of both studies (2 comparison groups) to be re-analyzed. Analysis can be done by combining the appropriate data obtained from the results of the study. This analysis is also carried out in a descriptive-explorative manner so that intact quantitative and qualitative data can be obtained to be processed information. The results of qualitative data analysis are expected to obtain credible data from the results of research that has been done. The research subjects were carried out randomly with a target sample of physics teachers in the category of new instructors from several provinces in Indonesia randomly, with 33 active respondents in their fields.

The concept of this research and development is designing by FIGURE 1 on the research design of the relationship between research variables.

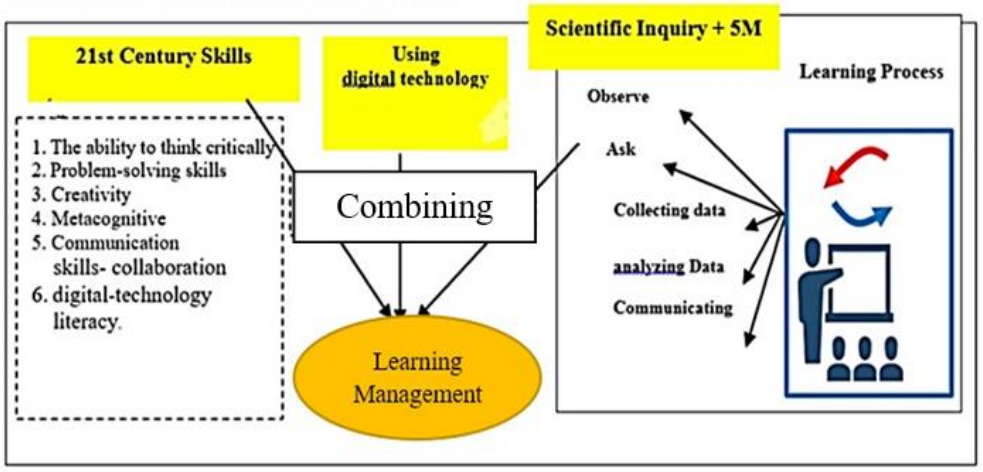

FIGURE 1. The research step by design.

Multivariate statistical tests: General Linear Model (GLM)

MANOVA statistical tests performed using SPSS software. Tests Manova test must meet several assumptions Manova must meet a number of assumptions that normality and homogeneity. Therefore, data analysis is divided into two phases, which MANOVA assumptions and hypothesis testing.

TABLE 1. Control and Experiment Table Perception

Class	Y1			Y2		
	Pretest	Treatment	Posttest	Pretest	Treatment	Posttest
Experiment 1	O1	X1	O2	O1	X1	O2
Control	O1	-	O2	O1	-	O2

RESULT AND DISCUSSION

TPACK stands for Technological Pedagogical Content Knowledge. It is a theory that was developed to explain the set of knowledge that teachers need to teach their students a subject, teach effectively, and use technology.

Learning problems related to the calculation of numbers become an obstacle experienced by most students, especially this becomes more serious when the concept of calculating learning is reflected in the daily life in the real world that should have been done so that the theory of understanding can be implemented concretely (Baran, 2018).

A preliminary study was conducted to analyze the needs and problems faced by teachers and students during physics learning at school. The initial activity carried out was a survey to collect information using a questionnaire using the Google Form, which can be accessed and have given the link to the respondent. The survey aims to determine students' perceptions of physics learning at school. Respondents are class X students at SMAN 6 Yogyakarta. The number of respondents used was 112 students. The survey results showed that 68.8% of students liked physics, then 38.4% of students disliked physics. This shows that the subject of physics is quite popular in the environment of class X students at SMAN 6 Yogyakarta.

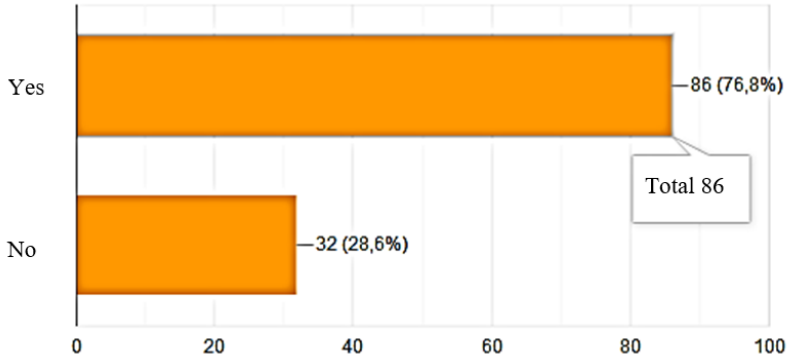

FIGURE 2. Students Who Have Difficulties in Learning Physics

Based on the data shown in FIGURE 1, as many as 79.8% of the 12th-grade students at SMAN 6 Yogyakarta had difficulty attending physics learning at school. Difficulties experienced by each student are very diverse. The following are some student responses related to the difficulties they faced while learning physics at school. The nature of learning physics is identical with mathematical equations and calculating with various equations. However, not all students can understand the concepts of physics through mathematical representation alone. This is reinforced by the preliminary study data, which shows that only 18.8% of students understand the presentation of physics concepts in the form of mathematical representations.

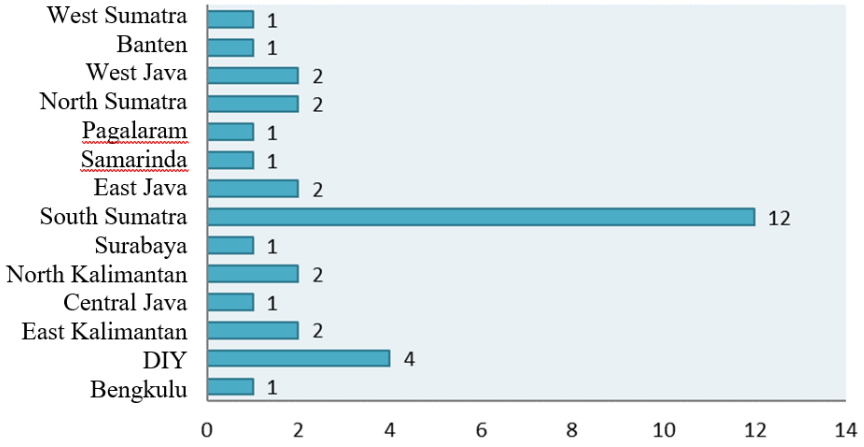

FIGURE 3. Distribution of Teaching Areas for Respondents

This preliminary study, in the form of a survey was conducted to see the profile of teachers related to the use of TPACK in physics learning activities at school. Survey respondents were 33 teachers from various regions in Indonesia. The distribution of each respondent is shown in FIGURE 2.

There were 31 respondents who participated in the preliminary study survey. The last education of respondents started from start 1 (S1) by 75%, and strata 2 (S2) physics education by 23%. The distribution of the area of origin of the respondents is addressed in FIGURE 4. The age of each respondent ranges between 23 - 53 years, with experience/length of teaching shown in FIGURE 3.

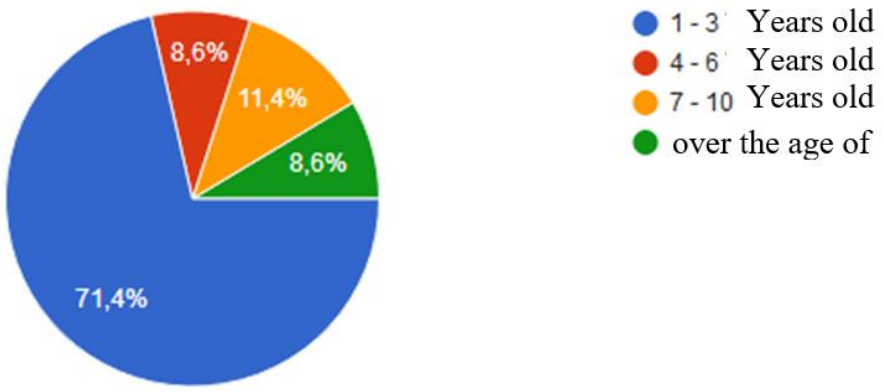

FIGURE 4. Teaching Experience / Length of Respondents

Based on the results of preliminary studies obtained, as many as 82.9% of respondents stated that Technological Pedagogical and Content Knowledge is the most important part that must be owned by the teacher when learning in class takes place. Furthermore, as many as 11.4% of respondents stated that Content Knowledge is the most important part that must be owned by the teacher when learning takes place in class. As many as 5.7% of respondents stated that Pedagogical Knowledge was the most important part of the learning process in the classroom.

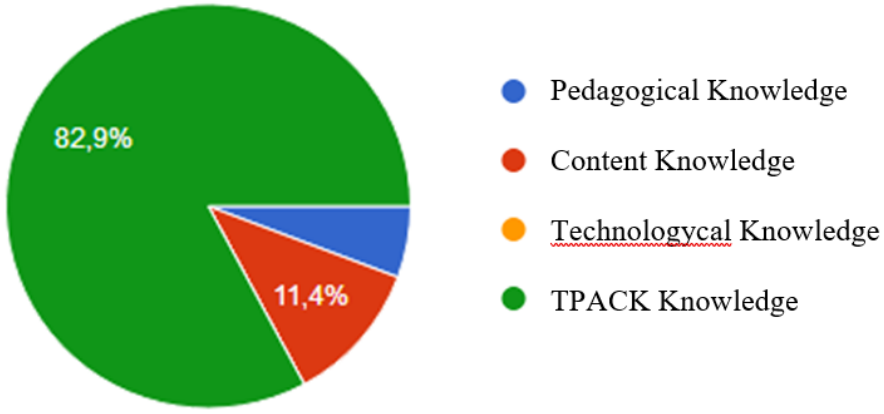

FIGURE 5. Respondents' perceptions of TPACK (Teacher Side)

Most respondents stated that the use of technology in 21st-century learning was the most important part of the learning process.

Following are the results of descriptive field analysis,

Statement: How important is the use of technology in 21st Century physics learning?

Respondent A: "Very important. At present it is like a necessity for technology literacy because various things have been linked to technology, including education. However, in learning physics it must also be considered material and the suitability of the technology used so that the use of technology is not only as a fulfillment of obligations, especially in the 2013 curriculum.

Respondent B: "It's very important because now the child's learning style is changing so the teachers have to adjust to what students need"

Respondent C: "As a tool to help visualize abstract physical material so that it is easy for students to understand"
Respondent D: "It is very important considering the attention of students to be more interested when technology is directly involved in learning".

Based on the results of the preliminary study, the teacher states that there are some obstacles that are experienced when integrating technology in learning physics at school. As many as 48.6% of respondents claimed that the most important obstacle was the lack of school facilities that support the integration of technology in schools. Furthermore, as many as 17.1% claimed to have limited time and skills to develop the media/technology needed. The same thing was also said by 14.3% who experienced limitations in the preparation of making media/technology that would be used in the learning process.

Optimizing the integration of technology in learning physics at school can be a positive potential that can be developed. This is supported by data that states that 42.9% of respondents are accustomed to using technology in learning physics. The technology most widely used by respondents is in the form of power points as much as 45.7%, learning videos as much as 22.9%, animations/simulations as much as 17.1%, and 0% using the barcode scanner Quick Response Code. Based on the problems and obstacles encountered, the TPACK can contribute to providing technological innovation to assist teachers in the development of TPACK in the physics learning process at school.

CONCLUSION

Based on the results of the study, TPACK is an important poin for give the powerful managing of educational learning, and field studies show that the teacher states that there are some obstacles that are experienced when integrating technology in learning physics at school. As many as 48.6% of respondents claimed that the most important obstacle was the lack of school facilities that support the integration of technology in schools. Furthermore, as many as 17.1% claimed to have limited time and skills to develop the media/technology needed. The same thing was also said by 14.3% who experienced limitations in the preparation of making media/technology that would be used in the learning process.

ACKNOWLEDGMENTS

The researcher examines each respondent's response regarding the teacher's initial perception of TPACK in Physics Learning through the collection of large-scale and random samples. TPACK is an important point for give the powerful managing of educational learning, and field studies show that the teacher states that there are some obstacles that are experienced when integrating technology in learning physics at school.

REFERENCES

Bahri, S & Bakri, F 2018, 'Implementation of Problem-Based Learning to Improve Physics Learning Outcomes of Class X IPA-4 in SMA 59', *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, vol. 4, no. 1, pp. 35-46.

Baker, AJ & Piotrkowski, CS 1996, *Parents and Children through the School Years: The Effects of the Home Instruction Program for Preschool Youngsters*.

Baran, M, Maskan, A, & Yasar, S 2018, 'Learning Physics through Project-Based Learning Game Techniques', *International Journal of Instruction*, vol. 11, no. 2, pp. 221-34.

Chalkiadaki, A 2018, 'A Systematic Literature Review of 21st Century Skills and Competencies in Primary Education', *International Journal of Instruction*, vol. 11, no. 3, pp. 1-16.

Emerson, L, Fear, J, Fox, S, & Sanders, E 2012, 'Parental engagement in learning and schooling: Lessons from research', *a report by the Australian Research Alliance for Children and Youth (ARACY) for the Family–School and Community Partnerships*, Bureau, Canberra.

Gokdere, M 2012, 'A Comparative Study of the Attitude, Concern, and Interaction Levels of Elementary School Teachers and Teacher Candidates towards Inclusive Education', *Educational Sciences: Theory and Practice*, vol. 12, no. 4, pp. 2800-06.

Gutman, LM & Midgley, C 2000, 'The role of protective factors in supporting the academic achievement of poor African American students during the middle school transition', *Journal of youth and adolescence*, vol. 29, no. 2, pp. 223-49.

Hechter, RP 2012, 'Pre-service teachers' maturing perceptions of a TPACK-framed signature pedagogy in science education', *Computers in the Schools*, vol. 29 no. 1-2, pp. 53-69.

Hechter, RP, Phyfe, LD, & Vermette, LA 2012, 'Integrating technology in education: Moving the TPCK framework towards practical applications', *Education Research and Perspectives* (Online), vol. 39, p. 136.

Henderson, AT & Berla, N 1994, *A new generation of evidence: The family is critical to student achievement*.

Henderson, AT, & Mapp, KL 2002, *A New Wave of Evidence: The Impact of School, Family, and Community Connections on Student Achievement*, Annual Synthesis.

Kafyulilo, A, Fisser, P, & Voogt, J 2016, 'Factors affecting teachers' continuation of technology use in teaching', *Education and Information Technologies*, vol. 21, no. 6, pp. 1535-54.

Koh, JHL, Chai, CS, & Lee, MH 2015, 'Technological pedagogical content knowledge (TPACK) for pedagogical improvement: Editorial for special issue on TPACK', *The Asia-Pacific Education Researcher*, vol. 24, pp. 459-62.

Mairisiska, T, Sutrisno, S, Asrial, A 2014, 'Pengembangan Perangkat Pembelajaran Berbasis TPACK pada Materi Sifat Koligatif Larutan untuk Meningkatkan Keterampilan Berpikir Kritis Siswa', *Edu-Sains: Jurnal Pendidikan Matematika dan Ilmu Pengetahuan Alam Universitas Jember*, vol. 3, no. 1, p. 59664.

Masrifah, M, Setiawan, A, Sinaga, P, & Setiawan, W 2018, 'Profile of senior high school in-service physics teachers' technological pedagogical and content knowledge (TPACK)', *Journal of Physics: Conference Series*, vol. 1097, no. 1, p. 012025.

Mercier, EM, & Higgins, SE 2013, 'Collaborative learning with multi-touch technology: Developing adaptive expertise', *Learning and Instruction*, vol. 25, pp. 13–23.

Musiek, FE, & Baran, JA 2018, *The auditory system: Anatomy, physiology, and clinical correlates*. Plural Publishing.

Phillips, KP 2014, *The Emerging Republican Majority: Updated Edition*, Princeton University Press.

Supriadie, D, & Darmawan, D 2012, *Komunikasi Pembelajaran*, Remaja Rosdakarya, Bandung.

Trilling, Bernie, & Fadel, C 2009, *21st Century Skills: Learning for Life in Our Times*, John Wiley & Sons, 978-0-47-055362-6.

Wiggins, G & McTighe, J 2011, *The Understanding by Design guide to creating high-quality units*, VA: ASCD, Alexandria.