



The Relationship Between TISE and TPACK among Prospective Biology Teachers of UNNES

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Abstract

The purposes of this study were to identify and describe the level of TISE and TPACK as well as the relationship between TISE and TPACK of prospective biology teacher 2014 and 2015 batches of UNNES. Quantitative descriptive was chosen as the design for this study. A total of 190 prospective biology teachers 2014 and 2015 batches participated in this study. The instruments used were the Computer Technology Integration Survey from Wang et al., TPACK survey from Pamuk et al. and interview guidelines. The results of this study were most the prospective biology teachers had confidence in integrating technology and knowledge to integrate knowledge of technology, pedagogy, and content in teaching biology. Correlation test result showed that most of the TISE level of prospective teachers were in line with their TPACK level with correlation coefficient $r=0,611$ and $p<0.05$. The conclusions of this study were most the prospective biology teachers had a moderate level of TISE and TPACK also there was a significant positive relationship between the level of TISE with TPACK among prospective biology teachers.

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INTRODUCTION

The technology that has been growing rapidly take an important role in various fields of community activity, education was no exception. The use of technology in the learning process of science provides many benefits, for instance improving student learning motivation, visualizing the material, and assisting the inquiry process (Maeng *et al.*, 2013). Therefore, in addition to mastering knowledge of pedagogy and content, preferably as prospective teachers need to adapt to the times, including utilizing technology for teaching. It is reinforced in Permenristekdikti No. 55 of 2017, Permendiknas No. 16 of 2007 about teacher competency standard and Permendikbud No. 22 of 2016 on process standard.

Research about technology integration model in learning have been developed, one of them is Technological Pedagogical and Content Knowledge (TPACK) (Keser *et al.*, 2015). TPACK is a conceptual framework in which technology, pedagogy, and content knowledge interact with each other, was developed by Mishra and Koehler. TPACK is an extension of the conceptual framework of PCK by Shulman (Mishra and Koehler, 2006). TPACK consists of seven knowledge subdomains, namely Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Pedagogical Knowledge (PCK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK) and Technological Pedagogical and Content Knowledge (TPACK).

Another important thing for a teacher to be able to integrate technology into teaching and learning is Technology Integration Self-Efficacy (TISE), self-efficacy of teachers in integrating technology (Keser *et al.*, 2015). Self-efficacy is a person's self-confidence in his or her ability to organize and perform tasks to achieve something (Bandura, 1997). TISE can be used as an indicator that has a big influence on the successful technology integration in learning (Oliver and Shapiro in Wang, 2004).

Many factors affect someone's TPACK, one of them is the personal factor (Chua *et al.* 2012). One of the internal factors that can affect teachers or prospective teachers in taking decisions for integrating technology is TISE (Niederhausser and Perkmen, 2008). Stewart *et al.* (2013) reported that intrapersonal factors such as TISE, outcome expectations, and interest in using the technology can affect the TPACK of teachers and prospective teachers.

TISE and TPACK are important provisions for prospective biology teachers because biology learning will be easier by integrating ICT into instructional strategies for teaching biology (Senthilkumar *et al.* 2014). Sukaesih *et al.* (2017) reported that TPACK of prospective biology teacher of UNNES in Pengelolaan Pengajaran Biology course needed to be improved, there were still few prospective teachers (32%) who used technology, and limited in terms of the type technology involved. TISE of prospective biology teacher has been unexplored yet. Therefore research about TISE as well as the relationship between TISE and TPACK among prospective biology teachers of UNNES are new and need to be done. Even so, the researcher has to measure the level of prospective teacher TPACK first to identify the relationship between TISE and TPACK. This study aimed to identify and describe the level of TISE and TPACK and determine the relationship between TISE and TPACK prospective biology teachers 2014 and 2015 batches of UNNES.

RESEARCH METHOD

Data retrieval this research was conducted in May-June 2018 in Biology Department of FMIPA UNNES. This study used a descriptive quantitative research design with two data retrieval techniques, i.e the questionnaire surveys and interviews. The sampling technique used is saturated sampling. A total of 190 prospective biology teachers 2014 and 2015 batches participated in the survey

and as many as 7 people were chosen to be interview respondents. These batches were chosen because prospective teachers were assumed to have taken all education courses. They were taken from the high, medium and low questionnaire score of each batch. This study went through several stages, i.e (1) preparation (making of proposals and research instrument) including the initial observation and literature study for the theory and questionnaires; (2) data collection, including surveys and interviews; (3) data analysis, including descriptive statistic analysis using Azwar categorization system and statistical test (normality, linearity, Pearson correlation and a simple linear regression).

This study used instruments (1) Computer Integration of Self-Efficacy survey from Wang et al (2004); (2) TPACK survey from Pamuk et al (2013); and (3) interview guidelines. Wang et al. reported that the TISE instrument had post-survey factor loadings ranging from 0.73 to 0.81 and reliability value Cronbach's alpha coefficient post-survey 0.96. Pamuk et al. also reported that TPACK survey instrument had factor loadings ranging from 0.540 to 0.835, and Cronbach's alpha reliability value between 0.759 to 0.950. This instrument covered seven subdomains of knowledge (TK, PK, CK, TPK, TCK, PCK, and TPACK).

RESULTS AND DISCUSSION

TISE Level of Prospective Biology Teacher 2014 and 2015 Batches of UNNES

The survey data was calculated and classified into three criteria (high, medium and low) by referring to Azwar categorization system. The result is shown in the following table.

Table 1 TISE Level Frequency Distribution of Respondents

No.	Criteria	Number of Respondents	Number of Respondents Based on Batch	Percentage (%)
1	High	18 people	9 people from 2014 batch 9 people from 2015 batch	9,47
2	Moderate	146 people	78 people from 2014 batch 68 people from 2015 batch	76,84
3	Low	26 people	10 people from 2014 batch 16 people from 2015 batch	13,69

The result above showed that most of the prospective biology teachers had sufficient confidence in integrating instructional technology. A prospective biology teacher who had a higher TISE level more confident in integrating diverse technologies in the classroom and vice versa. Analysis of interview results had similarities with survey data, in which prospective teachers with high and moderate level felt confident to integrate technology in teaching and learning activities, while a prospective teacher with low level felt less confident. Prospective biology teacher 2014 batch were more confident to integrate technology rather than 2015 batch. Based on these interviews, several factors that could influence the TISE of prospective biology teachers have been identified. Concerning obstacles about technology, limited time allocation, student's interest, and enthusiasm appeared as external factors. The internal factor identified was technological mastery owned by prospective teachers.

Level of TISE can be influenced by a variety of things and can be different for each person. Low level of TISE can be caused by a lack of prospective teacher's ability to use instructional technology. It causes them to feel not or less confident to integrate instructional technology, so the results of questionnaires analysis showed a low level of TISE as well. Self-confidence in using technology is the most important thing to integrate technology (Wang et al., 2004). Prospective teachers with a moderate level of TISE are likely to have sufficient ability to use technology, so they are quite confident to integrate technology. The high level of TISE can be caused by the ability of prospective teacher which are very adequate in using technology, so they are very confident to integrate technology into the class. Self-efficacy has a significant correlation with a person's ability to use technology

(Anderson et al., 2007). This result was consistent with a social cognitive theory which explains that an individual who has higher abilities or skill in doing something, may also have a higher efficacy and vice versa (Pajares, 2002).

Enactive experience (i.e experiencing positive, negative, or neutral consequences for an action) is the most powerful source of efficacy (Albion, 2002; Wang et al., 2004 and Abitt, 2013). The experience of doing tasks successfully can improve self-efficacy (Bandura, 1997). Prospective teachers have not much teaching experience yet, so it's natural when they are less confident in integrating technology. Based on the results of the questionnaire and interview, prospective teachers 2014 batch have more confidence in integrating technology rather than 2015 batch. Prospective teachers 2014 batch have participated in school teaching internship, so it can be said that they have more teaching experiences than prospective teacher 2015 batch. Strong self-efficacy is a product of time and variety of experiences (Bandura, 1997). Those experiences helped them to develop their confidence and skill to use instructional technology (Farah, 2011).

Success in using technology is strongly supported by the teacher, and even becomes a major factor that very influential (Wang et al., 2004). Increasing level of TISE for prospective biology teachers to create effective biology learning need to be done from college. According to Stewart et al. (2013), the efficacy source of prospective teacher derived from the experience of others (vicarious learning). Therefore, prospective teachers are advised to frequently explore the examples of learning undertaken by friends or teachers who have an acquisition in integrating technology. These examples of would be a good start to improve the level of TISE.

TPACK of Prospective Biology Teachers 2014 and 2015 Batches

TPACK survey data analysis was accomplished by calculating the mean of each subdomain and classifying TPACK level into three criteria. This mean calculation aimed to find out which subdomain that dominates respondents. The result can be seen in the following diagram.

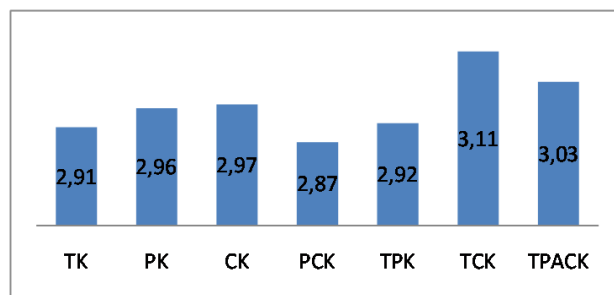


Figure 1 Mean of Each Subdomain of TPACK among Prospective Biology Teacher.

Based on the diagram above, it can be seen that the highest mean of basic core knowledge (TK, PK, and CK) was CK (content knowledge) and the lowest was TK (technological knowledge). The highest mean of the second core knowledge base (TCK, TPK, and PCK) was TCK and the lowest was PCK.

Table 2 TPACK level frequency distribution of respondents

No.	Criteria	Number Of Respondents	Number of Respondents Based on Batch	Percentage (%)
1	High	29 people	18 people from 2014 batch 11 people from 2015 batch	15,26
2	Moderate	137 people	74 people from 2014 batch 63 people from 2015 batch	72,11
3	Low	25 people	5 people from 2015 batch 12 people from 2014 batch	12,63

Based on Table 2, most of the prospective teachers (72.11%) had a moderate level of TPACK. It means that they have been able to integrate knowledge of technology, pedagogy, and content in learning practice. Analysis of interview data showed the same results as the survey results. The interview results showed that prospective teachers who have high TPACK have knowledge of technology, pedagogy, and content superior to prospective teachers with medium and low TPACK and vice versa. In addition, the prospective teachers 2014 batch had a higher TPACK than the prospective teachers 2015 batch.

The level of TPACK can be influenced by prospective teacher frequency technology use. Prospective teachers with a high TPACK may more often to use of technology in their daily life rather than prospective teachers with medium or low TPACK. Whereas prospective teachers with medium TPACK probably more often rather than prospective teachers with a low TPACK. Individual who use technology more frequently in their daily lives indirectly have improved their knowledge and ability in the use of instructional technology and expected to have a higher TPACK (Cheng and Xie, 2018). Conversely, individuals who use technology rarely tend to have no additional knowledge and ability to use technology.

Survey and interview results of the study showed that prospective teachers 2014 had a higher TPACK than prospective teacher 2015 batch. Prospective teachers 2014 batch had experiences in school teaching practice. Those experiences have made them more confident in teaching and increased their knowledge, especially pedagogical knowledge. It was consistent with the previous study which found that there was a significant difference between the knowledge gained with teaching experience and proves John Dewey's learning concept, "knowledge is the result of work experience transformation" (Junnainna et al. 2012).

The Relationship between TISE with TPACK

Statistical analysis that used to test the relationship between TISE and TPACK was the Pearson product-moment bivariate correlation test. The results of this calculation were correlation value $r=0.611$ and significance $p<0.05$. This result indicated that there was a significant and positive relationship between the level of TISE and TPACK prospective biology teachers of UNNES. Simple regression test was conducted to find out how likely TISE gave a contribution to TPACK. From this regression test, it was known that TISE contributed to TPACK in amount of 37,3% and the rest was determined by other factors. It can be internal and external factors. The external factors may include lack of information technology facilities support and skills training. Internal factors affecting TPACK include interpersonal factors such as outcome expectation and interest in educational technology (Stewart et al. 2013).

The relationship between the two variables was positive. It means if an increase in one variable occurs, it will be followed by an increase in the other one. If there is an increased level of TISE occurs, it will cause an increased level of TPACK. The result of this study reinforces previous research which revealed that TISE and TPACK has a positive and significant relationship (Nathan, 2009 and Abitt 2011). Other studies prove a significant positive relationship between TPACK with TISE (Ariani, 2015 and Keser et al., 2015). The results of these studies indicate that actually there is a reciprocal relationship between TISE with TPACK. Self-efficacy can affect how the knowledge and skills acquired and vice versa (Pajares, 2002).

Confidence in integrating technology is recognized as one of the factors that affect teachers to decide which technology will be used (Abitt, 2011). Individuals will tend to choose tasks which they feel competent and confident and avoid activities that they can not (Pajares, 2002). Teachers with higher TISE level have spent a lot of effort to integrate technology, more enthusiastic in participating a course and continue learning by using technology than teachers who have low levels of TISE (Ertmer et al., 2003). In addition, teachers who have high self-efficacy tend to make experiments with learning

methods, see how the improvement of the methods and also experimenting with the instructional material (Wang et al., 2004). Conversely, prospective teachers that have low self-efficacy doubt with their ability and tend to be afraid to try. Their confidence in integrating technology will make the chance to gain experience using various type of technologies. Those experiences most likely will increase TPACK. Therefore, individuals who have high levels of TISE tend to have high levels of TPACK as well.

Relations among subdomains of TPACK have been known through a study. TK was the most positive influence on TPACK compared with PK and CK. Then PCK had a lower correlation than TCK and TPK, and TCK had the strongest correlation compared with others (Pamuk et al., 2013). The results of this study reinforce that something related to technology will affect TPACK, including self-efficacy in integrating technology.

It has been confirmed that TISE has a positive influence on TPACK. That is, one way to improve or develop TPACK is by increasing prospective teacher's TISE. Wang et al. (2004) stated that mastery experience and vicarious experience can improve TISE. Mastery experience will only be experienced by prospective teachers when they have teaching internship and microteaching course. TISE resources of prospective teachers can come from other's experience (Stewart et al., 2013). New teachers who do not have a lot of teaching experience also tend to base their self-efficacy from other teachers that they observed. Wang et al. (2004) revealed that vicarious learning experience using the CD-ROM can improve self-efficacy prospective teachers.

CONCLUSION

Most of the prospective biology teachers 2014 and 2015 batches had a moderate level of TISE and TPACK. It means that they had sufficient self-efficacy in integrating technology and able to integrate technology, pedagogy and content knowledge into biology learning. There was a significant positive relationship between TISE and TPACK prospective biology teachers 2014 and 2015 batches.

REFERENCES

- Abbitt, J.T. 2011. An Investigation of the Relationship between Self-Efficacy Beliefs about Technology Integration and Technological Pedagogical Content Knowledge (TPACK) among Preservice Teacher. *Journal Digital Learning in Teacher Education*, 27(4): 134-143.
- Albion, P.R. 1999. *Self-efficacy Belief as an Indicator of Teachers' Preparedness for Teaching with Technology*. Available in <http://www.usq.edu.au/>.
- Anderson, S.E., J.G. Groulx dan R.M. Maninger. 2011. Relationship among Preservice Teachers' Technology-Related Abilities, Beliefs, and Intentions to Use Technology in Their Future Classroom. *J. Educational Computing Research*, 45(3): 321-338.
- Ariani, D.N. 2017. Hubungan antara Technological Pedagogical Content Knowledge dengan Technology Integration Self Efficacy Guru Matematika di Sekolah Dasar. *Jurnal Madrasah Ibtidaiyah*. 1(1): 79-91.
- Bandura, A. 1997. *Self-Efficacy: The Exercise of Control*. New York: W.H. Freeman and Company.
- Cheng, S.L. dan K. Xie. Relations among Teacher Value Beliefs, Personal Characteristics, and TPACK in Intervention and Non-intervention Settings. *Teacher and Teacher Education*, 74: 98-113.
- Ertmer, P.A. & A.T. Ottenbreit-Leftwich. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education*, 42(3): 255-284.
- Farah, A.C. 2011. *Factors Influencing Teachers' Technology Self-Efficacy: A Case Study*. Disertasi. Virginia: Liberty University.
- Junnaina, H. Chua, Hazri, dan Jamil. 2012. *Factors Influencing the Technological Pedagogical Content Knowledge (TPACK) among TVET Instructors in Malaysian TVET Institution*. International Conference on Education and Educational Psychology. Penang. Malaysia.
- Kementerian Pendidikan Nasional. 2007. *Peraturan Menteri Pendidikan Nasional Nomor 16 Tahun 2007*. Jakarta : Kementerian Pendidikan Nasional.
- Kementerian Pendidikan dan Kebudayaan. 2016. *Peraturan Menteri Pendidikan dan Kebudayaan Nomor 22 Tahun 2016*. Jakarta: Kementerian Pendidikan dan Kebudayaan.

- Kementerian Riset, Teknologi dan Pendidikan Tinggi. 2017. *Peraturan Menteri Riset, Teknologi dan Pendidikan Tinggi Republik Indonesia Nomor 55 Tahun 2017*. Jakarta: Kementerian Riset, Teknologi dan Pendidikan Tinggi.
- Keser, H., F.G.K Yilmaz dan R. Yilmaz. 2015. TPACK Competencies and Technology Integration Self-Efficacy Perceptions of Pre-Service Teachers. *Elementary Education Online*, 14(4): 1193-1207.
- Mishra, P. dan M.J. Koehler. 2006. Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record*, 108(6): 1017-1054.
- Koehler, M.J dan P. Mishra. 2009. What is Technological Pedagogical Content Knowledge?. *Contemporary Issues in Technology and Teacher Education*, 9(1): 70.
- Koehler, M.J., Mishra P., K. Kereluik, T.S. Shin dan C.R Graham. 2014. *Handbook of Research on Educational Communications and Technology*. New York: Springer Science+Business Media.
- Maeng, J.L., B.K. Muvley, L.K. Smetana, dan R.L. Bell. 2013. Preservice Teacher's TPACK: Using Technology to Support Inquiry Instruction. *Journal of Science Educational Technology*, 22(6): 838-857. Available in <http://link.springer.com>.
- Nathan, E.J. 2009. An Examination of the Relationship between Preservice Teachers' Level of Technology Integration Self-Efficacy (TISE) and Level of Technological Pedagogical and Content Knowledge (TPACK). Disertasi. Texas: University of Houston. Available in <http://eric.ed.gov>.
- Pajares, F. 2002. *Overview of Social Cognitive Theory and of Self-Efficacy*. Available in <http://www.uky.edu/~eushe2/Pajares/eff.html>.
- Pamuk, S., M. Ergun., R. Cakir., H.B. Yilmaz., dan C. Ayas. 2013. Exploring Relationships Among TPACK Components and Development of the TPACK Instrument. *Education and Information Technologies*: 1-23.
- Schmidt D.A., E. Baran, A.D. Thompson., M.J. Koehler, P. Mishra, dan T. Shin. 2009. Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers. *Journal of Research on Technology in Education*, 42(2): 123-149.
- Senthilkumar R., Sivapragasam C., dan Senthamarai kannan B. Role of ICT in Teaching Biology. *International Journal of Research*, 1(9): 780-788.
- Stewart, J., P.D. Antonenko, J.S. Robinson, dan M. Mwavita. Intrapersonal Factors Affecting Technological Pedagogical Content Knowledge of Agricultural Education Teachers. *Journal of Agricultural Education*, 54(3): 157-170.
- Sukaesih S., S. Ridlo, dan S. Saptono. 2017. Analisis Kemampuan Technological Pedagogical and Content Knowledge (TPACK) Calon Guru pada Mata Kuliah PP BIO. Seminar Nasional Pendidikan Sains. Surakarta.
- Suryawati, E., L.N. Firdaus dan Y. Hernandez. 2014. Analisis Keterampilan *Technological Pedagogical and Content Knowledge* (TPACK) Guru Biologi SMA Negeri Kota Pekanbaru. *Jurnal Biogenesis*, 11(1): 67-72.
- Wang L., P.A. Ertmer, dan T.J. Newby. 2004. Increasing Preservice Teacher's Self-Efficacy Beliefs for Technology Integration. *Journal Research on Technology in Education*, 36(3): 231-250.