TPACK Observation Instrument: Development, Validation, and Reliability

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Abstract. The aims of this study is to develop an observation instrument and test the validity and reliability used to measure the performance of biology teachers to apply TPACK in the learning process. This research is included in the DDR. The steps to develop TPACK observation instruments are, (1) analysis of products to be developed; (2) initial product development; (3) product validation; (4) field trials; and (5) product revisions. TPACK observation instrument was trialed on 11 biology teachers in two provinces, Yogyakarta and Central Java in August 2018, involving 4 rater. Face validity and empirical validity were carried out. Instrument face validity involves 2 expert judgements and empirical validity is determined by looking for Biserial Correlation value. Intra class correlation coefficient (ICC) is used to test reliability. Empirical validity based on the value of Biserial Correlation shows that all items are valid with R count > 0.602. The reliability value of the TPACK instrument disclosed by the ICC is 1.000, which means that the instrument has a high reliability level. In addition, the development of both reliable and valid scale related to the technological pedagogical content knowledge of biology teachers’ would be promote further studies.

Keywords: TPACK, Biology Teacher, Learning process, Observation Instrument, Validity, Reliability

INTRODUCTION

Teachers as educators play an important role in the teaching and learning process. A teacher takes part in efforts to form students as superior and highly competitive individuals. Thus, students need to be educated by professional teachers so as to produce the good quality outcomes. Professionalism is a performance quality that can be interpreted as the demands of a professional attitude to carry out their duties and obligations. Teachers as professionals are required to work in the corridor of professionalism, therefore must uphold the professionalism of their work. Based on UU No. 14 of 2005 concerning Teachers and Lecturers who read: “Professional is a job or activity carried out by someone who needs expertise or skills that meets certain quality standards or norms and requires professional education.” At the next point, “The teacher has the main task, namely, educating, teaching, guiding, directing, training, evaluating and evaluating the students.” In the teaching and learning process, professional teachers not only teach, but also must educate, meaning the teacher's task is not only method and teaching, the teacher must also be able to motivate students, have high skills and broad-mindedness
(Suryadi, 2014). So that professionalism can be interpreted as a person's skill level as a professional or a job as a profession. Professionalism is also reflected in the attitude and commitment of members of the profession to work based on professional standards and codes of ethics as educators.

Based on Permendiknas No. 16 of 2017, it is stated that teacher competency standards include pedagogic, personality, social, and professional competencies. The fourth competency integrated in teacher performance, in professional terms, there is a specific component that must be possessed by a teacher who correlates with the requirements set by the teaching profession. This confirms that professional teachers are required to have competence as educators. Teacher must master the teaching material (content) according to their area of expertise. However, it is not enough just that, the teacher must also be able to transfer the content to their students so that it is easy to understand. In this case, the content of biological material for high school is too many, so a method is needed to package the material.

Rapid and increasingly modern technology and information development is one of the characteristics of the 21st century (globalization era). The development of this technology has an influence on paradigm changes about education. So that to see the results of the quality of education needs to follow the development of education in the era of globalization. Learning the era of globalization is a transition of learning where the curriculum developed requires school organizations to change the learning approach that is initially centered on the educators (teacher-centered learning) into a learner-centered learning approach (student-centered learning). This is in accordance with the demands of life in the future that students are given the opportunity and are required to be able to develop their skills in mastering ICT, students are expected to have the ability to use technology in the learning process that aims to achieve students' thinking and learning skills. This certainly encourages teachers to participate in developing their abilities in mastering technology.

The ability of teachers is not merely to develop the ability of Paedagogical or Content only in learning, but it requires an understanding of technology so that learning is in accordance with the times in this modern era. H.A.R Tilaar (1990: 205) mentions that one profile of 21st century professional teachers is mastering strong science and technology. This is a breakthrough that must be done in the 21st century in education, teachers must be able to utilize technology in improving the learning quality. Schoen & Fusarelli (2008) research results show that the pedagogical ability of teachers and the use of ICT as an instructional tool are factors that help teachers and schools to meet challenges in preparing students by improving the skills needed in the 21st century. According to Koehler and Mishra (2009: 63) a teacher must master pedagogic, content, and technological abilities. This capability is called Technological Paedagogical Content Knowledge (TPACK). Based on the research results of Papanikolaou (2014), Kazua (2014), Mishra and Koehler (2006), Alazzam et al (2012), Chai et al (2013), Allan et al (2010), Jimoyiannis (2010), Khan ( 2011), Baran et al. (2011); show that TPACK can be used to guide the efforts of educators in facing the challenges of teaching and learning brought about by rapidly changing technology.

Mishra and Koehler (2009) menggambarkan TPACK secara keseluruhan yang terdiri dari dasar-dasar pengajaran dengan teknologi, presentation of concepts through technology, teaching content, developing constructive methods through pedagogical techniques. In general, TPACK involves (1) presenting concepts through the use of technology; (2) utilize technology in teaching content knowledge through pedagogical methods and techniques; (3) identify what makes concept learning easy or difficult and determine how to use technology to enable students to solve problems they might face; and (4) decide how to use technology to teach students new knowledge or strengthen their previous knowledge (Mishra dan Koehler, 2006; Koehler dan Mishra, 2009).

Based on the Indonesian National Qualifications Standards (KKNI), the teacher is at C7 level which means the teacher is able to plan and manage resources under his responsibility, and evaluate comprehensively its work by utilizing knowledge, and technology to produce strategic development
steps. Thus, all elements of TPACK should have been mastered by the teacher, but so far TPACK is still in the form of knowledge. So it is important to evaluate how the application of TPACK in the learning process.

Evaluation of teacher performance has been done a lot, but this evaluation has not yet directed specifically to the application of content in the field of science / expertise combined with pedagogic and information technology. During this time, evaluation also uses more data revealed by attitude scale instruments (survey), so that it has not observed teacher performance in learning process. This is because there is no instrument in the form of an observation sheet to measure the teacher's TPACK, especially the biology teacher. Based on the description that has been stated, it is necessary to research the development of instruments to measure the teacher's TPACK.

RESEARCH METHODS

The type of this research was Design and Development Research (DDR). This instrument was trialed in two provinces, Yogyakarta and Central Java. The data collection was conducted on August 2018. The sample in this research is the biology teacher in two provinces taken from 3 schools from Yogyakarta and 3 schools from Central Java with the total teachers are 11 teachers. The preparation of instruments based on five steps. The steps to develop TPACK observation instruments are, (1) analysis of products to be developed; (2) initial product development; (3) product validation; (4) field trials; and (5) product revisions. Instrument validation using face validity and empirical validation. Face validity by involving two expert judgments and empirical Validation based on Biserial correlation values, with provisions, if R counts> 0.602, then the item is valid. Instrument reliability using Intraclass Correlation Coefficient (ICC) with provisions, the closer to 1,000, the instrument has a higher value of reliability.

FINDINGS AND DISCUSSION

The results of the analysis of the face validity by expert judgment are presented in table 1 below

| Item | Score (%) | Information |
|------|-----------|-------------|
| 1    | 3         | 75          |
| 2    | 4         | 100         |
| 3    | 4         | 100         |
| 4    | 4         | 100         |
| 5    | 4         | 100         |
| 6    | 4         | 100         |
| 7    | 4         | 100         |

Based on the data in Table 1, expert judgment 1, item number 1 has a score of 75%, which means it is valid and numbers 2 to 7 have a score of 100%, which means having a high validity value. Assessment from expert 2, items number 1.6, and 7 have a score 75%, which means is valid and items number 2 to 5 have a score 100%, which means having high validity value.

The results of the analysis of empirical validity based on Biserial Correlation values (Field, A. (2009); Widhiarso, W. (2010)) are presented in table 2 below

| Item | r-p.bis | p    | r-bis |
|------|---------|------|-------|
| 1    |         |      |       |
| 2    |         |      |       |
| 3    |         |      |       |
| 4    |         |      |       |
| 5    |         |      |       |
| 6    |         |      |       |
| 7    |         |      |       |
Based on the data in Table 2, the Biserial Correlation value shows that all items are valid with R count > 0.602.

The results of the analysis of reliability the instrument based on Intraclass Correlation Coefficient values are presented in Table 3 below.

| Table 3. The result of the reliability of the instrument based on Intraclass Correlation Coefficient (ICC) values |
| --- | --- | --- | --- | --- | --- |
| | Intraclass Correlation | 95% Confidence Interval | F Test with True Value 0 | |
| | | Lower Bound | Upper Bound | Value df1 df2 Sig |
| Single Measures | 1.000b | 1.000 | 1.000 | 1.561E17 | 10 | 30 | .000 |
| Average Measures | 1.000c | 1.000 | 1.000 | 1.561E17 | 10 | 30 | .000 |

Based on the data in Table 3, the ICC value of 1.000, which means that the instrument has very high reliability values based on an inter-rater agreement.

These results indicate that the TPACK Instrument is appropriate to measuring biology teachers about the TPACK domain. Despite the small sample size, the researcher has a good indications that observation, as revised, is a reliable measure for TPACK and related knowledge domains. This observation instrument was designed with specific objectives/purposed in mind: evaluating the teacher applying TPACK in the learning process. Over the years, several instruments have been developed to measure constructs such as teacher technology skills, technology integration, access to technology, and teacher attitudes about technology (Becker & Riel, 2000; Knezek & Christiansen, 2004; Keller, Bonk, & Hew, 2005). Although progress was made in the development of valid and reliable instruments for this purpose, this instrument different from others because measuring biology teachers applying TPACK in the learning process through observation rather than teacher attitudes or teacher technology use and integration. This extends the work of Archambault and Crippen (2009) and Mishra and Kohler (2005) by making other powerful instruments specifically targeting teachers and thoroughly evaluating their capabilities of development on the TPACK domain.

Readers are reminded that this observation is specifically designed for teachers who have included the C7 level in the KKNI. Therefore C7 teachers generally need to be able to integrate technology in the learning process, this supports the idea that the TPACK framework relies on content that must be integrated with pedagogical and technological (Mishra & Kohler, 2006). Based on the results of this instrument, revising items for this subscale can strengthen the validity of the TPACK instrument. The research plans included continuous revisions and improvement/refinement of instruments, including adding more items to several TPACK subscales.
CONCLUSION
From the results of this study, it can be concluded that the instrument is valid and reliable so that it can be used to measure the performance of biology teachers in applying TPACK in the learning process.

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