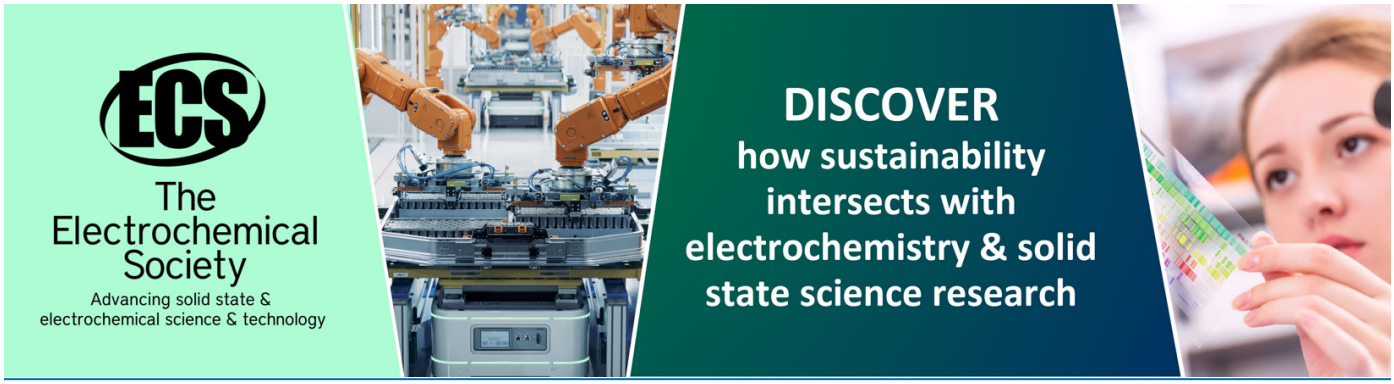
The investigation of science teachers' experience in integrating digital technology into science teaching



IOP Conf. Series: Journal of Physics: Conf. Series **1013** (2018) 012079 doi:10.1088/1742-6596/1013/1/012079

The investigation of science teachers' experience in integrating digital technology into science teaching

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Abstract. The use of technology into science learning encounters problems. One of the problem is teachers' less technological pedagogical and content knowledge (TPACK) on the implementation of technology itself. The purpose of this study was to investigate science teachers' experience in using digital technology into science classroom. Through this study science teachers' technological knowledge (TK) and technological content knowledge (TCK) can be unpacked. Descriptive method was used to depict science teachers' TK and TCK through questionnaire that consisted of 20 questions. Subjects of this study were 25 science teachers in Bandung, Indonesia. The study was conducted in the context of teacher professional training. Result shows that science teachers still have less TK, yet they have high TCK. The teachers consider characteristics of concepts as main aspect for implementing technology into science teaching. This finding describes teachers' high technological content knowledge. Meanwhile, science teachers' technological knowledge was found to be still low since only few of them who can exemplify digital technology that can be implemented into several science concept. Therefore, training about technology implementation into science teaching and learning is necessary as a means to improve teachers' technological knowledge.

1. Introduction

Integrating technology into science teaching and learning has been concerned by many countries [1,2,3,4]. Effectiveness of technology implementation in science teaching is the core of technology integration itself. Nowadays, the implementation of technology into science teaching still remains some problems. The quality of technology implementation in science teaching and learning mainly influenced by science teachers.

Technological pedagogical and content knowledge (TPACK) is considered as knowledge that corresponds to teachers' ability to integrate technology into their class [1,5,6]. Numerous studies had been carried out to investigate pre-service and in-science teachers' TPACK. It is believed that pre-service science teachers' TPACK are still low in their last year of teacher preparation program [7]. Technological pedagogical knowledge is believed to be factor that has the strongest relationship to TPACK [8]. Science teachers achieve and reach competency of integrating ICT by means of TPACK based professional learning workshop [4]. Through collaborative design of technology-enhanced science lessons, science teachers' TPACK were found to be improved. In addition, there are three kinds of science teachers who integrate technology into their teaching which are technology-infusive (TI), technology transitional (TR), and planning and design (PD) [9].

Most of study about pre-service and in-service TPACK employed self-reported survey on TPACK consisting question about technological knowledge, pedagogical knowledge and content knowledge. Knowledge interplay are included in the survey which are technological pedagogical knowledge, technological content knowledge, pedagogical content knowledge and technological pedagogical content knowledge [10]. Another way to unpack TPACK were used by the utility of extended content representation [6]. Nevertheless, there has not been any studies unpacking science teachers' experience on technological knowledge by using contextual instrument. Therefore, the purpose of this study was to investigate science teachers' experience on technology integration during professional training. Contextual instrument was used in the study which is questionnaire about science teachers' technological knowledge and technological content knowledge.

2. Methods

This study utilized descriptive method to investigate science teachers' experience in integrating digital technology. It is lead to the identification of science teachers' technological knowledge and technological content knowledge. Twenty five science teachers were involved in the study. Every science teachers has different learning experience in regard to their working life. The study was performed in the context of science teacher professional training. The training was aimed at strengthening science teachers' skill of conducting science teaching and learning in junior high school.

This study used questionnaire consisting of 20 questions. Seven questions were asking science teachers demography data. Nine questions were asking science teachers' view about the necessity of teacher professional training. Meanwhile, four questions were asking view about technology integration. Questions concerning view about technology integration were composed in the form of multiple type. Science teachers were asked about their habits of integrating technology into their science classroom. The teachers were asked whether they never, always or sometimes integrating technology. Those who always or sometimes integrating technology into which unpacking type of technology that they used whether digital or non-digital. Specific type of digital and non- digital technology used were explore through open question attached in each type of technology chosen.

The type of digital technology were classified more detail into three groups which are: 1) hardware, 2) software 3) online program. Another question was added to each group of digital technology. Moreover, the last question asked science teacher preference of integrating digital technology or non-digital technology into their teaching.

3. Result and Discussion

This section explains the description of science teachers' experience in integrating technology that lead to technological knowledge and technological content knowledge identification. Data gained are expressed in chart.

3.1. Science Teachers' Technological Knowledge (TK)

In this study, science teachers' experience in using technology into their classroom was the first asked. Twenty four of 25 science teachers stated that they sometimes use technology into their teaching. One teacher said he always use it. This fact indicates that almost all of the teachers previously do not comprehend the word 'technology' refers to. They view technology as only digital tools. This facts indicate that science teachers' TK are still low. This is because (TK) refers to several technologies, from non-digital technologies such as pencil and paper to digital technologies such as computer, software and online teaching tools [10]. Another feature indicating TK is knowledge about modality modalities that are presented for delivering information [11]. In contrast, when science teachers were asked to mention non-digital technology they used in their classroom, thirteen teachers explain several standard technology they commonly used to support their teaching. This inconsistency confirms less teachers' technological knowledge. Types of non-digital technology used is shown in Table 1.

Table 1. Type of non-digital technology in-use

Types	Amount
Laboratory kits	11
Biology charts	1
Measurement tools	2
Torso	1

Table 1 shows the most used of non-digital technology. It is found that laboratory kit is the most used. This fact imply that non-digital technology still preferable to support science laboratory activity. There has not been any digital aid that is used to support laboratory activity. Whereas, digital technology was found can be used to support inquiry instruction [12] even it is possible to carry out inquiry based computational experiment [13].

Another indication of science teachers TK is the number of digital technology types they commonly used during their teaching experience. Data from questionnaire shows that hardware that mostly used by the teachers are computer, laptop, and smartphone. Meanwhile, software used are power point presentation, and flash animation. This finding indicates science teachers less technological knowledge since there are a large number of software that can be used to support science teaching. For example, digital video software, word processing/desktop publishing, digital audio software, digital imaging software can be used to support their teaching [1]. Spreadsheet is also another variant that can support the teaching [14]. Moreover, the teachers states only use E-learning to support their teaching. Nevertheless, science teaching and learning can also be supported by the use of online text book [1].

3.2. Science Teachers' Technological Content Knowledge (TCK)

Technological content knowledge (TCK) refers to knowledge about how to choose technologies that high represent and endorse certain content-based precepts [10]. Technological content knowledge (TCK) can be embodied by the content-specific software [1]. Based on the questionnaire, science teachers have enough TCK. It is indicated by the content specific software that they mentioned when being asked about digital technology within their teaching experience.

Several science topics are considered to be appropriate with the utility of learning software. Those topics are: 1) Excretion 2) Reproduction 3) Organ system 4) Digestive system 5) Circulatory system 6) States of matter 7) Heat 8) Light and 9) Solar system. Some of the topics are appropriate to be conducted by software utility since they contain abstract concepts. However, it is also found that the teachers used software for conveying the topic of 'States of Matter' which is more appropriate when being implemented by hands on activity. Nevertheless, there is no further information describing whether the software used fully or complementary. This condition is limitation of this study. Multiple data resources are then important to explore this fact more deeply and to better understand science teachers' technological knowledge.

The sufficient of science teachers' technological content knowledge in this study is also found by analyzing teachers' answer about the preferable technology to support science teaching and learning. Five teachers viewed that digital technology is the best tool. Two teachers considered non-digital technologies is better. Meanwhile 18 science teachers preferred both of digital and non-digital technologies. The use of those two kinds of technology should be matched with characteristics of the concepts. This finding in line with belief that TCK supports teachers to match technology with certain content [15].

4. Conclusion

Based on the study it is concluded that science teachers generally have a lot of experience in integrating technology into science teaching and learning. Nevertheless, the teachers' experiences were limited since they still have low technological knowledge. Most teachers view technology as digital devices but further realize low-tech technology as standard technology. This less technological knowledge impact on experience in using software to support the teaching. Whereas, science teachers' TCK is found to be better than their TK. It is indicated by the content specific software that they

mentioned when being asked about digital technology within their teaching experience. However, there is no detail information explaining whether the teachers use software fully or complementary. This condition is the limitation of this study. Multiple data resources are then important to explore this fact more deeply and to better understand science teachers' technological knowledge.

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