

Indonesia Teacher Competencies in Integrating Information and Communications Technology for Education

By Muhammad Takwin Machmud^{*}, Rosidah[±], Della Fadhilatunnisa[°]
& M. Miftach Fakhri[♦]

The focus of this study is to identify teacher competencies and readiness in implementing technology for teaching activities and their attitude towards them. Indonesian teachers were included as a sample of study which was selected through a random sampling technique. The questionnaire and interview script were adapted with the components of Information and Communications Technology (ICT) Competency Framework for Teachers (CFT) that was released by UNESCO as an indicator, which consists of several aspects, those are: (1) Understanding ICT for education policies; (2) Curriculum & Assessment; (3) Pedagogical; (4) Digital skills; (5) Administration; and (6) Teacher development. The result shows positive trends that most of Indonesian teachers possess these attributes, according to the ICT competencies attribute aspect such as employed ICT into recent curriculum and assessment. However, teachers are still lacking in their ideas towards contribution and innovation in ICT development for learning. The results about teacher attitudes toward ICT results show positive feedback, but still lack ICT technology access and training. In conclusion, Indonesian teachers possess high standards of ICT competencies, but still lack supporting systems such accessing ICT facilities.

Keyword: *ICT for education, ICT competencies, technological literate, teacher readiness, teacher competencies*

Introduction

Nowadays, the presence of technology is influencing major transformations in the educational system. This transformation is shown by the change of methods in delivering knowledge in classroom. For example, a teacher is acting like a musical conductor for teacher-centered teaching, then changes into student-centered learning. According to Sumintono et al. (2012), the use of technology for education is transforming the teachers' role as knowledge distributors into learning facilitators.

^{*}PhD Candidate, Department of Educational Technology, Khon Kaen University, Thailand.

[±]Associate Professor, Faculty of Mathematics and Science, Universitas Negeri Makassar, Indonesia.

[°]Lecturer, Faculty of Economic and Business, Universitas Islam Negeri Alauddin Makassar, Indonesia.

[♦]Lecturer, Universitas Cokroaminoto Palopo, Indonesia.

Since the constructivism theories dominate the educational view, many constructivist scholars believe that learning through technology could provide meaningful learning by presenting an authentic context. Moreover, the implementation of technology has the potential to support effective communication between students and teachers. This communication is effectively melting rigid relationships between teacher and students, which can benefit students in creating more ease to access information from the expert and to enrich the knowledge by improving learning experiences (King and South 2017, Vitanova et al. 2015). Majority of people believe that technology used for education started in the last century. However, the implementation of technology for teaching and learning has existed since 2,000 years ago. Basically, the presence of technology is enhancing human learning, especially in answering the fundamental reason why/how humans learn. In our educational system today, the branch of education that is implemented to integrate technology is known as Educational Technology. Generally, educational technology was defined as the tools that assist the process of information and knowledge transfer (Huang et al. 2019). This general definition is often misunderstood by our society which set technology as a teaching tool, rather than supporting tools for learning. According to Jhurree (2005), the presence of technology should not replace the teacher's role. Technology should be transforming into supporting tools to achieve learning goals and improving the quality & efficiency of educational systems.

Besides shifting our educational system, the presence of technology is also affected towards teachers' performance. As an important part of 21st century education, the teachers have to possess a sense of creativity in constructing innovative learning by integrating ICT technology media into the learning activities (Herliani and Wahyudin 2018). Ahmad et al. (2016) mentioned that well-prepared teachers will use technology to facilitate teaching as a promising platform to enhance effective and efficient teaching and learning activities. This statement is empowering teachers to be technologically literate, in which teachers have an the ability to engage technology as the media for integrating, accessing, communicating, creating, and evaluating information in the learning process through higher thinking.

Technological literacy is an important qualification for teachers. Moreover, it is becoming the part of teacher pedagogical competencies as mentioned by Indonesian MOE Regulation about standard qualification and competencies for teachers (No.16 of 2007), which state "the application of information and communication technologies are important for teacher in learning activities." This regulation is demanding teachers to utilize ICT to create an effective teaching and learning environment (Syahid et al. 2019). The demand on competencies for teachers is also seen as a global need. The United Nations Educational Organization released 6 main aspects which promote several activities to develop teacher competencies, including: (1) Understanding ICT for education policies aspect; (2) Curriculum & Assessment aspect; (3) Pedagogical aspect; (4) Digital skills aspect; (5) Administration aspect; and (6) Teacher development aspect. The importance of ICT competencies is also mentioned as the crucial competencies for creating ICT-based classroom management. The teacher who has better ICT

competencies is important for their performance and students' learning achievement activities (Syahid et al. 2019). According to Takwin et al. (2018), a professional teacher is supposed to master specific competencies in ensuring appropriate learning content presented to the learner. In the International Symposium on Open, Distance, and E-Learning 2018, the Head of ICT Centre for Education of Indonesian Ministry of Education stated that only 40% of Indonesian teachers have readiness and competencies for technology implementation for learning purposes.

There are several strategies and efforts to improve ICT competencies of teachers, including proper teacher training, access to the ICT hardware for teachers (Mahdum et al. 2019, Vitanova et al. 2015), and establish regulations for standardizing the qualifications and competencies for teachers. In fact, the reality shows ICT implementation for education faced several obstacles which could affect the ICT teacher competencies (Nurhabibah et al. 2018). As Hermawan et al. (2018) mentioned, several obstacles to implement ICT in teaching and learning processes exist such as lack of policy, changing curriculum, gaps of teacher quality, gaps of education quality, lack of infrastructure, lack of planning, and lack of skilled workers. Previously, Son et al. (2011) conducted a study which focused on computer literacy of Indonesian English teachers in 2011. The study result shows several obstacles such as facilities, time consuming, internet access, individual skills and readiness during implementation of ICT media for educational purposes. In conclusion, this recent study was conducted to respond to current questions about Indonesian teachers' competencies in using ICT media for teaching and learning purposes.

Methodology

The sample of study includes 300 teachers from elementary schools, junior high schools, and senior high schools. Moreover, the sample also involved teachers who teach in government and private schools. The simple random sampling technique was used to select participants as objects of the study in which the subject of study has equal probability of being chosen as a sample. The data is collected by using questionnaire form and interview. The content of questionnaire is constructed base on the Indonesian MOE regulation. The questionnaire is administered in an online form using Google form, while the interview form is conducted through telephone line.

Results and Discussion

Instrument Validity and Reliability

Maintaining the quality of items in assessing the teacher competencies is important in accurately measuring teacher competencies in using technology for educational purposes. The instrument validity analysis involved an expert validator

in educational technology, instructional media development, and lecturer in University. The Index of Item Objectives Congruence (IOC) is used as model to assess instrument validity. The result of validity checking shows 25 items proposed are accepted to use as items for the self-assessment questionnaire. On the other hand, measuring reliability of the instrument through the implementation of internal consistency approach, which is tested based on single test administration (Gog et al. 2007). These reliability test results show the alpha value is 0.93. According to Tavakol and Dennick (2011), the acceptable value of alpha is > 0.70 , means the analysis of alpha values is accepted ($0.93 > 0.70$).

Teacher ICT Competencies Analysis

The questionnaire items are constructed by using six aspects based on ICT CFT that were released by UNESCO including: (1) Understanding ICT for education policies aspect; (2) Curriculum & Assessment aspect; (3) Pedagogical aspect; (4) Digital skills aspect; (5) Administration aspect; and (6) Professional development aspect.

ICT Knowledge and Understanding Towards Education Policies

The first aspect is emphasizing how teachers have understanding towards the national education policies for ICT. Moreover, teachers must be able to design, modify, and apply these national policies for learning purposes. Additionally, the first aspect is also emphasizing teachers' roles in giving critiques and suggestions towards national policies. The establishment of national education policies is according to the national priority in all sectors of education (UNESCO 2013). The presence of policies is also for managing the regulation and society behavior on implementing effective and efficiency systems for education. According to Bottino (2003), the proper educational policies for ICT must emphasize its roles as a demand pull, that driven-based user needs and pedagogical understanding. The demand pull approach is implemented by several countries including Indonesia by promoting teacher main competencies (MOE decree for teacher standard qualification and competencies No.16 of 2007).

Through the depth of understanding educational policies and the role of ICT for education can lead teachers to optimize the utilization of technology for learning purposes. This recent study shows the majority of teachers are the design of their ICT instructional media occasionally (Table 1). They argued that preparing and creating proper instructional media using ICT media takes more time. The others also state the lack of information and knowledge in using ICT media is becoming a main barrier for teachers in developing their own instructional ICT media. However, Tamrin et al. (2017) mentioned that reason is not becoming an excuse for teachers to create proper learning media. He also stated that preparing and planning teaching material and instructional media is supposed to be the responsibility of the teacher.

Table 1. Aspect of Understanding ICT in Education Policies

Item	Result in percentage				
	Never	Rarely	Sometimes	Often	Always
I design and create my own ICT media for learning purposes.	5.3%	18.3%	45.3%	23.7%	7.3%
I participate in workshops, training, & conferences as an effort to develop a national ICT program.	28%	35.3%	27%	7.7%	2%
I contribute the ideas through research article about ICT development for national education.	51.7%	25.3%	18.7%	4%	0.3%

Teacher knowledge about ICT role's in educational policies will also give an advantage for them to contribute their perspective in the form of suggestion and criticize for the improvement of using ICT media for educational purposes. Events such as workshops, training, and conferences are known as the most effective way in improving specific prowess and programs. As Ravn and Elsborg (2011) mentioned, conferences are a source of knowledge, ideas, and inspiration. The lack of participation in events such training, workshops, and conferences can be affected in the development of teacher content knowledge, teaching skills, and practices (Darling-Hammond and McLaughlin 2011). This study result (Table 1) shows teachers have low interest in attending the conferences, workshop, and training. Majority of teachers reasoned that the overload of school activities made it difficult to join self-development events and activities. Since the implementation of full-day schools, the middle and high schools teacher work time are increasing. Full-day School program is based on the concepts of integrated activity and curriculum, meaning all student activities in school are packed in an educational system (including playing, eating, etc.) (Benawa et al. 2018). Practically, teachers must attend the schools from 7.00 until 16.00. Additionally, the lack of information and access to self-development resources is also becoming a major issue, especially for remote area teachers. The other way to contribute the development of policies is conducting, writing, and publishing research articles. Strengthening this claim, Harris (2015) states that research can be impactful to the policies' development as long as the result of conducted research can give feedback that shape policies that are adopted into practice. The research is also giving alternative perspectives that teachers can perform in solving educational problems. In fact, this study result shows teacher intensity in contributing to scientific articles is still low. They argued that the overload of activities in schools is becoming the obstacle to conducting and writing research articles. In conclusion, all these problems might be experienced by many teachers, but their professionalism is determined based on their effort to keep growing as the Indonesian MOE Regulation (No.16 years 2007) mentioned about professional development by conducting research activity.

Curriculum and Assessment

The aspect of curriculum and assessment is emphasizing teachers' excellent knowledge regarding the curriculum standard, assessment strategies, and student characteristic which is aiming to create complex problems for learning in measuring students' understanding. Moreover, the teacher must be able to integrate the use of ICT into the curriculum. Curriculum knowledge is known as an important element of teachers' pedagogy. According to Behar et al. (1994), curriculum knowledge is defined as the teachers' ability to apply theoretical principles and behaviors which refer to the several processes including: planning, implementing, and evaluating. Quoting the Shulman and Sykes statement, Ariav (1991) simplifies the definition of curriculum knowledge as the understanding of the curriculum form and the ways of the curricula are implemented in text and material. According to this definition, it clearly defines that the curriculum is covering the educational context holistically. This means that it is not only in the textual context, but also curriculum should be induced into the material of teaching and learning. As we know, the teaching and learning materials are referred to in the sources used to deliver learning, including the material sources and instructional media. In discussing curriculum knowledge of teachers, this study attempted to see the concern of teachers towards curriculum implementation toward their instructional material. The result (Table 2) shows that most teachers constructed their ICT media based on the national curriculum. Teachers mentioned that through the optimization of national curriculum into their instructional material and media (ICT media), they can facilitate learners to fulfill basic competencies.

Essentially, instructional media is facilitating the delivery of learning and building the communication between teachers and learners. Moreover, instructional media is also a component that, connected with other components of learning, creates expected learning environment (Widodo and Wahyudin 2018). Consideration to the classroom condition and students characteristics is also becoming standard in selecting instructional media. These characteristics of learners include age, cognitive level, and socioeconomic status. Proper instructional media can help the instructor to provide high quality teaching and learning processes, and affect the learner to learning outcomes. Moreover, it also increased learner interest and motivation during the learning process (Saravanakumar 2018). According to this study result (Table 2), majority of teachers often select the ICT devices in the learning process based on the classroom condition and student characteristics. Teachers believe using proper instructional media is effective in facilitating the delivery of learning materials and engaging learner motivation. On the other hand, selecting proper instructional media can also facilitate students who have difficulties in providing specific instructional media. For instance, students who come from low-income families are faced with difficulty in providing a personal computer/laptop. Several teachers suggested using mobile phones as an alternative, while the other teachers projected the material using LCD projection so each student can participate without using personal devices.

This aspect is also emphasized on the use of ICT for assessment. As an integral part of instruction, assessment has important functions to determine

whether the goals of education are achieved successfully or not. Jonassen et al. (2005) also mentioned that assessment is the most vital aspect in teaching and in the learning process, in which the assessment is the Achilles tendon in formal education. Many scholars and educators believe that the presence of modern technology is effective to help the process of assessment including creating task assessment, delivering the assessment, and grading. According to Marina (2016), the implementation of ICT for assessment is essential for every school and educational institutions to promote a better assessment. Due to the digitalization of education in Indonesia, teachers are encouraged to integrate ICT in supporting their activities, including assessment. This study also shows majority of teachers used ICT for evaluation tools frequently (Table 2). The national regulation is becoming the main reason teachers used ICT as evaluation tools. The swift assessment policies have received many complaints at first. This resistance is caused by the inability of teachers using the ICT application. Due to the implementation of policies, the teachers are starting to realize that the evaluation using ICT is more effective and efficient rather than traditional assessments. In brief, the teachers who have concerns on integrating of national curriculum into ICT and conduct an assessment using ICT media is assumed as qualified teachers (Redecker 2013).

Table 2. *Aspect of Curriculum and Assessment*

Item	Result in percentage				
	Never	Rarely	Sometimes	Often	Always
I use ICT media that is constructed based on national curriculum standards.	-	3.3%	15%	43%	38.7%
I select the ICT devices in the learning process based on the classroom condition and students characteristic.	3.3%	4%	18.3%	43.7%	30.7%
I use ICT multimedia applications such as spreadsheets, online rubrics, etc. as evaluation tools for learning outcomes.	7.7%	15%	27.3%	38%	12%

Pedagogy

The third aspect is about pedagogy which is emphasizing teachers must know the right moment to use ICT for class activities, as well as assisting the teacher's role in modeling the learning process, guiding students' understanding, and creating situations where students could develop their skills. Pedagogy is well-known as the approach and act of how a teacher teaches. Pedagogy is not only about the teaching technique, but how the teachers also induce teachers' belief, social value and social culture into the teaching and learning process. Pedagogy is also emphasized on meaningful interaction between teachers and learners in which the presence of respect is at the center of that interaction.

Many experts in education believe that by having a good understanding towards pedagogy, it can positively affect a teachers' performance, even the student learning process can be more effective. The proper approach in teaching will help learners to activate their higher thinking capability. The presence of ICT is creating new approaches in teaching, and turning it as pedagogical tools. ICT as a pedagogical tool is known as a teacher's knowledge, skills, and attitudes in applying technology for their professional activity including planning a lesson, research, communication, professional development, and self-development (Machumu et al. 2018). As pedagogical tools, the use of ICT should be accurately promoted in learning materials to achieve educational goals. Marpanaji et al. (2018) mentioned that instructional media is chosen to present the learning content and objectives. Moreover, the compatibility of ICT media to the content of educational curricula has benefit to ensure that learners obtain appropriate levels of information (Chaudhary 2018). As the study revealed, teachers have a concern in selecting ICT media that can effectively present learning content (Table 3). Teachers have mentioned that by using correct and suitable instructional media with the learning content will facilitate information and knowledge transfer in more effectively. Additionally, the use of compatible ICT media to learning content shows high engagement of students towards the learning content, and reduces boredom.

Teaching and learning in the 21st century is highly stressed on the constructivism learning theory. According to the constructivism view towards ICT as pedagogical tools, the traditional approach in teaching and learning was restructuring in terms of collaboration as a shift of traditional relation between teacher and learner, and shifting of domination of teachers-centered into students-centered. Learning activity that emphasized student-centered and collaboration is allowing the learner to develop their cognitive flexibility, articulating their learning reflection, and improve their social interaction. Additionally, Sangra and Gonzalez-Sanmamed (2010) mentioned the collaboration as the important element in learning activity. The presence of ICT positively supports collaborative learning by making the collaboration process more efficient. Moreover, ICT also contributed to building positive attitudes towards collaborative learning. Nowadays, many educators have concern around ICT implementation that promotes collaborative learning and a student-centered approach (Table 3). Teachers believe these strategies and approaches could stimulate learners in constructing their own understanding based on their experiences which is a part of meaningful learning. Moreover, teachers also mentioned the increase of learner involvement in classroom activities. According to the study conducted by Reif et al. (2015), student-centered practices can essentially increase students engagement and ownership towards a learning activity.

Table 3. *Aspect of Pedagogy*

Item	Result in percentage				
	Never	Rarely	Sometimes	Often	Always
I consider ICT learning media that I use has compatibility to the learning content.	0.7%	4%	11%	34.3%	50%
I use ICT learning media that promote student-centered learning.	2%	3.7%	20.7%	39.3%	34.3%
I use ICT learning media to provide learning activities that relevance to real-world activities.	0.3%	2.7%	27.7%	43.3%	26%
I use ICT learning media that promote authentic content based on current events.	0.3%	3%	25%	48%	23.7%
I use ICT learning media that promote critical thinking and problem-solving.	0.3%	2.7%	20%	41.7%	35.3%
I use ICT learning media that promote collaboration for students to construct their knowledge.	1.7%	2.7%	20%	41.7%	35.3%

As a part of constructivist learning theory, students-centered approach become a trend in the 21st century classroom and is supposed to promote learning that stimulates 21st century skills such as critical thinking and problem solving. Critical thinking and problem solving are the most important in formal education (Atsoglou and Jimoyiannis 2012, Karyotaki and Drigas 2016). The demand on critical thinking and problem solving is based on the demanding skills in the workplace. According to World Economic Forums for the future of jobs report (World Economic Forum 2020), critical thinking and complex problem solving is becoming the top five of the most demanding skills for the workplace by 2025. In Indonesia, problem solving and critical thinking are included as the most emerging skills in the workplace. Consequently, teachers must create a learning environment which is enabling the learner to engage critical thinking and problem solving. According to the study result (Table 3), it shows most teachers' attempt to integrate learning strategies that stimulate learner problem solving and critical thinking. According to the teachers' statement, they promote problem solving and critical thinking by imposing real world cases and phenomena into learning activities. Hence, learners can activate their prior knowledge to solve an occurring problem. However, there are also teachers who implement critical thinking and problem solving occasionally state their argument that the lack time to prepare proper material is becoming the major reason, while the other said several learning content are not suitable to impose problem solving and critical thinking. Previously, the presence of authentic activities is mentioned as an important element to promote problem solving and critical thinking in learning activities. Nowadays, the presence of modern ICT technology are considered as effective tools to provide authentic learning (Saravanakumar 2018). Teachers also show their high consideration in

using instructional media that promotes authentic activities (Table 3). Teachers revealed that authentic activities can provide actual phenomena which can facilitate learners to understand learning content more deeply. The other teachers also state the benefit of authentic activities that can prepare learners with the condition that learners might face in their future careers. As Oliver and Herrington (2000) state, the application of ICT for learning is considered to successfully engage for real-world activities through the concept of situated learning strategies. In brief, concerning the pedagogical element in implementing ICT as instructional media, is a key success to promoting meaningful learning, and effectively engaging learner motivation. As educational scholars mentioned, the correct use of technology-enhanced classrooms will affect learning processes holistically in promoting constructivist learning, and the demanding skills for the 21st century.

Digital Skills

Nowadays, the demand on technological literacy is becoming a requirement for teachers to possess digital skills. Possessing a proper digital skill will assist teachers in selecting and evaluating proper resources and instructional media that are used for teaching activities. This aspect discusses the application of digital skills which are emphasized by teachers' knowledge about the basic operations of ICT. Defining the essence of teaching will directly determine which digital skills are demanded by teachers. Teaching has essential purposes on delivering, enriching, remediating, and monitoring students' learning. Hence, the teachers should possess several important abilities such as content presentation and delivering, word processing, information management, and electronic network usage (Table 4). Moreover, Mahdum et al. (2019) proposed several standards that can be used for assessing teacher ICT competencies, as follows: (1) operating computers; (2) possess ability for installing, assembling, setting-up, maintaining, and solving problems of personal computers; (3) computer programming; (4) word processing; (5) spreadsheet; (6) managing databases; and (7) creating interactive presentations as interpersonal communication (Mahdum et al. 2019).

Understanding the function of hardware and software is the most essential part of operating ICT. Having this knowledge will support teachers in implementing various learning using ICT as instructional media. Lack of this knowledge is one of the major reasons why teachers are avoiding ICT implementation as instructional media. The result of the study revealed that the majority of teachers can operate hardware and software supporting ICT. Moreover, most teacher response shows a positive response in applying online ICT applications for learning purposes such as using a search engine, downloading the information, using hyperlink media, and using online communication tools. Seeking the reason of how teachers obtain that knowledge and ability in implementing ICT, the most common answer is the shifting of regulation from government that required teachers to conduct their professional work using ICT. On the other hand, the younger generation of teachers mentioned that they were exposed to ICT since an early age. According to the results of the study, it can be concluded that the majority of Indonesian teachers already have good skills in empowering ICT media for learning purposes. According to Organisation for Economic Co-operation and Development (2001),

teachers must possess a wider range of technical and pedagogical skills, and continuous self-improvement in updating the latest trend of technology and modes of use. Moreover, lack of ICT knowledge and skill can be affected to teacher perspective toward ICT use for teaching and learning activities (Mahdum et al. 2019).

Table 4. *Aspect of Digital Skills*

Item	Result in percentage				
	Never	Rarely	Sometimes	Often	Always
Operating ICT hardware for learning activities.	-	2%	17%	51.7%	29.3%
Operating productivity software (such as word processing, presentations, graphic design, etc.)	0.3%	3.3%	20%	48%	28.3%
Using search engines (Google search) in finding learning content.	-	1.3%	6.7%	38%	54%
Downloading the information and learning content from the website.	-	2.7%	8.7%	39.7%	49%
Using hyperlink and hypermedia to provide learning content	0.3%	6%	24.3%	44.7%	24.7%
Using online communication tools such as e-mail and social media for learning purposes.	-	1.3%	10%	35.3%	53.3%
Installing educational software independently	2%	10%	26.3%	41%	20.7%

Organization and Administration

The fifth aspect is Organization and Administration, which emphasizes the guaranteed access of the internet to the whole class including group and individual activities, and also flexibly applying technology to support collaboration (Table 5). The study revealed that teachers who use the ICT facilities provided by schools is still low. The lack of proper facilities provided by schools is a common reason, especially for schools that are located in remote areas. According to a survey in 2015, only 58% of total schools in Indonesia (118,000 schools) have access to the Internet. It should be also noted that 17,000 schools in Indonesia have unreliable access to electricity (Retnawati 2019). Teachers also complained that the number of distributed facilities is still limited. This phenomena shows Indonesia has a similar back story about inequity throughout the years.

Overcoming the lack of facilities in schools, many educators suggested learners use personal ICT devices to support classroom activities. This typical approach is known as BYOD (*Bring Your Own Devices*), which encourages students to bring their private devices for learning purposes. BYOD has benefit to overcome the lack of ICT distribution among learners during classroom activities (McLean 2016). Moreover, teachers should possess proper competencies including an ability to effectively integrate the devices into classroom activities (Rae et al. 2017). In brief, teachers rarely used the facilities provided due to several reasons

such as limited resources provided by schools. However, the teacher is already familiar with technology as instructional media and employed some strategies to overcome the limitation of ICT devices.

Table 5. *Aspect of Organization and Administration*

Item	Result in percentage				
	Never	Rarely	Sometimes	Often	Always
I use the facilities which is provided by the school in the learning process (such as computer laboratory, LCD Projector, etc.)	15.7%	25.3%	33.7%	20.7%	4.7%
I emphasize students to use personal ICT devices to support the learning process.	4%	13.3%	30%	39.7%	13%

Teacher Professional Development

The last aspect is emphasized teachers in applying ICT media to prepare additional learning material, developing their pedagogical knowledge, and collaborating with the experts and fellow teachers in supporting their professionalism as a teacher (Table 6). Teacher professionalism is not just about pedagogical aspect, the other aspect is also becoming important element to support their professionalism such as social interaction, personal character, and their desire for growth. Supporting the development of teachers' professionalism, the role of ICT media is not only as a pedagogical tool, but also in supporting the development of teacher and educator professionalism. Thakral (2015) mentioned that ICT is a powerful and effective tool to facilitate teacher professional development. This statement was proved by a recent study that shows teachers' high frequencies in using ICT media to support their self-improvement, and also updating their knowledge about new findings in their related subject(s). In the discussion about finding new knowledge to support on teacher-related subjects, the majority of teachers have an agreement on the ICT effectiveness in gathering learning content. Teachers mentioned that the ability of search engines as a collecting and seeking tools is becoming the main reason teachers made their choice for ICT media rather than conventional media. Strengthening these claims, Thakral (2015) states the presence of ICT media is highly supported in teaching activities by enhancing the initial preparation. Furthermore, the roles of communication and collaboration are also emphasized by teacher professional development. The importance of having a contact and communication between teachers is allowing them to possess a more knowledgeable, constructive approach to learning. Moreover, it also increased teachers' positive attitudes toward other teachers, such as an appreciation of the views and experiences of other teachers (Organisation for Economic Co-operation and Development 2001). The result of the study shows that the majority of teachers are often using ICT media as communication and collaboration tools with educational experts and other teachers. According to the teacher sample in this study, sharing information about educational policies, evaluation format,

administrative task, and consulting about teaching strategy are the most common topics.

Additionally, this study also assessed the ability of ICT as an administrative tool. The results show a high proportion of teachers using ICT use it to carry out their administrative tasks. Teachers stated that completing an administrative task today is more complicated without using technology. The features in shorting and selecting data for managerial purposes are the reason why teachers highly depend on technology.

Table 6. *Aspect of Curriculum and Assessment*

Item	Result in percentage				
	Never	Rarely	Sometimes	Often	Always
I use ICT devices in all teaching activities and for teachers' administrative activities.	1%	5%	30.7%	33.3%	30%
I use ICT media to improve my professional skills as a teacher and updating my knowledge about recent issues associated with my teaching subject.	0.7%	6.3%	27.3%	34.7%	31%
I use email and social media as collaboration with educational experts and fellow teachers.	1.3%	6%	22.7%	48%	22%
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
Internet and online media helps me in gathering learning content rather than using conventional media (books, encyclopedias, etc.)	-	2.3%	4.3%	54%	39.3%

In conclusion, teachers' ICT competency is related to knowledge and skills about ICT. The lack of teachers' competency can affect their enthusiasm to the implementation of ICT in teaching and learning activities. According to the previous result, it shows that Indonesian teachers show positive responses in almost all aspect of ICT competences that identify them for possessing good ICT competencies. The high attribute aspects include the curriculum and assessment; pedagogy; digital skill; administration and professional learning; while the aspects of understanding ICT in education policies is the only aspect which has low attributes. This aspect was identified in how Indonesian teachers lack innovation and idea contribution to ICT development for learning. Vitanova et al. (2015) also suggested several strategies to achieve higher level of teachers' ICT competencies by increasing the use of ICT in a professional manner, including: (1) Having online communication with colleagues; (2) Using web resources, consumables,

and software to create learning material; and (3) Using ICT to conduct administrative tasks.

Identify Obstacles Using ICT

The importance of ICT is not only achieving the educational, but also becoming an important factor to a complete restructuring of the educational system, promoting new, interactive models of education, new educational pedagogy, and emphasizing lifelong learning (Vitanova et al. 2015). However, teachers face several obstacles when applying ICT as instructional media. The obstacles of using ICT media could be determined into two types based on teacher perspective which include external and internal obstacles. Indicating the obstacle in learning through ICT media, this study conducted an open-ended interview which consisted of 5 main questions. The interview is conducted for a randomly-selected group of teachers (15 people) which is divided into three different age groups, that is young teachers (20-30 years old), middle-age group teacher (31-50 years old), and elderly teacher (>50 years old).

The first question is addressing on assessing internal obstacles in applying ICT media. The question asked: "How do you know about using technology in learning process?" Majority of the age group gave positive responses towards the role of ICT. They believe that ICT is greatly beneficial to providing learning material, especially for a difficult topic. The middle age and elderly teacher groups also mention that ICT helps them to improve their professional skills and completing professional administration requirement. In brief, teachers have positive attitude towards the ICT and show no rejection to the use of ICT for educational purposes. Teachers' negative attitudes towards ICT use in the classroom is greatly affected by lack of skills and knowledge in operating ICT software or hardware (Ghavifekr et al. 2016).

The external obstacle in applying ICT is examined by administering three questions, as follows: (1) "Does your institution facilitate the use of technology in learning activities?"; (2) "Is there any technical obstacle in technology's implementation?"; and (3) "Does the use of ICT for learning is more efficient or time consuming in teaching process?" The first question is identifying what kind of support the institution is offering in providing technology for learning purposes. Majority of the teachers said that the schools already distribute basic support, but it is limited. However, several teachers argued that the quality of facilities depends on the schools' condition including location, school society, and government support. Moreover, several teachers mentioned that some of their schools have regulations that prohibit the use of personal gadgets during the learning process. They argued that the use of technology during the learning process could distract learners' attention.

The second question is centered around the technical issues during implementing ICT. Majority of teachers mentioned the difficulty of connectivity to the internet to conduct online learning, especially for schools which are located in rural areas. Additionally, the elder teachers had mentioned the issues such as lack of training in operating recent ICT software and hardware. Providing proper

technical support is crucial for teachers, so they can focus on delivering their subject material (Ping et al. 2003). The last question is focused on addressing the efficiency of using ICT for learning. Majority of respondents said the use of technology could reduce time-consuming learning processes, especially for a difficult topic. However, the young and middle age teacher groups mentioned the specific topics that are time-consuming during the preparation process. Strengthening this claim, the previous study shows similar external obstacles faced by teachers, such as: (1) Unstable internet connection and electricity; (2) Lack of ICT-related training; (3) Small number of ICT media distribution and limitation access to schools facilities such as computer laboratory; and (4) Limited time for teachers to design their own learning media (Mahdum et al. 2019). The interview also administers questions about the types of ICT hardware and software that teachers used during the teaching process. All of the respondents mentioned laptops and PC's are the most favourable to use during the learning process, and there are only 10 respondents who use smart phones frequently. Besides that, Google (search engine) and Microsoft office are still the most favourable software applications used for learning purposes. The YouTube video web engine is the second favourable software application which most teachers used to provide a real-world example for learners. There are only 5 respondents using Learning Management Systems (such as Edmodo app, Google classroom, etc.) to facilitate teaching and learning activities.

In conclusion, the importance of identifying the obstacle is the most vital area in developing teacher competencies. Indonesian government needs to improve classroom management, and modern classroom management must involve technology in its planning, material selection, methods selection, and evaluation activity (Syahid et al. 2019). The recent study identifies the internal obstacles such as lack of self-confidence, negative attitude towards change, and having a poor perception towards technology are not the major issues which facing by teachers today. However, teachers are still having issues with external obstacles during applying ICT for learning purposes, such as the lack of access toward resource, proper training, and technical issues. The key factor in the use of ICT is sufficient computer labs and ICT equipment. On the other hand, the teachers had used their own personal ICT and various software applications for supporting their teaching and professional activities (Ghavifekr et al. 2016).

Conclusion

The recent study has aimed to identify teacher competencies in integrating technology for learning activities that referred to the standard competencies for teachers released by the Indonesian Ministry of Education, and also attempted to indicate the obstacles in performing ICT in the classroom. The study revealed that Indonesian teachers have a good level of ICT competencies. However, some teachers still lack innovation and idea contribution to ICT development for learning. On the other hand, the teachers have shown a positive attitude toward ICT. However, some teachers still lack ICT technology access and training.

According to the Ray Clifford quote, “Computers will not replace teachers. However, teachers who use computers will replace those who don’t.” This quote is giving the message that ICT competencies (including skill and knowledge) for teachers are important in modern education. A teacher who has high levels of competencies is considered a competitive teacher rather than the others who have negative views towards ICT. Additionally, having an outstanding ICT competency is not merely enough for teacher, the ability in overcoming any internal and external obstacle is also important for teachers.

References

- Ahmad M, Badusah J, Manzor AZ, Karim AA, Khalid F, Daud MY, et al. (2016) The application of 21st century ICT literacy model among teacher trainees Mazalah. *TOJET: The Turkish Online Journal of Educational Technology* 15(3): 151–161.
- Ariav T (1991) Growth in teachers’ curriculum knowledge through the process of curriculum analysis. *Journal of Curriculum and Supervision* 6(3): 183–200.
- Atsoglou K, Jimoyiannis A (2012) Teachers’ decisions to use ICT in classroom practice: an investigation based on decomposed theory of planned behavior. *International Journal of Digital Literacy and Digital Competence* 3(2): 20–37.
- Behar LS, George PS, Taylor P, George PS (1994) Teachers’ use of curriculum knowledge. *Peabody Journal of Education* 69(3): 48–69.
- Benawa A, Peter R, Makmun S (2018) The effectiveness of full day school system for students’ character building. In *IOP Conference Series: Materials Science and Engineering* 288(1).
- Bottino RM (2003) ICT, National policies, and their impact on schools and teachers’ development. In *Information and Communication Technology and the Teacher of the Future*, 41–47. Springer.
- Chaudhary B (2018) The role of ICT in promoting constructivism. *International Journal of Technical Research & Science* 3(1): 1–4.
- Darling-Hammond L, McLaughlin MW (2011) Policies that support professional development in an era of reform. *Phi Delta Kappan* 92(6): 81–92.
- Ghavifekr S, Kunjappan T, Ramasamy L, Anthony A (2016) Teaching and Learning with ICT Tools: Issues and Challenges from Teachers’ Perceptions. *Malaysian Online Journal of Educational Technology* 4(2): 38–57.
- Gog T, Paas F, Savenye W, Robinson R, Niemczyk M, Atkinson R, et al. (2007). Data collection and analysis. In *Handbook of Research for Educational Communications and Technology*, 762–806. Routledge.
- Harris R (2015) Impact of information society research in the global south. In A Chib, J May, R Barrantes (eds.), *Impact of Information Society Research in the Global South*, 21–43. Springer Nature Singapore Pte Ltd.
- Herliani A, Wahyudin D (2018) Pemetaan kompetensi teknologi informasi dan komunikasi (TIK) guru pada dimensi pedagogik. (Mapping of teacher information and communication technology (ICT) competencies in the pedagogic dimension). *Jurnal Penelitian Ilmu Pendidikan* 11(2): 134–148.
- Hermawan HD, Deswila N, Yunita DN (2018) Implementation of ICT in education in Indonesia during 2004-2017. In *Proceedings - 2018 International Symposium on Educational Technology, ISET 2018, May*, 108–112.
- Huang R, Spector JM, Yang J (2019) *Educational technology a primer for the 21st century*.

- Springer Nature Singapore Pte Ltd.
- Jhurree V (2005) Technology integration in education in developing countries: guidelines to policy makers. *International Education Journal* 6(4): 467–483.
- Jonassen DH, Lee CB, Yang CC, Laffey J (2005) The collaboration principle in multimedia learning. In RE Mayer (ed.), *The Cambridge Handbook of Multimedia Learning*, 247–270. Second Edition. Cambridge University Press.
- Karyotaki M, Drigas A (2016) Online and other ICT-based training tools for problem-solving skills. *International Journal of Emerging Technologies in Learning* 11(6): 35–39.
- King J, South J (2017) *Reimagining the role of technology in higher education*. Office of Educational Technology, U.S. Department of Education.
- Machumu H, Anathe R, Almasi M (2018) ICT as a pedagogical tool in secondary schools teaching and learning: policy and practices interplays. In *EdMedia+Innovative Learning Conference*, 1827–1832. Amsterdam, June.
- Mahdum M, Hadriana H, Safriyanti M (2019) Exploring teacher perceptions and motivations to ICT use in learning activities in Indonesia. *Journal of Information Technology Education: Research* 18: 293–317.
- Marina M (2016) Information and Communication Technology (Ict) and its role in educational assessment. *Englisia Journal* 3(1): 23–37.
- Marpanaji E, Mahali MI, Putra RAS (2018) Survey on how to select and develop learning media conducted by teacher professional education participants. *Journal of Physics: Conference Series* 1140(1): 1–10.
- McLean KJ (2016) The implementation of bring your own device (BYOD) in primary [elementary] schools. *Frontiers in Psychology* 7(1739): 1–3.
- Nurhabibah, Setiawan A, Yanti H, Miraj YZ, Yannuar (2018) Analysis of ICT literacy competence among vocational high school teachers. *IOP Conference Series: Materials Science and Engineering* 306(1): 1–7.
- Oliver R, Herrington J (2000) Using situated learning as a design strategy for web-based learning. In *Instructional and Cognitive Impacts of Web-Based Education*, 178–191. IGI Global.
- Organisation for Economic Co-operation and Development (2001) Learning to change: ICT in schools. In *Educational Technology & Society*. OECD Publications.
- Ping LC, Teo YH, Wong P, Khine MS, Ching Sing Chai S, Divaharan H (2003) Creating a conducive learning environment for the effective integration of ICT: classroom management issues. *Journal of Interactive Learning Research* 14(4): 405–423.
- Rae G, Dabner N, Mackey J (2017) Bring your own device (BYOD) and teacher pedagogy in a New Zealand primary school. *Teachers and Curriculum* 17(2): 53–60.
- Ravn I, Elsborg S (2011) Facilitating learning at conferences. *International Journal of Learning and Change* 5(1): 84–98.
- Redecker C (2013) *The use of ICT for the assessment of key competences*. European Union.
- Reif G, Shultz G, Ellis S (2015) *A qualitative study of student-centered learning practices in New England high schools*. Nellie Mae Education Foundation.
- Retnawati E (2019) Efforts to support and expand the use of educational technology as a means of delivering learning. *International Journal of Indonesian Education and Teaching* 3(1): 128–136.
- Sangra A, Gonzalez-Sanmamed M (2010) The role of information and communication technologies in improving teaching and learning processes in primary and secondary schools. *ALT-J: Research in Learning Technology* 18(3): 207–220.
- Saravanakumar A (2018) Role of ICT on improving quality of education. *International Journal of Innovative Science and Research Technology* 3(12): 717–719.

- Son J-B, Robb T, Charismiadi I (2011) Computer literacy and competency: a survey of Indonesian teachers of English as a foreign language. *Computer-Assisted Language Learning Electronic Journal (CALL-EJ)* 12(1): 26–42.
- Sumintono B, Wibowo SA, Mislan N, Tiawa DH (2012) Penggunaan Teknologi Informasi dan Komunikasi Dalam Pengajaran: Survei pada Guru-Guru Sains SMP di Indonesia. *Jurnal Pengajaran MIPA* 17(1): 14–15.
- Syahid AA, Sunarya DT, Sudin A, Sunaengsih C, Karlina DA (2019) ICT competences of primary school teachers. *Journal of Physics: Conference Series* 1318(1): 1–4.
- Takwin M, Pansri O, Parnichparinchai T, Vibulrangson S (2018) Developing a self-assessment instrument for analysis of the social and personal competencies of teachers in senior high schools in Indonesia. *Journal of Physics: Conference Series* 1028(1): 1–5.
- Tamrin M, Azkiya H, Sari SG (2017) Problems faced by the teacher in maximizing the use of learning media in Padang. *Al-Ta Lim Journal* 24(1): 60–66.
- Tavakol M, Dennick R (2011) Making sense of Cronbach's alpha. *International Journal of Medical Education* 2(1): 53–55.
- Thakral P (2015) Role of ICT in professional development of teachers. *Learning Community-An International Journal of Educational and Social Development* 6(1): 127–133.
- UNESCO (2013) *UNESCO handbook on education policy analysis and programming, volume 1: education policy analysis*. UNESCO Digital Library.
- Vitanova V, Atanasova-Pachemska T, Iliev D, Pachemska S (2015) Factors affecting the development of ICT competencies of teachers in primary schools. *Procedia - Social and Behavioral Sciences* 191(Jun): 1087–1094.
- Widodo S, Wahyudin (2018) Selection of learning media mathematics for junior school students. *Turkish Online Journal of Educational Technology - TOJET* 17(1): 154–160.
- World Economic Forum (2020) *The future of jobs report 2020*. World Economic Forum.