Teacher's belief and mathematical knowledge contributing ICT literacy in an Indonesian context

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Abstract. This paper covers the perception of four mathematics senior school teachers in the Banyumas region, Indonesia, on the factors of contributing to ICT literacy. Two factors of ICT literacy contribution were gained based on the result of a semi-structured qualitative interview. Those were internal factors and external factors. The internal factor is the teacher's belief, which consist of basic skills, workload, motivation, and the teaching style pattern of the teachers. The external factors are reflected in the teacher's knowledge factors, such as technological guidance knowledge, technological management knowledge, and technological integrity knowledge.

Then, the result of this study indicates that the teacher's workload and the proficiency of the teacher's principles can be classified into basic knowledge in the curriculum. In contrast, assessment, teacher motivation, and teaching style patterns can be classified into the teacher's awareness of understanding ICT in education. Moreover, In the context of technological management knowledge can be classified in organization and administration, technological guidance knowledge is obtained from professional teacher learning, and technological integrity knowledge can be included in integrating technology in pedagogy.

1. Introduction

Industrial Revolution 4.0 became the primary foundation for technological development in the world. Technological developments also have a positive impact on education. Education rings the life of every human being for the betterment. According to Tomljenović and Zovko [1], good technology teaching will have a positive impact on students. Teaching mathematical technology provides a new nuance for students [2]. It also becomes a direction of UNESCO by giving students the feel of technology [3]. Nevertheless, It is a challenge for teachers to bring technology into teaching.

The implementation of teaching mathematics in the classroom by always giving a touch of technology provides conditions where teachers are required to have ICT literacy skills [4]. ICT literacy is essential for teachers to enable them to use technology in their teaching. It may become an obstacle if one does not equip with ICT literacy. Some factors that can contribute to teacher ICT literacy derived from external factors as well as internal factors [5]. Alas [6] explained that the teacher's self-factor contributed 78% of teacher ICT literacy; the rest came from external factors such as the environment.

ICT literacy encourages teachers to change their belief on the use of technology in teaching and learning [7]. At first, the teachers who believed that the teaching carried out so far was quite sufficient for students in the current era, must be changed towards teaching technology [8]. Besides, in order to
change teacher belief, the proficiency of teacher principles becomes a vital matter to be discussed as a contributing factor to teacher ICT literacy [9]. Teachers who have low principle skills in technology will find it challenging to have functional ICT literacy. The evidence presented thus far supports the idea that the research conducted by Juniati [10], the proficiency of weak teacher principles, is one cause of failure in teaching technology. Adisusilo [11] said another thing; the implementation of teaching could not run well if the responsibility held by the teacher were low. Thus, teaching meant for students. It resulted in that teaching classroom should be proficient for students to be successful.

Another opinion stated by Nugraha [12], teacher motivation becomes a tool that used to support ICT literacy. High motivation owned by teachers, also contributed to the willingness of teachers to learn and continue to improve themselves following the development of existing technology. Low motivation will not help in developing ICT literacy. Another factor that can contribute to ICT literacy is the teacher thinking style [13]. The traditional thinking of teachers who are not concerned with technology in teaching will contribute negatively to ICT literacy. Teacher's teaching style should be in line with technological development. Subsequently, rapid technological development brings high teacher thinking in learning and developing ICT literacy [14].

Besides, factors contributing to ICT literacy came from the outer side. One of them is technological guidance knowledge. Teachers who have difficulty developing ICT literacy need to get technological guidance [15]. Good knowledge of technological guidance from external contributes positively to the improvement of ICT literacy that teachers own. Within the school environment, teaching schedules needed to guide teachers to develop technology and improve existing ICT literacy. Thus, teachers are given not only a teaching routine but also develop the ability and understanding of functional ICT literacy. It is also in line with the results of research conducted by Saleh [16] the routine provided by schools to develop the ability to use technology once a month, giving a 16% increase in literacy for mentor participants. Sukmana et al. [17] also said that the implementation of guidance is also carried out by the government every two months, and the results provided contribute 21% of teaching literacy skills.

ICT literacy supporting knowledge, such as technology management, can be a useful contribution [18]. The teachers have many teaching activities and many class administration activities. They need help to do all these activities to be more systematic. One way to help them take care of all teaching and administration is through technology. Good technology management knowledge contributes to the fulfillment of the regularity of teaching and administrative balance [19]. Besides, good technology management knowledge indicates that ICT literacy is also functional [20]. The implementation of technology management is not only useful for teachers to do all activities at school but also to overcome students' problems.

The knowledge that must possess besides the management of technology is knowledge of technological integrity. Integrating existing technology becomes more innovative. They were applying innovative teaching to help students overcome difficulties in learning. Teachers can use a variety of technological resources to help students overcome their academic problems [21]. It believed that students need attention because they have various problems. Thus, it led to a variety of technical knowledge to detect problem-solving experienced by students [22].

Various factors contributing to ICT literacy, as mentioned above, become an essential issue studied in mathematics teaching in the Banyumas regency, Indonesia. The researcher provides an overview of the factors that contribute to ICT literacy in mathematics teachers in the Banyumas regency. It resulted in new knowledge to teachers in other regencies. Factors contributing to ICT literacy must identify to enhance ICT literacy and minimize the obstacles experienced by teachers in developing ICT literacy.

2. Methodology
This study employed a qualitative approach using a one-one interview as a method. The interview design was a semi-structured interview. A semi-structured interview is a mix of a structured interview, and open interview or recognized as an unstructured interview. According to Creswell [23], the best method
to explain factors and sub-factors is to use the method of a semi-structured interview. This study covers the factors influencing ICT literacy among high school teachers in Banyumas, Indonesia.

The sample selection method for the interview was purposive sampling. This sampling method can increase the chances of getting the information needed to understand the case [24];[25]. The samples are teachers living in urban and sub-urban who have the level of ICT literacy. One teacher chooses for each school sample, i.e., two (2) urban schools, and two (2) sub-urban schools and each school. Thus, the selected teachers are four respondents based on the urban location category and suburban schools, as well as the teacher's ICT literacy level, high and low proficiency. The researcher put code PB for urban respondents, PLB for sub-urban respondents, and L for data.

The validation of the interview aims at ensuring the question items. It was conducted four (4) times for each respondent and took two (2) hours to complete. Qualitative studies, analysis of data gathering involves a process of continuous reflection, which may apply along with the data collection process [26]. In this study, the interrater involved in validating the process. The data analysis process includes some steps that adapted from Creswell [23]. (1) compile and provide data for analysis; (2) reading overall data and examining audio records; (3) fostering code sharing for data using Atlas.ti 8 tool; (4) creating the factor; (5) connecting the factor; and (6) interpreting the purpose of factor.

3. Result
In summary, two factors influence the Mathematics teacher's ICT literacy in Banyumas, Indonesia. Those are teacher's belief and knowledge. In the belief factor, several sub-factors can explain its contribution to ICT literacy, such as teacher's basic skills, teacher's duties, teacher motivation, and teaching style. Furthermore, the second factor is the teacher's knowledge factor, which includes technological guidance knowledge, technological management knowledge, and technological integrity knowledge.

3.1. Teacher's belief factor

3.1.1 Basic skills sub-factor
Teacher basic skill proficiency is one of the sub-factors expressed by participants influencing their teaching and belief. Several participants argued that weak teacher essential skill ignores abstract mathematical concepts and applications, but they tend to teach more accessible mathematical concepts. Explicitly, PB1 explained that she put more emphasis on the proficiency of teacher principles needed in teaching, before focusing on skills in ICT literacy. He also added that the teachers in his school, especially in the Technical school, were more concerned with mathematical applications. However, the teacher experienced challenges to carry out duties using ICT due to low proficiency of the technological principle:

"... as I explained before, as a teacher, I always try and learn to improve myself. But sometimes it is constrained by the low proficiency of our technological principles. I think this creates obstacles for me to innovate in technology in the classroom ... " (PB1-L0309).

When asking questions about how teachers use technology in teaching, PLB2 spontaneously answers that some of the relationships are negative, especially if their basic skills are low:

"... we believe and believe that teaching is exciting and easy to remember using technology, but we have difficulty using it, this is due to our low proficiency in using technology. So, we use teaching more traditionally than using technology in teaching ... " (PLB1-L0043).

In addition to the teacher's basic skills level, the teacher's workload is also considered a sub-factor that influences the teacher's confidence in ICT literacy.

3.1.2 Teacher's duties sub-factor

Teacher's duties are one of the sub-factors of the belief that influences ICT literacy in mathematics teaching. The participants in urban and suburban school stated that the burden of duties at school obstructs to teach well.

"... now the national curriculum makes it difficult for us to develop ourselves. Because we are desired to do a lot of disciplines ..." (PB2-L0387).

PLB2 also said that the workload he got at school made it difficult for him to improve ICT literacy, so he believed that the workload is the constraint that hinders him from developing ICT literacy.

"... we know that teaching mathematics requires special expertise, especially now there is an era of the industrial revolution. 4.0 teachers need to spend time and energy learning technology that can be integrated in mathematical teaching. However, knowing yourself now that the available curriculum makes it difficult for us to give time to provide a foundation for teaching. We do a lot of administration staff. Different from the past, which requires teachers not to carry out complicated administration processes ..." (PLB1-L0338).

3.1.3 Teacher motivation sub-factor
Teacher motivation is a significant element that shows the extent to which teacher confidence contributes significantly to ICT literacy. PB2 and PLB1, they explained that the motivation of teachers would decrease if the age of the teacher increases, as stated below:

"... I am now almost 50 years old; I think I am enough to be a teacher, enough to teach what I have done. Not because I do not want to teach well, but my age has made it difficult for me to progress, and it is difficult for me to have the enthusiasm of teaching is like my friends who are in their 30s. When I get older, my motivation decreases, and it makes me unable to move forward as fast as my friends ..." (PLB2-L0320).

3.1.4 Teacher teaching style sub-factor
The teacher's teaching style is one of the factors of teacher belief that affects ICT literacy. The majority of participants found that belief made it difficult for them to change the style of thinking of the teacher. Specifically, the interview participants emphasized that teachers emphasized teaching elements that were following their style of thought, such as direct teaching and guided teaching. It is what they teach with the question of minimizing their minds when teaching students in class:

"... I think my teaching is suitable for the needs of students. I have seen that students are good in mathematics. I do not need to make teaching innovations that require much technology. Then students will not rely on existing mathematical teaching ..." (PB2-L0492).

PB1 also argued that if teachers believe that technology can improve the quality of teaching mathematics and be useful for students, then teachers will try to use technology and change their traditional belief towards technological confidence in the world of education.

"... if I may argue that the teacher's teaching style influences what the teacher does like in class. If the teacher thinks that technology is suitable for students and good for the teacher in helping with mathematical teaching, then he will try to use ICT literacy and use it in teaching mathematical technology in the classroom. However, if the teacher thinks that teaching is enough just by direct teaching. Then that is what the teacher will do ..." (PB1-L0042).

3.2 Teacher's knowledge factor
The interview shows that the knowledge factor influences the mathematics literacy of mathematics teachers. Between the sub-factor for the knowledge factor, they are technological guidance knowledge, technological management knowledge, and technological integrity knowledge.

3.2.1 Technological guidance knowledge sub-factor
Technological guidance knowledge is a sub-factor in the knowledge factor that contributes to teacher ICT literacy. In this issue, participants agree that technological guidance knowledge is essential to improve ICT literacy.
"... we as mathematical teachers are important to improve the quality of our ICT literacy because we realize that the era has changed. Technology is a good friend to students in their daily lives. Therefore, teaching in the classroom can also be introduced to technology. "Most of us face difficulties in developing ICT literacy skills. We need guidance to find out more about technology and get more expertise in it ..." (PLB2-L0039).

PLB2 also explained that technology guidance for teachers could improve ICT literacy. The need for guidance indirectly leads them to use ICT literacy in the classroom. The findings of the interview from PB2 also hold the same opinion; the lack of technological guidance knowledge is the leading cause of the low ICT literacy of teachers.

"... we as teachers also need guidance, and this does not mean teachers can do everything. Changes in the system, government regulations, and technological developments also become challenges. We need to improve ourselves as teachers. Need guidance from those who are valuable in the field of technology so that teachers can improve their quality in the field of ICT literacy. I think it is important and obligatory for us to get such guidance ..." (PB2-L0044).

3.2.2 Technological management knowledge sub-factor
ICT literacy used to manage technology. In education, they were especially teaching, the teacher's ICT literacy ability used to do administration and teaching technology in the classroom. For example, the use of ICT literacy in managing technology is through its use on the personal web. A teacher can use the personal web for teaching mathematics in class. The existence of ICT literacy that owned may be used to take care of the web. Also, good knowledge of technology management from the teacher, the application of technology in the classroom is increasingly varied and innovative, like the use of existing applications. PB2 said that technology management knowledge could help process his web for teaching mathematics in class.

"... there are also many things that we feel are lacking in terms of technology. Devising technologies such as how to manage personal web for students to access, how to use mathematical content to teach mathematics in class and more. Technology management is also essential for us so that we may be helped by technology. Taking care of technology, just as we help teachers to improve teaching in today's technological era ..." (PB2-L0045).

3.2.3 Technological integrity knowledge sub-factor
Technological integrity knowledge use to see the various technological relationships that exist to enhance mathematical teaching. The interview participants said that they used various sources of technology in their classroom teaching. For example, PLB1 in teaching trigonometry, he used the application of technology commonly used in the world of astronomy. He also used other technological sources, such as the use of engineering tools in road construction. The application of various sources of technology requires him to use technological integrity knowledge.

"... emm, technology is very broad in its sequence. We, as teachers, must be good at integrating various technologies available so that their role is maximum in education—examples of problems that arise in the real world, such as difficulties in using the concept of trigonometry. We may use technology applications to explain trigonometry in astronomy. Or if we are mistaken about how to exhibit the angles of the inner triangle and the outer, we can use the angle implements commonly used by engineering technicians to make more things. There are still many technologies that can be combined in mathematical teaching ..." (PLB2-L0047).

Besides, PB1 said that the teaching media used in the class demanded that she have technological integrity knowledge. Like the use of PowerPoint media combined with the application Kahoot. He needs integrity knowledge skills in using existing technology.

"... I often use PowerPoint media combined with the application of Kahoot in my mathematical teaching. In addition to facilitating teaching, it makes students interested in my teaching. Their learning experiences are more meaningful and truthful their world now that is close to technology ..." (PB1-L0043).
The findings of the interviews have given an idea of the factors of teacher's belief and teacher's knowledge that contributing to the teacher's ICT literacy among Indonesian senior mathematics teachers in The Banyumas region. The summary of interviews in summative statements stated in Table 1 and the factors present in Figure 1.

**Table 1.** The summative statement's summary for interviews results

| Factors or Sub factors | The summative statement's summary |
|------------------------|----------------------------------|
| Belief and Knowledge   | Lack of continuity in classroom teaching with the development of technology inhibits the achievement of ICT-based mathematics teaching, and it influenced ICT literacy |
| Basic skills           | The poor of basic skills teachers and the way for teachers teaching mathematics in a simple and abstract approach, as well as the use of technology in teaching, influences ICT literacy. |
| Teacher's duties       | The workload of the teacher hinders the effort to maximize learning technology, and it was influenced by ICT literacy. |
| Motivation; Teaching style | Teacher motivation distinguishes their teaching style, and it would influence the provision of teaching using technology and, subsequently, ICT literacy. |
| Technological guidance knowledge; technological management knowledge; and technological integrity knowledge | More emphasis on technological guidance knowledge affects technological management knowledge and technological integrity knowledge. That knowledge assists teachers in managing technology and technological integrity in classroom teaching. It contributed to affecting ICT literacy |

**Figure 1.** The factors contributing to teacher's ICT literacy
4. Discussion
Factors contributing to teacher ICT literacy are internal and external factors. The result from the interview is that the belief factor is an internal factor, while the external factor is the knowledge factor. Within the belief factor, four sub-factors contribute to ICT literacy, including the basic skills, teacher's duties, teacher motivation, and teacher teaching style. Likewise, the sub-factors that exist in the knowledge factor consist of technological guidance knowledge, technological management knowledge, and technological integrity knowledge.

Teacher's belief factors contribute to ICT literacy. There is a sub-factor in belief, and it is the teacher's basic skills. It is as explained by PB1, PLB1, and PLB2, and they said the low proficiency of the teacher's basic skills would make it difficult for them to develop their ICT literacy. It led to their low ability to use technology in the classroom. The findings of this study are also in line with research conducted by Kafyulilo et al. [20] and Chong Ai Peng and Shaffe Mohd Daud [27]. The basic skills of teachers contribute to ICT literacy; 25% of teachers with low-basic skills contribute only 4% of ICT literacy. Apart from that, PB2's opinion said that excellent basic skills would contribute to the fulfillment of ICT literacy needs. It is also explained by Abel et al. [2], they explained the importance of teacher skills in developing ICT literacy.

Based on the analysis of this study, it was found that belief in a subject is a catalyst for teaching skills. According to Yusri and Goodwin [28], many belief have been implemented to overcome the problem of attitude towards technology. Such a belief, many researchers call the belief of the role of technology in education [29]. As a result, many researchers recommend that the role of technology be taken into account. According to Prestridge [30], the belief in the role of technology aims to inject teachers in overcoming problems related to ICT literacy. Besides, Chan, Chai, and Abang Abdullah [31], in their study states that teachers need to be aware of the importance of technology in real life to enable them to appreciate the technology and literacy of ICT. By changing teachers' belief about the role of technology in education is essential, then this can improve ICT literacy in teaching. An understanding of the importance of the role of technology in education can guide teachers to engage in technology to cultivate teachers' ICT literacy skills [32].

Highlighting the findings of this study, although there were respondents who mentioned workload problems that interfered with their teaching, this was still under control. In general, in most situations, interview participants can be said to have less trouble controlling the workload. It may be due to the teaching experience factor itself, the majority of which has over ten years of teaching experience. As with previous research findings [33], teachers with more experience are smarter in dealing with different types of problems, depending on the situation, time and place. This teacher's wisdom can indirectly produce a controlled and conducive teaching environment, able to increase awareness of the role of technology that can control teaching constructively, and in turn able to improve teachers' ICT literacy.

The workload of teacher's duties might lead to a burden of the teachers since it exceeds the quantity of time that is efficient. It brings about a lousy impact on improving the quality of a teacher's self. Moreover, increasing ICT literacy should be done by every teacher in the current technological era. Tomljenović and Zovko [1] said that excessive teaching hours harmed the development of teacher ICT literacy. Viewing ICT literacy is vital for the fulfillment of technology teaching in the current era, then Kaur and Singh [35] sets limits on the obligations and fulfillment of a teacher's personal development. The limitation offered is to provide one day off teaching for teachers to develop their potential, including the development of ICT literacy. It can provide a 27% increase in the quality of teachers themselves in terms of ICT. The opposite experienced by PB1 and PLBI, teach final grade students. The challenge that PB1 and PLBI would do to prepare students to be able to take the National Examination successfully. It led to much focus on the National Examination. The teaching activities carried out also emphasize the material that will test on the National Examination. Such teaching can not be interpreted as effective teaching by incorporating technology into it.

In the term of effective teaching, teacher motivation becomes a significant factor. Moreover, technology teaching demands need to be mastered by teachers, not only motivation to teach but also motivation to develop innovative teaching with the use of technology. It has an essential impact on the
mastery of ICT literacy. The role of ICT in mathematics teaching is also explained by Abel et al. [2], which illustrates that teachers with high levels of ICT literacy mastery provide better teaching innovations. Good mastery of ICT literacy is also contributed by the high motivation of teachers to keep learning and develop their ICT literacy skills. PB2 and PLB1 explained that low teacher motivation influenced by teacherage. Teachers over the age of 45 influence teacher motivation. The ability to keep up with the rapid pace of technological development cannot do along with the obstructing ability due to the age of the teacher.

In addition to motivation, the teacher's teaching style becomes one of the sub-factors that contribute to teacher ICT literacy. PLB2 said that traditional teaching was easier to do and applied in teaching. Teachers who have traditional thinking will also give traditional teachings, such as direct teaching or teacher-centered teaching. It positively does not contribute to the development of teacher ICT literacy. A different thing was said by PB1, who said that the teacher's teaching style, which emphasized teaching technology, encouraged them to try to use ICT literacy in the classroom. Mastery of ICT literacy increases the pattern of their thinking follows the development of the technological era as it is today. This opinion also supported by Mathomo [36] and Tengku Wook et al. [37]; they explain the teaching of technology following the level of change in teacher thinking. Teachers with technological thinking will have an impact on teaching nuanced technology. It is different if the teaching is traditional. Thus, teachers are not aware of the change in technology.

Factors contributing to ICT literacy also obtained from external factors such as knowledge factors that can obtain from technological guidance knowledge, technological management knowledge, and technological integrity knowledge. The technological guidance factor considers that teachers need to be given guidance and encouragement from outside to increase ICT literacy. As explained by all participants agree to spend the time and place used to guide teachers to improve their quality, including ICT literacy. It is done because the teacher is stuck with many teaching duties and other class administration. So they need a regular program to guide teachers to develop the quality of their ICT literacy. Supianti [38] said that the use of ICT in the classroom is done by teachers who are accustomed to being guided by more competent parties, so it covers the need of students. The benefits felt teachers in Bengkulu who accustomed guided work together with the local government to develop the potential of teachers there [39].

5. Conclusion
This paper contributes to current interpretations of contributing factors of ICT literacy by reporting on the perceptions of four teachers teaching in four Banyumas senior schools. The results of this study provide essential leads for schools and policy developers in maximizing their efforts to respond to the challenges of ICT literacy in senior schools. Teachers also report several of variables that act belief factors contribute to ICT literacy. These include the teacher's basic skills, teacher's duties, teacher motivation, and style of teacher teaching style. The findings of this study indicate the teacher's basic skills and the teacher's duties can be classified into basic knowledge in curriculum and assessment. In contrast, teacher motivation and style of teacher teaching style can be classified into a teacher's awareness of understanding ICT in education. The findings confirm that knowledge factors as external factors such as technological guidance knowledge, technological management knowledge, and technological integrity knowledge. In the context of technological management, knowledge can be classified in organization and administration, technological guidance knowledge obtained from professional teacher learning, and technological integrity knowledge can be included in integrating technology in pedagogy.

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