Teachers’ perspective on the application of information and communication technology (ICT) in mathematics learning

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Abstract. This research aims to comprehend how the impact of ICT in mathematics learning, particularly in middle school, and to study teachers’ perspective toward implementation of ICT application in mathematics learning based on the gender of teaching teacher. The research method is descriptive, giving questionnaires and interviewing 56 mathematics teacher in West Java, Indonesia. The results showed in applying ICT in mathematics learning, categories show many times 45%, ever applied 54%, and never applied 1%.

1. Introduction

The rapid development of Information Technology and Communication (ICT) encourages the Government of Indonesia to implement ICT in education. Therefore, E-education is proclaimed in 2001 through The Presidential Decree No.6 and continues to grow so that various terms appear, such as virtual school, virtual university, e-teacher, e-test, e-library, e-assignment, e-learning, distance learning, mobile learning, and others. In 2013, the national curriculum required teachers to use ICT in learning in classrooms. The objectives of ICT implementation are to improve efficiency [1], effectiveness[2,3], transparency, accountability, and comfortable learning. Especially in learning mathematics, ICT distribution is a medium that can be used by teachers to enhance the students’ cognitive and affective abilities [1], to present concepts imaginatively and creatively, to motivate students’ interest [4], and to give a chance to explore concepts comprehensively [5].

Until now, many students do not like math, because mathematics is difficult, abstract, rigid, and has many formulas. Additionally, the way teachers teach is also a problem that influences students’ interest. Therefore, the use of ICT in mathematics learning would be helpful. By using ICT, teaching materials can be designed in such a way that the subject material is more easily understood by students in an appropriate time, and repetition can be done.

The success of implementing ICT in learning mathematics [6] is influenced by many factors, such as the teachers’ skills in using ICT [7], and gender factor. This research aims to (1) determine on how ICT applications are implemented in teaching mathematics at high school level in West Java and (2) to determine the teachers’ perspective on the implementation of ICT applications based on gender.

2. Method

The research method used is descriptive. Data were obtained by providing questionnaires and interviews with 56 mathematics teachers in West Java, consisting of 38 senior high/vocational
school’s teachers and 18 junior high school teachers. The results of the questionnaires and interview data were analyzed descriptively.

3. Result and Discussion

3.1. Result

**Questionnaire results** are shown in Table 1. In general, the teaching method currently conducted by the teacher is sufficient enough to improve students' thinking skills but still needs to be developed further, because 21% of teachers still feel that the current teaching method is still inadequate. The ability of teachers and students in the use of ICTs is good enough but still needs to be improved. Matters that need to be of concern to the government, particularly the West Java education office, and school principals, is the improvement of school facilities to supporting ICT because there are still many (38%) teachers who feel that the school facilities lack support. Most of the teachers (55%) thought that ICT-based learning needed to be applied in mathematics learning, and 99% of teachers had used ICT in mathematics learning, and 45% often do it.

Based on gender, the highest difference (27%) is the male teacher's view of the need for ICT-based learning applied to mathematics subjects. The majority of male teachers consider it very necessary while the majority of female teachers consider it necessary. The percentage which is far different is the ability to use ICT, the percentage of male teachers with good ICT skills (44%) more than women (32%). However, male teachers see that the percentage of students with poor ICT skills (24%) is more than female teachers (10%). Likewise, in school facilities, male teachers who saw their school facilities support only 12% less than female teachers (26%). However, the gap of the percentage of male and female teachers who have used ICTs is not too wide.

| No | Statement                                                                 | Category    | Gender (%) |
|----|---------------------------------------------------------------------------|-------------|------------|
|    |                                                                           |             | M          | F          |           |
| 1  | Is the teaching method of mathematics teachers currently sufficient to improve students' thinking skills? | Inadequate | 21         | 24         | 19        |
|    |                                                                           | Average     | 57         | 60         | 58        |
|    |                                                                           | Adequate    | 20         | 16         | 23        |
| 2  | Is your ability to use ICTs good?                                         | Not good    | 9          | 8          | 16        |
|    |                                                                           | Average     | 50         | 48         | 61        |
|    |                                                                           | Good        | 41         | 44         | 32        |
| 3  | Is the ability of students in the use of ICTs good?                        | Not good    | 16         | 24         | 10        |
|    |                                                                           | Average     | 61         | 64         | 55        |
|    |                                                                           | Good        | 23         | 20         | 29        |
| 4  | Have facilities in your school supported the implementation of ICT-based mathematics learning? | Not support yet | 38         | 40         | 35        |
|    |                                                                           | Enough support | 41         | 48         | 35        |
|    |                                                                           | Support     | 21         | 12         | 26        |
| 5  | Should ICT-based learning be applied to current mathematics subjects?      | No need     | 0          | 0          | 0         |
|    |                                                                           | Need        | 45         | 28         | 55        |
|    |                                                                           | Necessary   | 55         | 72         | 45        |
| 6  | Have you ever used ICT-based learning in teaching mathematics?             | Has never been | 1          | 4          | 0         |
|    |                                                                           | Some time   | 54         | 56         | 52        |
|    |                                                                           | Often       | 45         | 40         | 48        |

For teachers who have used ICT-based mathematics learning, further questions are asked about what forms of ICT they have or never done. The results are shown in Table 2 below.
Table 2. The forms of ICT that have been and never been done by teachers

| No | Never do the following things? | (%) Ever | (%) Never |
|----|--------------------------------|----------|----------|
| 1  | Using ICT-based learning media such as interactive CDs, videos, PowerPoint, and others | 96       | 4        |
| 2  | Assign students to search for material from the Internet (Google) | 96       | 4        |
| 3  | Using mathematical software like GeoGebra, Cabri, Geometers Sketchpad, Maple, and others | 52       | 46       |
| 4  | Do online learning | 39       | 61       |
| 5  | Conduct learning through social media | 59       | 41       |

Table 3 shows that the most common forms of ICT carried out by teachers are using ICT media such as interactive CDs, videos, PowerPoint, etc. The teachers also assign students to search for material from the Internet (96%). While the least form of ICT application is online learning (39%). However, more than half of the teachers have conducted learning through social media and used mathematical software. Other forms of ICT that have been used by respondents are learning using android applications, making teaching materials using Macromedia Flash, Padlet, Edmodo, Quipper, statistics with Microsoft Excel, Computer-Based Exams, Online Exams, and the use of blogs as learning media.

Interview results. Interviews were conducted to respondents who had implemented ICT in mathematics learning. This interview consists of 6 questions. The first question is, ‘How do students respond when you use ICT-based learning in mathematics learning?’ 85% of teachers answered that most of their students liked it and were enthusiastic, and responded well to the use of ICT in learning mathematics. This is because ICTs made it easy and fun for students, so that it increased students’ spirit of learning, especially for students who do not like mathematics and who prefer practice compared to theory. However, there are also students who are indifferent, less enthusiastic, who do not like it. This is because of the limitations of tools and skills in ICT.

The second question, ‘Do you make your own or use the existing ICT-based mathematics teaching materials?’ 36.73% of the teachers create their teaching materials using PowerPoint, e.g., by adjusting the material. Sometimes they make the teaching materials together with other fellow math teachers. 28.57% of teachers use existing teaching materials, download materials from Google or YouTube. 34.69% did both, made their own, and used existing teaching materials. Sometimes they modify or develop existing teaching materials tailored to the needs of the students.

Third question, ‘What are the obstacles in using ICT-based learning?’ The biggest obstacle in using ICT-based learning is inadequate facilities and infrastructure such as laboratories, LCD projectors, computers, and Internet access (66%), lack of time because mathematics learning using ICT requires a lot of time in preparing it and in the learning process (20%), poor ICT skills of teachers and students (10%) due to lack of experience and training in ICT, there are still students who do not know the benefits and needs of ICT in learning (2%), and students need direct teacher explanations directly (2%).

Fourth question, ‘What is the positive impact of using ICT in learning mathematics?’ The positive impact of using ICT in mathematics learning is (1) students become more interested and enthusiastic about learning mathematics because ICT can increase student interest and motivation; (2) students become more focused in learning; (3) students become more creative; (4) students are more open in finding material; (5) students feel there is another atmosphere in learning mathematics; (6) students learn mathematics with fun; (7) students feel that is easier to understand mathematical concepts; (8) students can keep up with the times; (9) an increasing score in student learning outcomes; (10) increasing ICT skills of students and teachers; (11) more interactive ICT-based teaching materials; (12) teaching materials can be used repeatedly and easily renewed; (13) easier to convey problems in
mathematics learning; (14) broaden students' knowledge in mathematics learning; (15) the material is delivered effectively and efficiently; (16) clarify visual illustrations; (17) save time; (18) reduce mathematical anxiety; (19) improve mathematical skills; (20) learning is not limited to space and time; (21) adds variation in mathematics learning.

The fifth question, ‘What are the negative impacts of using ICT in learning mathematics?’ Negative impacts include: (1) students who are slow in absorbing information experience difficulties in understanding mathematical concepts (without being explained by the teacher); (2) students can access videos and internet sites that are not healthy and/or play games during learning; (3) students use many sources of uncertainty; (4) student contextual learning decreases; (5) students become lazy to write; (6) students' dependence on ICT, for example: depending on calculator, drawing depends on the application (software) mathematics; (7) reduced human interaction, students become lazy to socialize physically; (8) lack of students’ kinetic movements; (9) students become focused on the media but become less focused on understanding the material presented; (10) lack of students’ control in learning.

The sixth question, ‘How to overcome the negative impact of using ICT in learning mathematics?’ (1) teachers work with parents to conduct guidance and supervision when students use computers/mobile phones in learning in the classroom and at home; (2) teachers need to provide understanding to students in using the Internet so that they are not misused and to remind them not to open negative sites and play games; (3) the teaching materials prepared by the teacher must be interesting, so students use technology to learn, not for other purposes; (4) doing mixed learning, a combination of the use of ICT with classical learning, for example, not just download e-books, but still buy printed books, not only visit digital libraries, but also still visit libraries; (5) making a mature learning plan so that learning objectives can be achieved; (6) the teacher recommends which reliable sites should be opened by students; (7) conduct socialization and introduction of ICT in mathematics learning; (8) learning is done in groups and can also use peer tutors; (9) a full school’s infrastructure to support the learning process; (10) frequently use ICT so that students become more accustomed; (11) teachers must be creative in presenting mathematical content on ICT-based teaching materials; (12) give understanding to write important materials in mathematics learning; (13) ICTs are used after the concept is well comprehended, and sufficient training; (14) evaluating and monitoring in each lesson.

3.2. Discussion

Based on the result of questionnaires and interviews, the sufficient method that is being carried out by the teacher still needs further development. The development of ICT-based methods can be used as an alternative because the ability of ICT teachers and students is good enough, the facilities are sufficient for support, and the need for the application of ICT in mathematics learning. The results of research [8] concluded that ICT could be used as a medium to avoid or reduce the use of miscommunication between teachers and students and from students who implement the Problem-Based Learning model with the Realistic Mathematics Education approach and the expository model [9]. These allow for the role of e-learning regarding mathematical literacy skills.

Crompton et al. [10] stated that digital technology promotes students’ knowledge and understanding of geometry in five ways: visualization, manipulation, cognitive tools, discourse promoters, and new ways of thinking. Muianga et al. [11] collaborative e-learning support the development of information management skills and problem-solving students and their cognitive strategies for independent learning.

Obstacles in using ICT-based learning in mathematics learning in secondary schools perceived by teachers are: (a) inadequate facilities and infrastructure; (b) lack of time; (c) ability and skills of ICT teachers and students; (d) lack of experience and training in ICT for teachers and students; and (e) students’ dependency to the teacher. The results are almost similar compared to the factors that prevent secondary school teachers in Malaysia from using ICT, namely (i) time obstacles; (ii) facilities and resources; (iii) supporting factors; (iv) programs and training [12]. Ghavifehr and Rosdy concluded that the integration of ICT in schools would be successful and beneficial for teachers and
students if the implementation process is appropriate and adequate from the earliest stages to maintenance. In practice, the teacher must be given time to learn and explore, facing the "trial and error" phase before they are truly comfortable with their used[13].

The implementation of ICT in mathematics learning has positive and negative impacts, as described in the results of the study. The positive impact of ICT is more dominant than the negative results [14]. The negative impact mentioned in the interview question 5 above, is not much different from other countries, for example, Nigeria, the result of Mobi et al. research on the negative influence of the application of ICT in middle school in Nigeria, ICT can be overused, can distract students during class hours, students can also see pornographic sites, etc. [15]. The way to overcome negative efforts is to approach using ICT with other people who have been described in the interview question 6 above.

When viewed based on gender, male teachers need ICT-based learning in mathematics subjects while female teachers need too, although in essence both see that ICTs need to be applied in mathematics learning, in addition to streamlining the learning process of mathematics, it also improves ICT literacy of teachers and students. According to the questionnaire, the ICT skills of male teachers are better than women. The results of a teacher survey measured the quantity and quality of ICT use of students [16]. Results from 929 teachers at all levels and 38 Queensland public schools showed that female teachers (73% of full-time teachers in public schools in 2005) were significantly less confident than their peers in using ICT.

4. Conclusion

Regarding the application of ICT in mathematics at secondary education in West Java, almost all teachers of mathematics education in secondary schools in West Java ever use ICT in mathematics learning. The forms of ICT that are most often carried out by teachers are using interactive CD media, videos, and PowerPoint, and also assigns students to search for material from the internet. While the least form of ICT application is online learning. Half of the teachers have done learning through social media and use mathematical software. Other forms of ICT that have been carried out are learning using android applications, making teaching materials using Macromedia Flash, statistics with Microsoft Excel, Computer-Based Exams, and the use of blogs as learning media. Teachers’ perspective on the implementation of ICT in mathematics learning based on gender, while the majority of male teachers consider it very necessary while the majority of female teachers see the need for and the ability of male teachers to be better than women.

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