

Teachers' Perception Towards ICT in Mathematics Class: A case study in Yogyakarta Secondary Schools

Wahyu Setyaningrum
Yogyakarta State University (UNY)
Wahyu_setyaningrum@uny.ac.id

Abstract – Many countries have been integrating ICT in the classroom. Indonesia is heading towards integrating ICT in education. Teachers' perception is an important aspect to support the ICT integration. This paper presents the survey's results to fifty mathematics teachers in twenty Junior High Schools located in the rural area of Yogyakarta province. The survey reveals that most mathematics teachers participated in this study perceive that ICT has important role in mathematics class. They believe that ICT has positive impact on teaching and learning mathematics in the classroom. However, it is hard for some teachers to integrate ICT in the classroom due to a number of reasons such as technical barriers (computers availability, limited internet connection, electricity shortage, limited budget, and curriculum constrains) and human resources limitation (limited technology literacy both teachers and students, low teacher's motivation and little support from head-teacher). In addition, the teachers also point out another restrain that is students' readiness in using ICT for teaching and learning processes. The findings suggest that trainings for teachers in using ICT are needed and further efforts are required to encourage teachers to use ICT in the classroom. Furthermore, students' readiness needs to be assessed in the future research.

Keywords: ICT, mathematics, teachers' perception

I. INTRODUCTION

Nowadays, technology becomes an important part in daily life. It has been supporting education for a long time through the innovation in technology such as radio, tape-recorder, television, camera, computer, software and internet. Furthermore, it has been change the process of teaching and learning in the classroom, for example, the way teachers teach, the way students learn and the way schools are managed. Kessler [1] argues that ICT can enhance learning process in eight ways: 1) better simulations and models; 2) global learning; 3) virtual manipulatives; 4) probes and sensors; 5) more efficient assessment; 6) storytelling and multimedia; 7) E-books; and 8) epistemic games. The students can get learning materials easily from internet and explore the materials using many kinds of software that provided in the internet. They also can share and discuss the materials with others students. Consequently, teachers are not merely as sources of knowledge, but rather as facilitators and partners of students in learning processes.

The phenomena above also occur in the field of teaching and learning mathematics at schools. Previous research studies have been found that technology has many advantages in teaching and learning mathematics, for example: Burril [2], Ellington [3] and Olive and Makar [4]. In a simple way, technology can help students to deal with long and complicated calculations and complex models or complex problems. In a broader context, technology can change the nature of mathematics taught in the classroom by engaging students in more mathematical activities such as doing experiment, investigation and problem solving activities that can encourage them not only to find the answers but also to ask questions when solving mathematical problems [5, 6].

Indonesian government have been realizing the importance of ICT in education, therefore they suggest in the newest curriculum (curriculum 2013) that ICT should be integrated in teaching and learning processes in the classroom [7]. However, previous research studies that have been conducted in several parts of Indonesia found that there are many obstacles faced by teachers in integrating ICT in education. The common obstacles for teachers in integrating technology in teaching and learning processes in the classroom are lack of knowledge and skills, lack of technical supports, lack of facilities (e.g.: electricity, computer, software and internet access), insufficient incentive or rewards for teachers and insufficient training for teachers [8, 9].

Considering the importance of ICT in education particularly in teaching and learning mathematics, this paper investigates teachers' perception in using ICT in mathematics class. Perception is an important factor

in implementing ICT in the classroom [2]. Perceptions could influence the willingness of the teachers in using technology in the classroom [10]. If they perceive ICT negatively, they tend to avoid using technology and vice versa. In addition, there are very limited studies on teachers' perceptions towards ICT that have been conducted in Indonesia. Therefore, this study tries to contribute on this issue by identifying perception of secondary school mathematics teachers in Yogyakarta, one city in Indonesia.

II. LITERATURE REVIEW

A. Teachers' Perceptions towards Integrating ICT in the Classroom

The perceptions of teachers toward using ICT in education system is a very complex phenomenon that includes receiving stimuli and information they get from their environment [11]. This process begins with cognitive process in the form of ideas, concepts and comprehension on the object they observe or they found [12]. Therefore, perception toward a certain object refers to responses towards opinion, ideas or situation that live in the memory and could affect their behavior. Other terms that are often used for a similar purpose with perceptions is views, opinion, and interpretation. This study focus on identifying teachers' perception towards integrating ICT in mathematics class. The perceptions in this study refers to the opinion of the teachers in using ICT in mathematics class. This includes their opinion related to the effectiveness, easiness and usefulness of technology in mathematics class.

The literature on teachers of mathematics has explored their beliefs on teaching and learning, their attitudes toward computers, and the obstacles they perceive in integrating technology. Early literature on this issue indicated that many teachers feared that using technology would harm students' understanding of basic math concepts, make them overly dependent on technology, and not be effective as an instructional tool [13, 14]. In addition, teachers indicated that they had not observed any software that really helped learning and using software did not save time in teaching or evaluation [15].

Literature also identified many factors influence the perceptions of teachers toward technology in teaching and learning processes. Teachers' educational beliefs about teaching and learning, about students, about pedagogy, and about the role of technology are several factors that strongly influence the ICT integration [16, 17]. The integration is not only influenced by internal factors of teachers, but is also influenced by environmental factors. For example, the support from head teachers and other teachers can affect teachers in integrating the ICT in the classroom. The availability of the gadget, curriculum, and support from supervisor and staff are the other factors that influence teachers' perception [18, 19].

In Indonesia, teachers seem to have similar obstacles as mentioned in the previous studies. Marwan [8] conducted a study in university, he found that lack of knowledge and skills, technical supports and incentive are main barriers for teachers in integrating technology in teaching and learning processes in the classroom. Moreover, Sumintono [9], in his study with science teachers, points out similar issues, limited teachers' skills, insufficient technology tools, and insufficient technical staff seems to be the most common problems in integrating technology in the classroom. There is no prior study, to the best known of the researchers, about secondary mathematics teachers' perception on technology usage hence this study aimed to fill this gap.

B. Technology Acceptance Model

There are many tools that have been developed to measure perception of technology usage. The technology acceptance model (TAM) is one of the most widely used models [20]. TAM was developed based on theory of reasoned action by Fishbein and Ajzen's [21]. This model was initially used as to measure user acceptance of computer technology. Several scholars claimed that TAM has good predictive power [22] which makes it easy to apply to different situations [10]. Thus, it is argued that TAM will also be useful in the predicting and explaining technology usage in Indonesia.

Empirical studies provide evidence that this model have high validity [23]. According to TAM, IT behaviors are mainly based on users perceptions of the easiness usefulness of the systems. Therefore, this model consists of two variables: perceived ease of use and perceived usefulness. Perceived ease of use refers to "the degree to which a person believes using a particular system would be free of effort" while perceived usefulness refers to "the degree to which a person believes that using a particular system would enhance his or her job performance" [24, p. 320]. The framework of the technology acceptance model is shown in Fig 1 below.

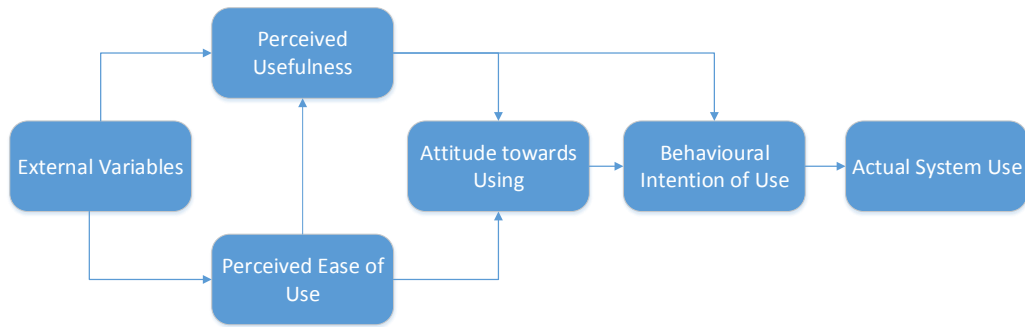


FIGURE 1. Technology Acceptance Model, adapted from [22]

The various studies conducted by researchers have tried to modify the TAM by adding new variables to it. For example, Agarwal and Prasad [25, 26] modified TAM by considering compatibility as a new variable. Moon and Kim [27] has added a new variable playfulness factors to study acceptance of the world wide web. Chau and Hu [28] combined the influence of peers with TAM.

The variables of TAM encompass the definition of perception of this study that mentioned in the previous section. Therefore, it is argued that TAM is an appropriate model for identifying teachers' perception for this study. This study modified the initial items of TAM to measure the perception of integrating ICT in education for mathematics teachers in secondary schools in Indonesia particularly in Yogyakarta. Sample of the measures and the variables are shown in table 1.

TABLE 1. Variabels and Sample Questions

Section	Sample questions
Perceived of Ease of Use	1. Using ICT in math class would be easy for me. 2. I would find it is easy to integrate ICT in mathematics class. 3. Using ICT in class requires much time to prepare. 4. Using ICT in mathematics class is confusing for my students. 5. It is difficult for me to use ICT in my mathematics class.
Perceived Usefulness	1. Using ICT allows me to increase my ability to teach mathematical concepts. 2. ICT would help me to illustrate the mathematical concept clearly. 3. Using ICT would enhance my effectiveness in teaching mathematics. 4. Using ICT would make mathematics more interesting for my students. 5. I cannot see any advantages of using ICT in my mathematics class.

III. METHOD

A. Participants

The research participants are fifty mathematics teachers in twenty Junior High Schools. These schools are located in the rural area of Yogyakarta province. The reasons for choosing schools in the rural areas is that there is limited access to the ICT. Therefore, we want know teachers' perceptions towards integrating ICT in education within that limitation.

The method of choosing the participants is voluntary and random sampling. All secondary mathematics teachers in all rural areas in Yogyakarta were invited to participate however only fifty of them are willing to participate.

B. Instruments

This research is a descriptive-qualitative research. The main tool of data collection is the questionnaire that elicits information on the respondents' views of the use of technology on the classroom. The questionnaire is developed based on TAM model, as discussed in the last part of literature review above. Data from questionnaire are enhanced by data gathered from interview with several teachers. Semi-structured interviews were used as the instrument for collecting data. Semi-structured interviews provide the researcher and participants with the opportunities to discuss some topics in considerable detail. In addition, the researcher can use cues or prompts to encourage the interviewee to consider the question

further [29]. The questions asked in the interviews were meant to uncover information about teachers' perceptions and their intention to use ICT in mathematics class. It also used to gather obstacles, if any, in integrating ICT in the classroom.

C. Analysis

Data gathered from questionnaire are sorted and organized using SPSS. The data then analyzed descriptively including mean, modus, median of data. On the other hand, data collected from interview are analyzed using thematic analysis approach.

IV. FINDINGS AND DISCUSSION

The aims of this study are 1) to determine Indonesian teachers' perceptions of applying technology in the classroom particularly in mathematics class; and 2) to identify the obstacles they may face in implementing technology. Based on these aims, the findings of this study are categorized under two main themes, namely: teachers' perceptions of integrating technology in the classroom and obstacles in applying technology in the classroom.

A. Teachers' Perceptions of Integrating Technology in Mathematics Class

The data of teachers' perceptions are mainly collected through survey questionnaire. The questionnaire consists of two parts. The first part of the questionnaire is aimed to portray demographic information of the participants such as gender, age, grade they teach in, and educational background. The characteristics of the participants are summarized in Table 2 below.

TABEL 2. CHARACTERISTICS OF THE PARTICIPANTS

	Categories	#Participants	Percentage
Gender	Male	22	44%
	Female	28	56%
Age	Less than 30 year-old	11	22%
	30-50	36	72%
	More than 50 year-old	3	6%
Grade	VII	15	30%
	VIII	23	46%
	IX	12	24%
Educational Background	Undergraduate	46	92%
	Postgraduate	4	8%

The second part of the questionnaire contains 25 items that modified from the TAM scale. In general, data from the survey show that more than half of the number of participants perceive positively on the integrating of technology in mathematics class. Some of them are stay neutral, they unsure whether ICT would bring any positive or negative contribution in their teaching. Meanwhile, a small number of teachers who believe that the integration of ICT in education is not urgent things to do because they and their students are not ready with the changes yet. The summary of the questionnaire data can be seen in Table 3.

TABEL 3. Data from Questionnaire

Category		Perception		
		Positive	Neutral	Negative
Gender	Male	81.82%	9.09%	9.09%
	Female	53.57%	28.57%	17.86%
Age	Less than 30 years old	90.91%	9.09%	0
	30-50	61.11%	22.22%	16.67%
	More than 50 years old	33.33%	33.33%	33.33%
Grade	VII	80%	13.13%	6.67%
	VIII	69.56%	21.74%	8.70%
	IX	41.67%	25%	33.33%
Educational background	Undergraduate	63.04%	21.74%	15.22%
	Postgraduate	100%	0	0

Taking into account gender differences, data in Table 3 show that most of the male teachers have positive perception of the integration of ICT in education. Meanwhile, only slightly more than half of the female teachers have positive perception, and more than a quarter are neutral. The interviews reveal that those who have positive perception, they believe that ICT would be beneficial for both teachers and

students. For example, ICT could provide interactive media and good illustrations so that it would help students in mastering mathematical concepts.

Another interesting data in Table 3 is that teachers who have positive perception are young teachers (less than 30 years old) and those who hold postgraduate degree. The young mathematics teachers claim that ICT has many advantages in teaching and learning mathematics. Similarly, teachers who have postgraduate degree also claim the power of ICT in mathematics class as their main reasons in having positive perceptions.

In relation to the grade, teachers grade VII tend to have more positive perception compare to their counterpart in grade VIII and IX. From the interviews with some grade VIII and IX teachers, they tend to hold negative perception with the integration due to the difficulties in adjusting with the recent curriculum. Grade IX teachers also express their worrying about the integration of ICT that might distract the preparation of the students for national examination.

In summary, the findings have revealed that the majority of participants are aware of the benefits of teaching with technology. They believe that the integration of technology into the classroom can enhance their teaching quality. This can be a good indication of successful implementation of the technology integration program if teachers know about the benefits of technology for teaching and make frequent use of it in their instructional activities [30]. Nevertheless, the teachers also notice several challenges in integrating ICT in education as discussed in the next section below.

B. Obstacles in Applying Technology in the Classroom

The interviews are aimed mainly to identify challenges faced by mathematics teachers in integrating ICT in the classroom. Most of the teachers claim that their technology literacy the main challenges for integrating ICT in mathematics class. They can cope with the rapid development of technology, as represented in the teacher' statement below:

Kami itu punya banyak sekali kerjaan, Bu. Ya tentang administrasi seperti membuat rpp, dan juga LKS. Kan sekarang setiap sekolah dituntut untuk membuat LKS sendiri. Jadi kadang tidak ada waktu untuk belajar tentang bagaimana menggunakan alat-alat teknologi yang semakin canggih. Begitu juga dengan software-software matematika banyak sekali yang baru-baru. Yang lama saja saya belum bias, sekarang ada lagi yang baru. Kadang saya malah bingung dan pusing sendiri hahaha

From the statement above, teacher argues that he has many administrative matter to do as a teacher and he does not have enough time to follow the technology development. In more specific, he refers to the development of mathematics software, he claims that he has not even finish to learn how to operate one mathematics software yet, but there is more new mathematics software to come. In relation to this, many teachers looking for some assistance from the government to conduct workshops or training for teachers so that they can upgrade their skills in ICT. Moreover, they questioning the technology skills of their students. They claim that many of their students have limited skills, some of them in the rural area even do not have any gadget. Thus, training in technology is an important ingredient in order to integrated technology in the classrooms effectively, as suggested by [31].

Several teachers also mention the technical barriers, for example insufficient number of computers availability at their schools, limited internet connection, electricity shortage, and limited budget. Grade IX teachers also point out that the density of the current curriculum as one of the constrains in using ICT in mathematics class. They argue that they have to deliver so many mathematical concepts in limited length of time, so they worried if the use of ICT would prevent them to finish the material they have to deliver. In addition, the issue of national examination seems to be one of the biggest constrain for mathematics teachers grade IX.

The other challenges found in the interview data are limited human resources who master in ICT to support the integration. In addition, the teachers also mention another restrain that is support from head-teachers. They claim the importance of leader's support. This is in line with the findings of study conducted by Puteh and Vicziany [32]. Diem [33] argues that "teachers who are supported are less likely to feel threatened and develop more positive attitudes toward technology" (p. 495).

V. CONCLUSION

Most of mathematics teachers in this study have positive perception in using ICT in mathematics class. This study also notices that ICT integration in mathematics class face many challenges yet it is possible to do. However, it is important to note at this point that this study involved a small number of teachers in one district. Therefore, the results might not necessarily to represent teachers' perceptions and

challenges in technology integration at other part of Indonesia. Some findings may be useful for future research or as a starting point for planning technology integration in schools.

REFERENCES

- [1] S. Kessler, "8 Ways Technology is Improving Education. 2010," Available at: <http://mashable.com/2010/11/22/technology-in-education/> [1 April 2016].
- [2] G. Burrell, G. Handheld Graphing Technology in Secondary Mathematics. Michigan State University and Texas Instruments, 2002.
- [3] A. Ellington, "A meta-analysis of the effects of calculators on students' achievement and attitude levels in precollege mathematics classes," *Journal for Research in Mathematics Education*, 34, 433–463., 2003.
- [4] J. Olive & K. Makar. "Mathematical knowledge and practices resulting from access to digital technologies" in C. Hoyles & J. Lagrange (Eds.), *Mathematics education and technology – Rethinking the terrain. The 17th ICMI Study* (pp. 133–177), 2010. New York: Springer.
- [5] A.M. Farrell, "Roles and behaviors in technology-integrated pre-calculus classrooms," *Journal of Mathematical Behavior*, 15, 35–53, 1996.
- [6] K. Makar, & J. Confrey, "Dynamic statistical software: How are learners using it to conduct databased investigations?" in C. Hoyles, J. Lagrange, L. H. Son, & N. Sinclair (Eds.), *Proceedings of the 17th Study Conference of the International Commission on Mathematical Instruction. Hanoi Institute of Technology and Didirem Université Paris 7*, 2006.
- [7] Peraturan Pemerintah Republik Indonesia Nomor 32 Tahun 2013, Tentang Perubahan Atas Peraturan Pemerintah Nomor 19 Tahun 2005 Tentang Standar Nasional Pendidikan Kurikulum 2013, 2013.
- [8] A. Marwan, "Teachers' Perceptions of Teaching with Computer Technology: Reasons for Use and Barriers in Usage," *International Journal of Instructional Technology and Distance Learning*, Vol. 5, No 6, 2008.
- [9] B. Sumintono, S.A. Wibowo, N. Mislana, D.H. Tiawa, "Penggunaan teknologi informasi dan komunikasi dalam pengajaran: Survei pada guru-guru sains SMP di Indonesia," *Jurnal Pengajaran MIPA*. 17, 1, 2012.
- [10] T. Ramayah, and M. Lo, "Impact of Perceived Usefulness and Ease of Use on Intention to Use a Enterprise Resource Planning (ERP) System," *The Proceedings of the International Borneo Business Conference, "The Impact of Contemporary Environment on Economics and Business, Kota Kinabalu, Sabah, Malaysia, 2004.*
- [11] M. Fleming, and H.W. Levie, *Instructional Message Design: Principles from the Behavioral Sciences*, New Jersey: Educational Technology Publications (53-95), 1981.
- [12] R.L. Atkinson, R.C. Atkinson, and E.R. Hilgard, *Pengantar Psikologi*. Jakarta: Erlangga, 1997.
- [13] M. Schmidt, and L. Callahan, "Teachers' and principals' beliefs about calculators in elementary mathematics," *Focus on Learning Mathematics in School*, 14, 17–29, 1992.
- [14] H.S. Drier, "Teaching and learning mathematics with interactive spreadsheets," *School science and mathematics*, 101(4), 170–179, 2001.
- [15] S. Guerrero, N. Walker, and S Dugdale, "Technology in support of middle grade mathematics: what have we learned?" *Journal of Computers in Mathematics and Science Teaching*, 23, 5–20, 2004.
- [16] A. Garthwait and H. Weller, "A year in the life: Two seventh grade teachers implement one-to-one computing," *Journal of Research on Technology in Education*, 37(4), 361–377, 2005.
- [17] Y. Kim, B. Grabowski and H. Song, "Science teachers' perspectives of web-enhanced problem-based learning environment: A qualitative inquiry" *Annual Meeting of the American Educational Research Association, Chicago, IL, 2003*. Retrieved: April 12, 2016 <http://www.ed.psu.edu/~bgrabow/pub12>.
- [18] S. Demetriadis, A. Barbas, A. Molohides, G. Palaigeorgiou, D. Psillos, I. Vlahava, I. Tsoukalas, and A. Pombortsis, *Cultures of negotiation: Teacher's acceptance/resistance attitudes considering the infusion of technology into schools. Computers and Education*, 41, 19–37, 2002.
- [19] W. Pelgrum, "Obstacles to the integration of ICT in education: Results from a worldwide educational assessment," *Computers & Education*, 37, 163–178, 2001.
- [20] M. Igbaria, T. Guimaraes and G.B. Davis, "Testing the determinants of microcomputer usage via a structural equation model," *Journal of Management Information Systems*, 11: 4, pp. 87-114, 1995.
- [21] M. Fishbein, and I. Ajzen, *Belief, Attitude, Intention and Behavior: An introduction to theory and research*, Addison-Wesley, Reading, MA, 1975.
- [22] K. Mathieson, "Predicting user intentions: comparing the technology acceptance model with the theory of planned behavior," *Information Systems Research*, Vol. 2(3), 173-191, 1991.
- [23] P.Y.K. Chau, "An Empirical Assessment of a Modified Technology Acceptance Model," *Journal of Management Information Systems*, Vol. 12 (2), 185-204, 1996.
- [24] F.D. Davis, "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly*, Vol. 13(3), 319-340, 1989.
- [25] R. Agarwal and J. Prasad, "A conceptual and operational definition of personal innovativeness in the domain of Information technology," *Information system research*, Vol 9, No2, pp 204- 215, 1998a.
- [26] R. Agarwal, and J.A. Prasad, "Conceptual and Operational Definition of Personal Innovativeness in the Domain of Information Technology," *Information Systems Research* (9:2), pp. 204- 215, 1998b.
- [27] J. Moon, and Y. Kim, "Extending the TAM for a World-Wide-Web context," *Information and Management*, 38, 217-230, 2001.
- [28] P.Y.K. Chau, and P.J. Hu, "Information Technology Acceptance by Individual Professionals: A Model Comparison Approach," *Decision Sciences*, 32(4), 699-719, 2001.
- [29] B. Hancock, *Trent Focus for Research and Development in Primary Health Care: In Introduction to Qualitative Research*. Nottingham: Trent Focus, 1998.
- [30] R. Zemsky, and W.F. Massy, *Thwarted innovation: What happened to e-learning and why*. 2004, [Online] <http://www.thelearningalliance.info/Docs/Jun2004> [Retrieved April 3, 2016].
- [31] C. Mouza, "Learning to teach with new technology: implications for professional development," *Journal of Research on Technology in Education*, 35(1), 272-289, 2003.
- [32] M. Puteh, and A.M. Vicziany, "How Smart are Malaysia's Smart School?" *SEAMEO Conference Bangkok, Thailand 5-9 July 2004*.
- [33] R.A. Diem, "Can it make a difference? Technology and the social studies," *Theory and Research in Social Education*, 28, 493-501, 2000.