Enhancing Indonesian Students' Self-confidence through the Integration of Problem-based Learning (PBL) and Technology

Pasttita Ayu Laksmiwati
SEAQiM, Indonesia
pasttitalaks@gmail.com

Abstract

Access to technology in learning is important and is essential in facilitating students' use of technology in their learning process**.** The aim of this study was to enhance students' self-confidence with Pythagoras' Theorem by using problem-based learning (PBL) and technology. The technology used was GeoGebra. This study was conducted at a state junior secondary schools in Indonesia. The researcher employed an action research methodology. Twenty-four second year students (12 boys and 12 girls) from the junior secondary school participated in this study. The sampling technique used was purposive random sampling. This study used a pre-experimental design with no control group with both qualitative and quantitative data collected and analysed. There were two cycles in this action research. The investigation showed that the integration of problem-based learning and technology has positive impacts on sample students' self-confidence. The students' mean score, which was 80.54 (average self-confidence) on the pre-test, showed an improvement in the post-test with 106.13 (high self-confidence). In addition, the researcher conducted interviews of three students. The result showed that the learning had as positive impact on the students' self-confidence. As part of 21st century society, students need to survive in the workplace and teachers can play their role in accomplishing this in the teaching and learning process. While the researcher cannot make generalisations due to the nature of the sample, nevertheless the integration of problem-based learning and technology in the mathematics learning process will be of interest to teachers and educators looking to improve their students' self-confidence.

Keywords: Problem-based Learning, technology, GeoGebra, self-confidence, Pythagoras' Theorem

Introduction

In this 21st century, people need to develop their skills to compete globally. They need to build their capabilities especially their performance to survive in the competition. So do Indonesian students to succeed in the 21st century society. In 2018 the Indonesian Ministry of Industry (KPRI) released a document 'Making Indonesia 4.0' setting out the ten national priorities for future development and number 7 aims to redesign the education curriculum and create a professional talent mobility program. Teachers can play their role in reaching this national priority by helping their students to improve their skills and knowledge in order to help them face the world's problems. Thus teachers need to provide students with meaningful learning, which is not only learning content but also encouraging students' motivation and confidence.

Over twenty years ago, NCTM (National Council of Teachers of Mathematics, 1989) stated that meaningful learning could contribute towards achieving mathematical literacy, giving all students the same opportunity to learn, and encouraging long-life learning. By using mathematics, students are able to become a part of a productive society. Teaching mathematics meaningfully can be used as a bridge in order to succeed in the 21st-century workplace, and help students become a part of a productive society.

In this era, the use of technology is developing and rapidly increasing. Indeed, technology in learning continues to be important. If used well, technology can help to improve the curriculum. However, to see these improvements teachers first have to prepare their students to use technology effectively. In mathematics learning, it can be done by using the freeware dynamic software program called GeoGebra.

Major longitudinal research coming from Singapore has revealed that experienced and successful teachers continually vary their approach where they 'weave' a number of different pedagogical strategies into their classroom (Luke, 2005). Teachers can choose from many approaches and one approach in using effective pedagogical strategies is problem-based learning (PBL).

If we now turn to the need for teachers to boost students' self-confidence. Students need to develop their self-confidence and get a chance to improve it. Despite its importance, Indonesian students are generally regarded as having low self-confidence. A survey conducted by TIMSS (Mullis, Martin, Foy & Arora, 2012) showed that Indonesian students exhibited low self-confidence: just 3% were classified as having high self-confidence in learning mathematics.

Based on the six principles for school mathematics such as equity, curriculum, teaching, learning, assessment, and technology (NCTM, 2000), this study focused on the integration of mathematics and technology using a problem-based pedagogy. This action research was designed to investigate the use of problem-based learning and GeoGebra as a technology to engage the students and enhance the students' self-confidence. This study examined two research questions. The first question was whether there were any changes in students' self-confidence by the integration of problem-based learning and technology in the mathematics classroom. The second question was how the learning environment had an impact on students' self-confidence.

Theoretical Framework

As explained in the introduction, it is clear that teachers must prepare their student to face the 21st century through the teaching and learning process. According to the definition provided by Duffy and McDonald (2010), learning can be explained as a complex activity that depends on why and how students do what they do. It is almost certain that through teaching and learning process, teachers can help student to succeed in the 21st century workplace (Care, Kim, Anderson, & Gustafsson-Wright, 2017), but there are several factors to be taken into consideration. One of them is self-confidence. Students' self-confidence will influence their learning because they need to trust their ability to solve a problem. Self-confidence is related to a belief that they can help themselves and others to achieve their goals (Schunk, 2012; McElmeel, 2002; Schiraldi, 2001). Consequently, self-confidence is necessary for learning and to help students achieve their learning goals.

The literature provides some important characteristics for self-confidence such as Branden (1985) who states that self-confidence is peoples' awareness and evaluation of a belief in their ability; 'Can I do this task?' or 'Can I pass the exam?', In the same vein, Srivastava (2013) notes self-confidence as an attitude that allows people to have a positive view and control of themselves. Burton and Platts (2006) explain that self-confidence is related to the belief in one's ability about of what one can and cannot do. Thus in this research study a student's self-confidence is defined as high if the student satisfies the criteria of having a belief in one's own abilities, a positive attitude, a positive self-acceptance, self-efficacy, belief in other abilities, self-control and effective action in any situation.

Creating and evaluating conjectures is an important aspect of a problem-solving in mathematics (Okubo, 2007). For example, in the Pythagorean relationship, if the sides and hypotenuse of any right-angle triangle, the area of the squares on the sides equals to the area of the square on the hypotenuse. The relationship summarized with the formula $a^2+b^2=c^2$ where c is the length of the hypotenuse (NCTM, 2000). Promoting mathematical understanding in the learning of Pythagoras' Theorem can be done by several ways. In many schools, teachers usually just give their students the formula of $a^2+b^2=c^2$, without giving any reasoning. In fact, to better understand about mathematics concepts students need to learn mathematics meaningfully as a part of their life. It is important for students to believe that learning mathematics is a part of understanding their life as a human activity. Sriraman and English (2010) argue that mathematics is a result of a human activity and the results are expressed as mathematical objects and these objects act as the building blocks of science and technology. As such mathematics teachers should attempt to integrate the use of technology in their classroom. The use of technology can help them to introduce the topic through a concrete concept investigation followed by an abstract one can can assist the students to learn the concepts meaningfully.

In Indonesia, the Pythagorean Theorem is taught in junior secondary school, but it continues to be used in the higher levels of school. The Pythagorean Theorem is defined as a basic skill compared to other mathematical concepts. For example, the Pythagorean Theorem a prerequisite to learn about distance between two points on a Cartesian plane and in three-dimensional space. If students want to know the length of the diagonal of rectangle given by the width and length, they need to know the concept of Pythagoras' Theorem. In fact, learning the Pythagorean Theorem may be difficult to some students, particularly when trying to understand the concepts not just calculating. Students sometimes fail to understand how to apply the theorem in real life contexts.

As pointed out in the introduction to this paper, this study will focus on the integration of mathematics and technology in mathematics learning. In teaching mathematics, the use of technology has to be integrated in the daily mathematics practices. Previous studies have reported that by integrating technology into everyday teaching practices, teachers can facilitate creative opportunities and supporting learning environments which help to foster mathematics knowledge and skills (Hohenwarter, Hohenwarter, & Lavicza, 2008). However, the use of technology will be most appropriate for learning when combined with effective instruction.

Technology becomes crucial in mathematics teaching and learning as it can improve students' learning,

> Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning (NCTM (2000, p.11).

It is easy to understand that technology can have essential impacts on students. The technological environments help teachers to apply their teaching and learning more effectively (NCTM, 2000). Hollebrands (2007) points out that technological environments give students great opportunities and help themselves to actively interact with various mathematical objects at different levels of understanding. When mathematics classroom are already integrated with technology, students can focus on developing their problem-solving, decision making, and their reflective reasoning skills. Another benefit is technology can help students learn in different ways by using (Saha, Ayub, & Tarmizi, 2010). Integrating technology and mathematics learning can be done by using GeoGebra. As a dynamic mathematics software, GeoGebra is free to use and download from http://www.geogebra.org. This dynamic software was created by Markus Hohenwater. Nowadays, this dynamic mathematics software has been translated into 40 languages. However, research on the use of GeoGebra in the mathematics teaching and learning process is still limited (Saha, Ayub, & Tarmizi, 2010). GeoGebra helps students to understand mathematical concepts more effectively and Furner and Marinas (2013) argue that GeoGebra is nowadays an up and coming dynamic learning media in school.

PBL as a learning approach was developed in Canada in the 1960s at the McMaster's Medical School. PBL is a learning approach that uses problems to start the lesson. Roh (2003) states PBL is a learning environment where the learning process starts with a problem to help student understand new knowledge and also engages students with a problem-solving activity. The use of real problems can encourage students to learn and develop their high order thinking skills (e.g. critical thinking and problem solving). Chamberlin and Moon (2009) suggest that teachers can use PBL in many grades and disciplines. Merttens (as cited in Muijs & Reynolds, 2011) argues that effective mathematics teaching involves problem solving activities. As Arends and Klicher (2008) argue, PBL helps students develop their thinking, their problem-solving, communication, and interpersonal skills better than the other learning approaches and by inference, the students will improve their self- confidence.

PBL pedagogy resonates with constructivism in facilitating students to build their own understanding. Arends and Klicher (2008) argue that there are five phases of PBL instruction. Based on the literature study, this research adopted and determines the phases as follows.

Table 1
The PBL Pedagogical and Learning Phases.

Phases	Teachers' Activities
Orient students with the problem.	Teacher explains the learning objectives and learning material. Teacher also motivates students to be actively involved in the learning process to solve problems.

Phases	Teachers' Activities
Organize students for study.	Teacher helps students define and organize the tasks that are related to the problems.
Assist independent and group investigation.	Teacher encourages students to collect data and information, do the experiment, and solve the problem clearly.
Develop and present artefacts and exhibits.	Teacher helps students collaborate with others and present the results.
Analyse and evaluate the problem-solving process.	Teacher facilitates students to make reflection and evaluate the problem-solving process.

However, PBL does attract criticism, Finucane, Johnson, and Prideaux (1998) state that the most often argument is that PBL is costly. Others claim that there is no confirmation that PBL is better than traditional method in improving motivation and facilitating the development of interpersonal skills (Berkson, 1993). Norman and Schmidt (1992) explain that the students in PBL classrooms do poorly on an actual multiple-choice test and to understand the concepts deeply, a longer time is needed relative to the conventional classroom.

Action research is known as teacher self-study and inquiry (Carr & Kemmis, 1986). An action reserch approach was used to allow reflective teaching by Koshy (2005) who stated that action research can facilitates teachers to study their own practice with the aim to improve their practice. While Tomah (2010) states that the main concerns of action research is to solve educational problem and change issues and providing educational improvements.

This study will attempt to use an action research process in its methodological approach.

Methodology

This research study will investigate the usefulness GeoGebra and problem based-learning in order to improve students' self-confidence in learning mathematics. The major purpose of this study was to enhance students' self-confidence in applying the Pythagorean Theorem by using a PBL pedagogical approach with technology. Another purpose of this study was to investigate the learning practices with the purpose to meet the following research objectives:

1. To determine any changes in students' self-confidence by the integration of PBL and technology in the mathematics classroom.
2. To describe how the learning has an impact on students' self-confidence.

Sample

This research was conducted at one of state junior secondary schools (SMP) in Wonosobo, Central Java, Indonesia. The school is located in the suburb area of Wonosobo. Most of the students' learning motivation is to continue their parents' businesses. Thus, they have a greater motivation to work rather than to learn. Moreover, based on the Indonesian national assessment called as *Ujian Akhir Nasional* (UAN), it is known that the school achieves at an average level.

Twenty-four second year students (12 boys and 12 girls) of junior secondary school participated in this study. The sample technique used was purposive random sampling. The researcher wanted to focus on particular characteristics of the population, which will answer the research questions.

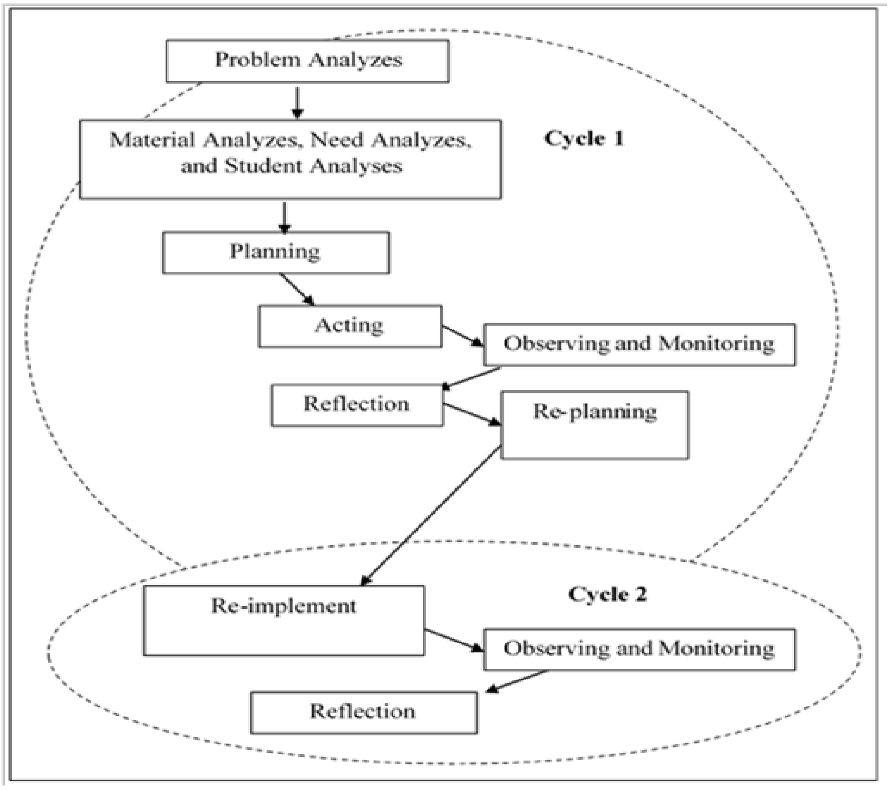

Figure 1. The research procedure.

Data Collection

This study employed classroom action research with the action research spiral consisting of four main steps, namely planning, acting, observing, and reflecting then re-planning and continuing the cycle (Carr & Kemmis, 1986; Kemmis, McTaggart, & Nixon, 2014). The cycle continued until there was an improvement with the students' self-confidence. The research procedure of this study is shown in figure 1.

Figure 1 shows that this study began with the problem as is contained in the objectives of the study, then with curriculum, needs, and material analyses. This phase included some preparation for a pre-test to be administered after cycle 1, a post-test, a questionnaire, student worksheets, an interview protocol, and an observation sheet. The students' self-confidence was observed daily by other teachers. Then, the acting phase was followed by the observation, reflection and re-planning phases.

The research was conducted over a two-week period from the last week of September to first week of November 2014. This study employed a pre-experimental design because there was no control group and it used a one-group pre-test and post-test design. The use of pre-test and post-test design was to find if any changes had occurred. Both qualitative and quantitative data were collected and analysed.

The students' self-confidence questionnaire used a *Likert* scale, rated from 1 (strongly disagree) to 5 (strongly agree). Students were classified by several descriptive criteria from very low to very high. The researcher classified the data for the pre-test and post-test and used the teachers (panel of experts) to confirm the classification. From the classification of the students' self-confidence, the information for student improvement was gained.

Cognitive aspects (e.g. students' achievement) were also assessed. There were pre-tests and post-tests as instruments to assess the students' achievement. Teachers used the results to understand the impact of the approach to the learning of the Pythagorean Theorem. By assessing the students' achievement, teachers determined how far their students achieved the learning objectives.

There were designed benchmark indicators of success for this research (Table 2).

Table 2
Designed Benchmark Indicators.

Scale		Interval	Criteria	Pre-test (%)	Target (%)
Affective	Self-confidence	$112 < X \leq 140$	Very high	0	20
		$93,33 < X \leq 112$	High	33.333	60
		$74,67 < X \leq 93,33$	Average	25	20
		$55,99 < X \leq 74,67$	Low	37.5	0
		$27,99 \leq X \leq 55,99$	Very low	4.167	0
		Mean score	Average	80.542	High
Cognitive			Learning mastery score		≥ 75 % passed

Table 2 shows the standard of affective and cognitive impacts used as benchmark indicators for this study. At the end of the lesson, the students were expected to have high self-confidence and 75% of them met this target. In addition, this school used 80 to 100 as the learning mastery score standard. The others components show the effectiveness of the learning process of integrating PBL and GeoGebra are shown below:

1. After the end of the learning process, the students were expected to have a students' self-confidence mean score equal or greater than 105 and possess a high self-confidence level.
2. It was also expected that 20% of the student would possess an average level, 60% would possess a high level, and 20% of the student would possess a very high level.

Findings and Discussion

This action research was conducted on 14-28 November 2014 at SMP Negeri 3 Selomerto, a state junior secondary school in Wonosobo. The learning process was designed and completed appropriately with the research procedure. There were two cycles in this action research. In the teaching and learning process, the students were divided into six groups consisting of 3-4 students. They completed the lesson and followed the PBL phases as seen in Table 1. The teacher engaged them in the first phase to be actively involved in the learning process, for example, by giving them motivation related to the material. Then, the teacher also facilitated them to do the task on the worksheets and activities in their groups.

This lesson was conducted over six meetings. The teaching and learning process design was administered to meet the characteristics of effective mathematics teaching that provide understanding of what students need to support their learning process effectively (NCTM, 2000). The students had to complete the task in groups and cooperate with each other. After finishing their group discussion, they prepared a presentation and presented their work in front of the class. While one group was presenting, the other groups paid attention and gave comments at the end. The teacher also gave the students opportunities to ask questions and reflect on the learning.

The first cycle began with the planning process which included the developing of lesson plans, students' achievement test, self-confidence questionnaire, and learning observation sheets. After planning the instruction, the teacher conducted the lesson and observed it. After finishing the first cycle, the teacher conducted the first reflection. The first reflection focussed on some problems that were found in the teaching and learning process. A case in point was did students learn effectively? Some of them like to work individually rather than collaboratively in group. Thus, the teacher tried to solve the problem with re-planning the lesson and then moved to the second cycle.

The second cycle started with re-planning. The teacher implemented the lesson with some improvements from the previous phase. The teacher focused on the students' discussion to guide the learning process more efficiently. The teacher also focused on facilitating and observing the discussion process. The teacher stimulated the students and increased their engagement in the learning process. After finishing the second cycle, the teacher completed a reflection and tried to solve the problems that occurred.

In this study the teacher used the PBL phases with the activity on the students' worksheets to facilitate them in the learning process. By using the students' worksheet, the teacher gave the students an opportunity to learn from the problems in context. The use of context in the worksheets assisted the students to learn more meaningfully about the concept. The motivation was to avoid learning mathematics with ready-made products (Freudenthal, 1973).

In Figure 2 there are example of students' worksheet that were used in the process of teaching and learning and an example of the introduction and students' worksheets where students could complete their work after manipulating the simulation using GeoGebra. The introduction consisted of a contextual problem aiming to help students connect with the mathematics concept. The context used in the example is a square. The students were given a problem related to the use of the Pythagorean Theorem to find the diagonal of a square.

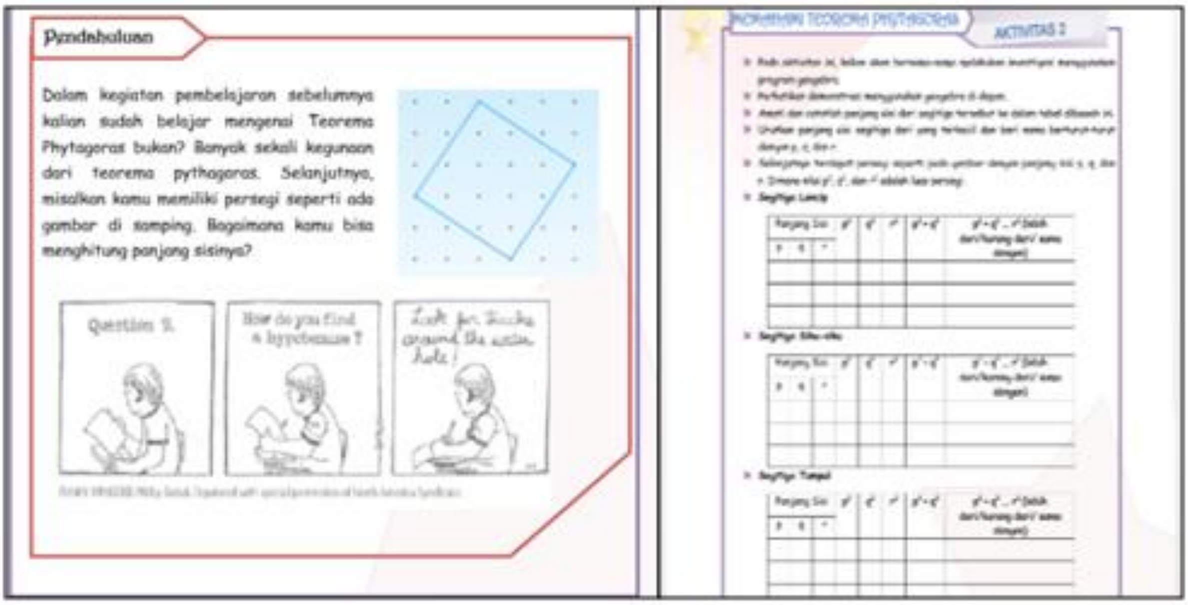

Figure 2. Example of introduction and activity.

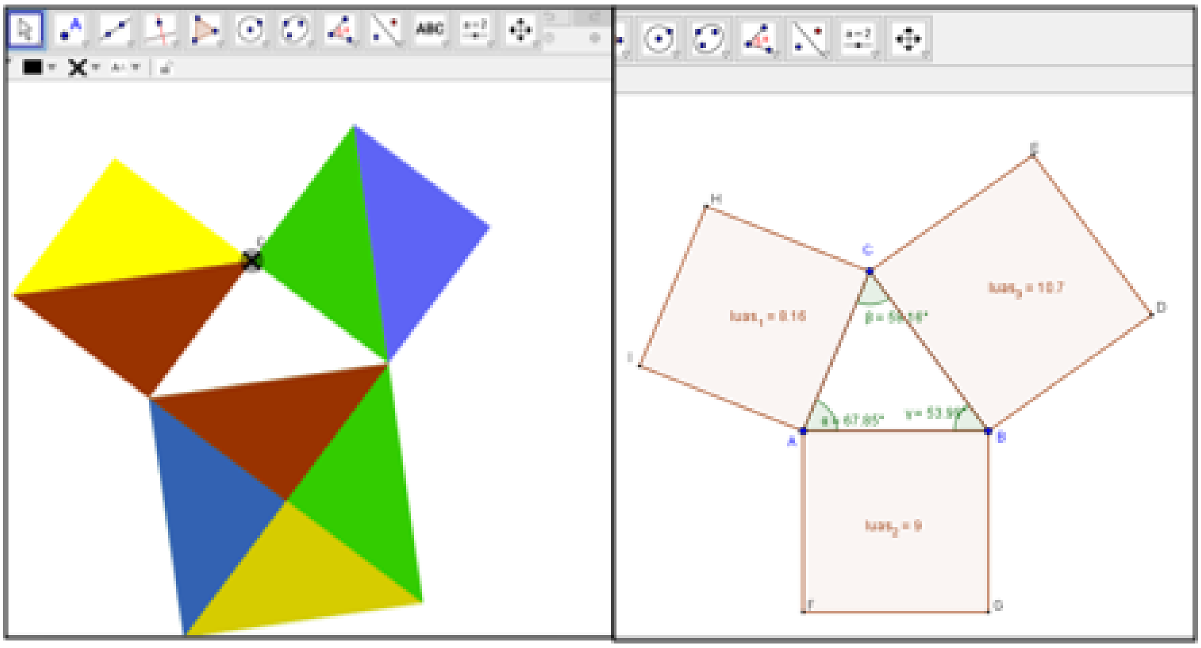

Figure 3. Example of GeoGebra worksheets.

Figure 3 is an example of a student's worksheet. In the left one, the student explored the worksheet according to the instructions and made conjectures of triangles. S/he tried to explore three different types of triangle; an acute, an obtuse, and a right triangle. S/he investigated the problem and explored to understand the Pythagorean Theorem.

S/he had some difficulties when exploring the worksheet. Some students could not use GeoGebra effectively because they were using it for the first time. Some creative students explored the worksheets and made various forms of puzzles. The students also did the task to prove the Pythagorean Theorem using a puzzle on their worksheets and GeoGebra as a hands-on experience. Figure 4 below shows a student's work.

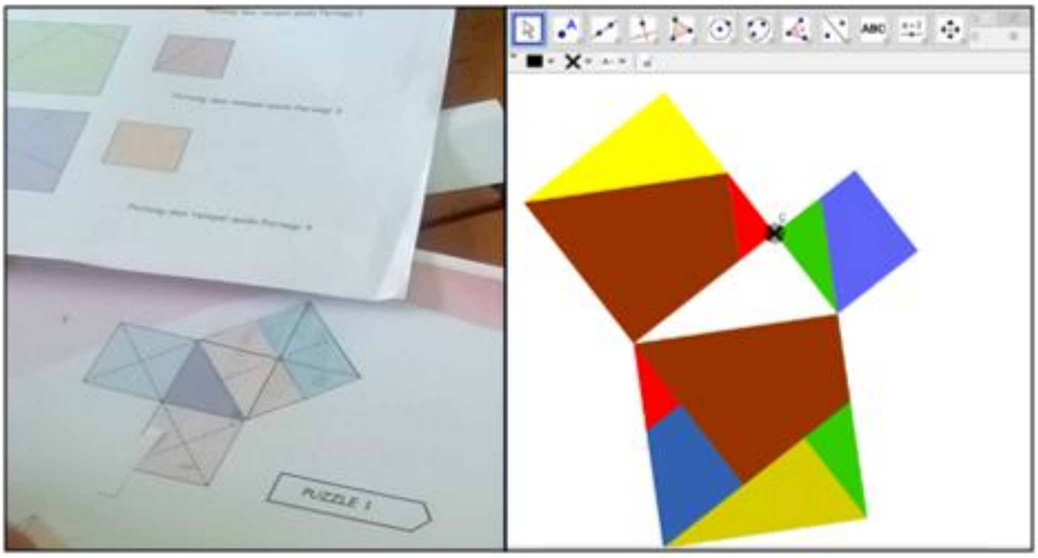

Figure 4. Example of student's works.

In the learning process the teacher followed the PBL phases that started with orienting students to the problem. In this phase the teacher explained the objectives and introduced the problem that was posted by the teacher. The teacher also checked students' perceptions, stimulated them by providing motivation to be actively involved in the learning process.

In the second phase of the PBL, the teacher helped and organized the task so that the students had the opportunity to work in groups. Next, the teacher gave them the opportunity to do trial and error while working on the worksheet. After the students engaged in the discussion and worked collaboratively, they presented the results to the others in front of the class. The last step, the teacher gave them the opportunity to reflect on about their work.

At the end of the teaching and learning process, teacher found the following improvements:

1. The teacher gave more attention to time management, to make the learning process more efficient;
2. The teacher gave more attention to make the discussion process more effective;
3. The teacher needed to do more observations while the students engaged in the discussion;
4. When some questions were asked by the students, the teacher needed to give them more opportunity to think and only give some clues about the answer. It means the teacher does not answer the questions directly.

This action research was a way to solve the teachers' own problems with various instructions. Instructions should be matched to the solution of the problems. This is in line with this study in which the teacher found several solutions that enhanced the learning process. The results of this study indicate that for the sample, the students' self-confidence was successfully enhanced.

Table 3 shows the average of the Pre-test, Test 2 (after Cycle 1), and Post-test (after Cycle 2) scores in the PBL and technology integration. These results include the two cycles of action research. The results show that there are several improvements in students' self-confidence percentage and mean scores from pre-test and the post-test. In the beginning, there were eight students (33.33 %) who had high to very high self-confidence and this increased to twenty-three students at the end of Cycle 2.

Table 3
Students' Self-confidence Scores

Descriptive Criteria	Pre-test	Test 2 (after Cycle 1)	Post-test (after Cycle 2)
Very high	0 %	0 %	20,83 %
High	33,33 %	83,33 %	75 %
Average	25 %	16,67 %	4,17 %
Low	37,5 %	0 %	0 %
Very low	4,17 %	0 %	0 %
Mean score	80,54	98,54	106,13

The figure below shows the increasing of students' self-confidence on mathematics learning.

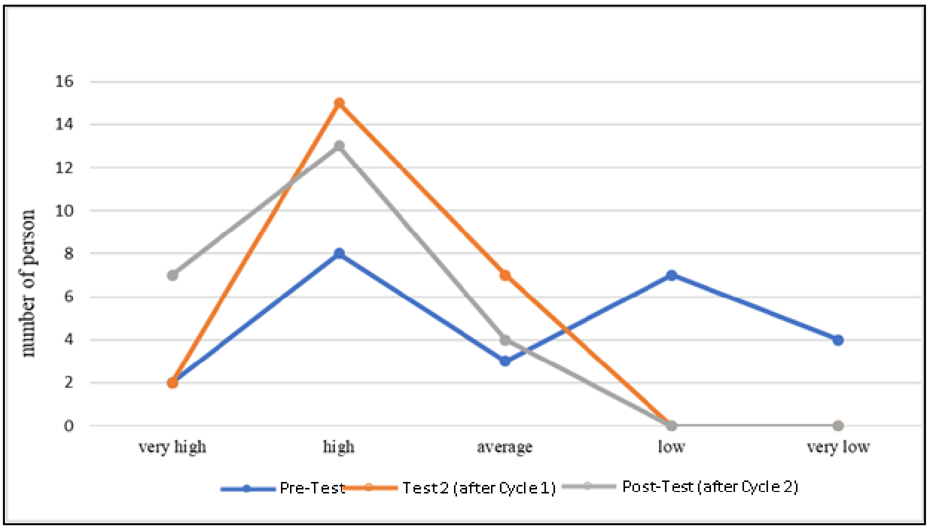

Figure 5. Students' self-confidence.

Based on Figure 5, it can be concluded that there were changes in the sample students' self-confidence. The information may indicate that the learning process had a positive impact on self-confidence. There were changes in their self-confidence following the integration of PBL and technology in the students' mathematics classroom. Table 3 shows that the mean score is increasing about 50% after Cycle 1. There were two students who got very high scores on self-confidence for the pre-test and the number increases to seven students after Cycle 2. At the beginning of the lesson, there were four students who had very low self-confidence which decreases to zero, which means that no one had very low self-confidence at the end of Cycle 2.

In addition, the researcher conducted interviews of three students and the teacher. The result indicated that the learning had an impact on the students' self-confidence. All of them said that they were interested and motivated during the learning process. Besides this, it also indicated that most of the students were actively engaged in the learning process. Some of them said that the instruction helped them to easier understand the concept of the Pythagorean Theorem. They learned to cooperate when doing a task in groups. They learned to be more confident by making use of the opportunity they got to present their work. Overall, the students had positive responses to the learning. From the result of the teacher's interview, it was easy to understand why the students could follow the learning process. They were actively engaged in the learning process and were motivated to learn.

To measure the effectiveness of the learning process, it was important to know how students achieved in understanding the Pythagorean Theorem concept. This view is supported by Joyce, and Weil (2004) who write that the effect of instruction not only assesses how well they achieve their affective impact, but also their ability to learn the specific topic known as the cognitive impact.

Turning now to the other evidence of cognitive impact is the students' achievement. Table 4 shows the result of the students' achievement.

Table 4

Students' Achievement Results

	Pre-test cycle 1	Post-test cycle 1	Pre-test cycle 2	Post-test cycle 2
Mean score	27.5	43.33	18.33	54.17
Learning mastery (%)	0	4.17	0	25

The above table records that there were changes and improvements in the class. The students' mean score increases from 27.5 to 54.17. Among them, only 25% of the students passed the benchmark. It means that only six students passed 75 points. It is difficult to explain this result, but it might be related to the time limitation with the lesson. However, there is an improvement on the learning mastery percentage: at the beginning, none of them passed the benchmark.

Based on the above discussion, it can be concluded that the integration of PBL and technology (GeoGebra) successfully improved the learning. The learning improvement is shown by the improvement of students' self-confidence. It means that the learning successfully enhanced students' self-confidence. However, these results were not very encouraging on the cognitive aspects. There are several possible explanations for this result. A case in point is the time limitation, unfamiliarity with GeoGebra and some students' misconceptions.

Conclusion

Returning to the questions posed at the beginning of this study, it is now possible to state that the first question of whether there are any changes in the students' self-confidence with the integration of PBL and technology in the mathematics classroom, the answer is yes. As to the second question of the learning having an impact on the students' self-confidence, the answer again is yes. The results of this investigation show that there are changes and a positive impact on the students' self-confidence. The affective impact and the students' achievement as the cognitive impact results together indicated that the integration of PBL and technology has a positive impact on students' self-confidence. Thus, this research indicates for this sample of students that the technology that is GeoGebra and PBL was useful for improving students' self-confidence.

In future investigations, it might be possible to investigate more deeply the relationship between students' self-confidence and achievement.

Due to the sample limitations of this study, the findings can only apply to the teacher and students in the sample and cannot be regarded as representing a wider group of Indonesia teachers or students. However, the finding can be of interest to teachers and educators in making comparisons with their own situation.

References

Arends, R. I., & Klicher, A. (2008). *Teaching for student learning becoming on accomplished teacher*. New York, NY: Routledge Taylor and Francis Group.

Berkson L. (1993). Problem-based learning: Have the expectations been met? *Academic medicine*, *68*, 79 88.

Branden, N. (1985). *Honoring the self: Self-esteem and personal transformation*. Los Angeles, CA: Bantam Books.

Burton, K., & Platts, B. (2006). *Building confidence for dummies*. West Sussex: John Wiley & Sons, Ltd.

Carr, W. & Kemmis, S. (1986). *Becoming critical: Education, knowledge and action research.* London: Falmer Press.

Care, E., Kim, H., Anderson, K., & Gustafsson-Wright, E., (2017). *Skills for a changing world: National perspectives and the global movement*. Retrieved from https://www.brookings.edu/wp content/uploads/2017/03/global-20170324-skills-for-a-changing-world.pdf.

Chamberlin, S. A., & Moon, S. M. (2008). How does the problem based learning approach compare to the model-eliciting activity approach in mathematics. *International Journal for Mathematics Teaching and Learning*, *9*(3), 78-105. Retrieved from http://www.cimt.org.uk/ journal/chamberlin.pdf.

Duffy, J. L., & McDonald, J. B. (2010). *Teaching and learning with technology (4th ed).* Boston, MA: Pearson Education.

Finucane, P. M., Johnson, S. M., & Prideaux, D. J. (1998). Problem-based learning: its rationale and efficacy. *Medical Journal of Australia*, *168*(9), 445-447.

Furner, J. M., & Marinas, C. A. (2013). Learning math concepts in your environment using photography and GeoGebra. In *the 25th Annual International Conference on Technology*, March, 21-24, 2013. Boston, MA: Pearson.

Freudhental, H, (1973). *Mathematics as an educational task*. Dordrecht: Reidel Publishing Company.

Hohenwarter, J., Hohenwarter, M., & Lavicza, Z. (2008). Introducing Dynamic Mathematics Software to Secondary School Teachers: The Case of GeoGebra, *Journal of Computers in Mathematics & Science Teaching, 28*(2), 135-146. Retrieved from https://archive.geogebra.org/static/publications/2009-Hohenwarter_Lavicza _IntroducingDynMath Soft- GeoGebra.pdf.

Hollebrands, K. F. (2007). The role of a dynamic software program for geometry in the strategies high school mathematics students employ. *Journal for Research in Mathematics Education*, 38(2), 164 - 192. Retrieved from https://eric.ed.gov/?id=EJ757035.

Joyce, B. & Weil, M. (2004). *Model of teaching* (7th). Boston, MA: Allyn and Bacon.

Kementrian Perindustrian Republik Indonesia (KPRI) (Indonesian Ministry of Industry) (2018). *Making Indonesia, 4.0.* Jakarta: Author.

Luke, A. (2005). Making new Asian pedagogies: Classroom interaction in Singapore classrooms. *Keynote address for Redesigning Pedagogy: Research, Policy, Practice (The first international conference on educational research)*. Singapore: National Institute of Education.

NCTM. (1989). *Curriculum and evaluation standards for school mathematics.* Virginia, VA: NCTM Inc.

NCTM. (2000). Principles *and standards for school mathematics*. Virginia, VA: NCTM Inc.

Norman, G. T., & Schmidt, H. G. (1992). The psychological basis of problem-based learning: a review of the evidence. *Academic medicine*, *67*(9), 557-565.

Kemmis, S., McTaggart, R., & Nixon, R. (2014). *The action research planner doing critical participatory action research.* Singapore: Springer.

Koshy, V. (2005). *Action research for improving practice: A practical guide*. London: Sage.

McElmeel, S. L. (2002). *Character education: A book guide for teachers, librarians, and parents.* Greenwood Village, CO: Libraries Unlimited.

Muijs, D., & Reynolds, D. (2011). *Effective teaching: Evidence and practice*. London: Sage.

Mullis, I. V., Martin, M. O., Foy, P., & Arora, A. (2012). *TIMSS 2011 international results in mathematics*. Boston, MA: TIMSS & PIRLS International Study Centre.

Okubo, K. (2007). Mathematical thinking and the acquisition of fundamentals and basics. In Collaborative Studies on Innovations for teaching and Learning Mathematics in Different Culture (II), *APEC International Symposium on Innovations for Teaching and Learning Mathematics in Different Cultures (II)–Lesson Study Focusing on Mathematical Thinking*. Tokyo: CRME Khon Kaen University and CRICED University of Tsukuba.

Roh, K. H. (2003). *Problem-based learning in mathematics* (ERIC Clearinghouse for Science Mathematics and Environmental Education). Retrieved from https://files.eric.ed.gov/ fulltext/ED482725.pdf

Saha, R. A., Ayub, A. F. M., & Tarmizi, R. A. (2010). The effects of GeoGebra on mathematics achievement: Enlightening coordinate geometry learning. *Procedia-Social and Behavioral Sciences*, *8*(2010), 686-693. Retrieved from https://www.sciencedirect.com/science/article/ pii/S1877042810022007.

Schunk, D. H. (2012). *Learning theories an educational perspective*. Boston, MA: Pearson Education, Inc.

Schiraldi, G. R. (2001). *The self – esteem workbook.* Oakland, CA: Kendall/Hunt Publishing Company.

Sriraman, B., & English, L. (2010). *Theories of mathematics education.* London: Springs.

Srivastava, S.K. (2013). To study the effect of academic achievement on the level of self-confidence. *Journal of Psychosocial Research*, *8*(1), 41-51. Retrieved from https://www.questia.com/library/ journal.

Tomal, D. R. (2010). *Action research for educators*. Plymouth, UK: Rowman & Littlefield Publishers.