

IMPROVING MATHEMATICAL CRITICAL THINKING ABILITY AND SELF CONFIDENT OF SENIOR HIGH STUDENTS BY USING DIRECT-INDIRECT TEACHING

Euis Eti Rohaeti¹, Sidik Tamsil²

Siliwangi Bandung Institute of Education

¹ e2rht@yahoo.com

ABSTRACT

This study was intended to investigate the development of students' mathematical critical thinking ability and self confidence through direct-indirect teaching (DIT). This study was a part of a master thesis and a sub-study of a Postgraduate Research Grant from DGHE in 2015. This study was a pretest-posttest quasi-experimental control group design involving 70 twelfth-grade students of a senior high school in Purwakarta which were chosen purposively. The instruments of this study were an essay test on mathematical critical thinking, a self confidence scale, and a scale measuring students' perception on DIT. The study revealed that students getting treatment on DIT attained better grades on mathematical critical thinking ability and self confidence than that of students taught by expository teaching, though the mathematical critical thinking ability grades were at medium level and the grades of self confidence were fairly good. Also, students performed positive opinions toward DIT and there was no association between mathematical critical thinking ability and self confidence.

Keyword: mathematical critical thinking, mathematical self confidence, Direct-Indirect Teaching (DIT), perception toward DIT.

A. Introduction

Basically, mathematical critical thinking ability and self confident attitude were important components of mathematics learning outcomes that should be developed on high school students. That statement was suitable with the cognitive and affective goals of mathematics teaching-learning process among other things were: a) to possess logical, critical, creative, innovative thinking, and self learning abilities; b) to demonstrate critical, creative, accurate, objective, opened thinking, self confident, curious, interest, persevere, persistent attitudes; c) to appreciate the beauty and the usage of mathematics in daily life, and to demonstrate to be fond of learning mathematics.

Besides that, Indonesia Mathematics School Curriculum 2013 suggested that teaching and learning mathematics should employ principles namely: a) students centered, b) to enhance students' critical thinking ability, c) to create satisfying and challenging learning situation, d) containing value, ethics, aesthetics, logic, and kinesthetics, and e) to provide various learning experiences by using various strategy which satisfying, contextual, effective, efficient and meaningful learning. Polya (1973), Glasersfeld and Nickson (as cited in Suparno, 1997), stated that teacher's role not only to deliver information but the most important things were: to have position as students, to understand what students think, to help students to think, and to learn to construct their knowledge. Basically, those opinion described constructivism philosophy that had distinctive characteristics: a) student active learning, b) information was related to previous students' knowledge in order to form meaningful and more complex knowledge; c) learning activities were oriented to investigation and invention. One of learning approach that based on constructivism philosophy was direct-indirect teaching-learning. That approach was a penetration of teaching-learning process that in a certain condition a concept was given directly and in other condition a concept was given in

indirect mode. Direct teaching-learning was a teacher centered process but the teacher still assured that there was students' involvement in a task form of solving problems through these steps of activities (Eggen and Kauchak, 2012); a) introduction and review; b) was a kind of students centered approach that similar to problem based learning that teacher took a role as a fasilitator, and students and teacher composed a learning community. Basden etl all (Ambarwati, 2011) stated that activities in indirect teaching-learning process were: a) to pose question that gave opportunity to students to arise their ideas; b) to motivate students to review problems accurately; c) to deduce a conclusion in class discussion; d) to relate the students' ideas; and e) to give students opportunity for thinking and giving explanation.

Some studies reported that direct-indirect teaching-learning succeeded to enhance various students' mathematical abilities better than that of conventional teaching (Ambarwati, 2011, Maya, 2005, Nugrohorini, 2013, Sumarni, 2005, Suryadi, 2005). Those studies found that the students reached good grade in various mathematical abilities. Besides that, some other studies that penetrated various innovative teaching-learning approaches reported that high school students attained better grades in critical thinking ability than that of students taught by conventional teaching (Jayadipura, 2014, Mulyana, 2009, Nugrohorini, 2013, Nurlaila, 2015, Ratnaningsih 2007, Rohaeti, 2008, Sinurat, 2014, Sumarmo et al, 2012, Widyaningtyas, 2015). Those studies reported that students attained fairly good grade in mathematical critical thinking ability. Other studies reported that students showed fairly good on self confident as well (Hendriana, 2009, Hendriana, Rahmat, Sumarmo, 2015)

Based on the aforementioned background, the research questions of this study are as following.

- 1) Were the grades of mathematical critical thinking ability and of its N-Gain of students taught by direct-indirect teaching higher than those grades of students taught by conventional teaching?
- 2) Was the grade of self confident of students taught by direct-indirect teaching higher than the grade of students taught by conventional teaching?
- 3) Is there association between mathematical critical thinking ability and self confident?
- 4) What is students' perception toward the conducted direct-indirect teaching ?
- 5) What kinds of difficulties that students faced in solving mathematical critical thinking tasks?

B. Theoretical Framework

1. Mathematical Critical Thinking Ability and Self Concept

Some experts defined the term of critical thinking differently. Gokhale (1995) defined a critical thinking problem was a problem which involved activities to analyze, to synthesize, and to evaluate concepts. In mathematics, Glaser (2000) clarified that mathematical critical thinking involved abilities and disposition which being combined with previous knowledge, mathematical reasoning, and cognitive strategy for generalizing, proving, and assessing mathematical situation reflectively. TIM (2013) suggested that hard skill and soft skill components of mathematics learning outcomes should be improved accordingly and proportionally. A component of soft skill components of mathematics learning was self-confident. Some experts stated that self-confident in similar meaning among other things were: a) Self-confidence of an individual toward his or her self that make he or she feel to be able to reach his or her life objectives (Hakim, 2002); b) Feeling of being able, comfortable, and satisfied toward his or her self (Molloy as sited in Hapsari, 2013); c) Viewpoint of an individual toward his or her self in mobilizing his or her motivation and

resources that be needed and be arouse in action which suitable with the demand of a task (Bandura, as cite inHendriana, 2009). Moreover, Bandura (as site in Hendriana, 2009)stated some indicators of self-confident as follow: a) To be confdent toward his or her self ability; b) To take action in taking a decision independently; c) To be unafraid to confront challenges; and d) To respect toward his or her self and effort.

Lindenfield (as site in Rifki, 2008)proposed two kind of self confident namely: a) Physical self-confidentthat was self confident that gave feeling and opinion that he or she was in good condition which being charaterized with: self affection, self understanding, having positive goals, and having positive thinking; b) Spiritual self-confident that was self confident attitudes that demonstrated through:ways of communication, emphatic attitude, having self appearance, and emotion controlling. Based on the usage, Weinberg and Gould (as cite in Wicaksono, 2009)proposed six positive effects from self confident those were: a) Self confidence developed positive emotion; b) Self confidence fasilitated consentration; c) Self confidence affected target; d) Self confidence improved effort; e) Self confidence influenced learning strategy; f) Self confidence influenced psychological momentum.

Self confident similar to value and character education could not be taught directly such as taught a certain mathematical ability, but it should be improved actively and continously through four ways namely: to give the understanding toward the meaning of term of self confident, to familiarize toward self confident behavior, to give example self confident behavior, and to carry out integrated and continous teaching-learning process (Aswandi, 2010, Ghози, 2010, Sauri, 2010).

2. Direct and Indirect Teaching and Learning

Direct and Indirect Teaching and Learning was a penetration of teaching process that in a certain condition a concept was taught directly but in other condition other concpet wa taught indirectly. Direct teaching was more teacher centered that provided information or skills step by step from a sub-topic to the other sub-topic (Flanders as cite in Ambarwati, 2011). This direct taching had two goals those were: to master learning materials and to attain various skills (Suprihatiningrum, 2013).Although direct teaching was teacher centered, the porcess still quarantee to happen the envolvment of students learning such as in solving individual tasks. Eggen and Kauchak(2012) proposed phases in direct teaching as follow: a) Intruduction and review: to introduce lesson and to review prevoius understanding; b) Presentation: to present, to explain, to ilustrate, a new skill through high quality example; c) Guided exercises: students exercice a new skill through teacher's guidance; d) Independent exercises: student excersises a new skill independly.

Like each kind of teaching process properly, direct teaching had advantages and disadvantages. Some of the advantages of direct teaching were: a) students know the reason of a content was going to give directly, the learning target was easy to assess, the teaching could be implemented broadly (Ambarwati, 2011); b) The teacher could be able to controll the content and the sequence of substance that would be taught, could be implemented in big or small class, could indentify important thing and difficulties that potensially faced by students, was effective for teaching concepts and skills for various achievement and self confident of students (Suprihatiningrum, 2013). Some of disadvantages of direct teaching were: a) Teacher should have good preparation and good oral (Ambarwati, 2011); students were less responsible (Jahr, 2011); c) Teachers' difficulty on overcoming the students' difference on ability, previous knowledge, level of students' understanding, students' learning styles or students' attractiveness, activr participation of students, teacher's difficulty

on finding feed back from students, was not appropriate for improving problem solving ability and students' self regulated learning (Suprihatiningrum, 2013).

In order to overcome the disadvantages of direct teaching, that mentioned teaching process should be combined with indirect teaching. Basden et al (as cite in Ambarwati, 2011) proposed that direct teaching basically was students centered, and teacher facilitated students' mathematical thinking process through some activities such as: to pose questions that enabled to arise student' ideas; to motivate students to analyze the problem more accurately, to draw conclusion from class discussion, to relate the come up ideas, and to give opportunity to students for thinking and explaining.

Some characteristics of indirect teaching namely (Robertson dan Lang, das cite in Ambarwati, 2011): a) To ask students' involvemnt actively in observing, investigating, drawing conclusion, and looking for alternative solution; b) Teacher was was more took a role as facilitator ; c) To be appropriate for learning comes of thinking ability, having attitudes and values; d) Process was similar importance to product of learning, students carry out investigation, problem solusion was open-ended, the lesson focussed on improvement of personal understanding for a long time.

Based on argument mentioned above, Ambarwati, (2011) summerized some charateristics of direct-indirect teaching as follow: a) Presentation of learning material in contextual form so that mathematical concept, procedure, and principle were acquired by students through problem solving and investigation activities; b) Supporter and simple content were taught through direct teaching, and for higher mathematical thinking ability was taught by indirect teaching accompanied with scaffolding strategy; c) The interaction was developed in multi direction.

3. Relevant Studies

A number of studies with high school students reported that direct-indirect teaching was more superior than conventional taeching in improving various mathematical abilities (Ambarwati, 2011, Maya, 2005, Nugrohorini, 2013, Sumarni, 2005, Suprihatiningrum, 2013, Suryadi, 2005). Other studies (Jayadipura, 2014, Mulyana, 2009, Rohaeti, 2010, Sinurat, 2014, Sumarmo dkk, 2012, Widyaningtyas, 2015) found that students taught by various innovative teaching-learning attained better grade on mathematical critical thinking ability than that of students taught by conventional teaching. However, the students' mathematical critical thinking ability were calssified between low and fairly good grades (40% -70% of ideal score). Those findings showed that high school students still faced difficulties in solving mathematical critical tasks. Beside that, other studies, Hendriana (2009), and Hendriana, Rahmat, Sumarmo (2015) reported that students attained fairly good grade on self confident.

C. Research Method

The purpose of this study were to analyze the effect of direct-indirect teaching toward the attainment, gain, and difficulties of high school students on mathematical critical thinking ability. Besides that, the study intended to analyze students' self confident, association between mathematical critical thinking ability and self confident, and students' opinion toward direct-indirect teaching as well. This study was a part of a magister thesis research (Tamsil, 2015) and a part of Second Post Graduate Research Grant from Directorate General of Higher Education (DGHE) (Hendriana, Rohaeti, Sumarmo, 2013). This study was a pretest-posttest quasi experimental control group design, which involves 70 eleventh grade

illustrated that students with high score of MCTA still possessed medium SC. It was rational that improving SC or other affective learning outcomes needed more long time than enhancing certain mathematical ability. This statement was fitting with opinion of Aswandi (2010), Ghozi (2010), Sauri (2010) that SC or other affective behavior could not be taught directly such as taught a certain mathematical ability, but it should be improved actively and continuously through four ways namely: to give the understanding toward the meaning of term of self confident, to familiarize toward self confident behavior, to give example self confident behavior, and to carry out integrated and continuous teaching-learning process.

4. Students' Difficulties in Solving Mathematical Critical Thinking Ability.

Score of each item of mathematical critical thinking ability on the both teaching approaches were illustrated in Table 4.

Table 4
Score of each item of mathematical critical thinking ability of students in the both teaching approach

Teaching approach	Desc. Stat.	No.1	No.2	No.3	No.4	No.5
	Ideal score	15	15	20	25	25
	\bar{X}	16,60	16,49	15,97	7,06	12,97
DIT	% of IS	82,71	65,94	79,86	47,43	64,86
	\bar{X}	10,69	10,37	14,34	4,37	7,09
ET	% of IS	53,43	41,49	71,71	29,14	35,43

Note:

1. To analyze the truth of an argument
2. To identify relevant or irrelevant data in problem of integral as anti derivative of a function
3. To analyze the truth of an argument
4. To identify assumption of an integral problem
5. To answer question related area of a region accompany with explanation

Data on Table 4 showed that students taught by DIT attained low score on item 4 (47,43 out of ideal score), and it was about to identify assumption of an integral problem. In other items they attained between fairly good and a good grade on mathematical critical thinking ability. However students taught by expository teaching except in item 3 namely about to analyze the truth of an argument they still had difficulties on almost item of mathematical critical thinking ability.

E. Conclusion, Implication, and Suggestion

1. Conclusion

The attainment, the normalized gain of mathematical critical thinking ability, and self confidence of students taught by direct-indirect teaching were better than that of students taught by expository teaching. The grades of students on those ability and self confidence were classified between fairly good and good, and they did not face difficulties in almost item of mathematical critical thinking ability. In the contrary, students taught by expository teaching attained low grade on mathematical critical thinking ability, and they still faced difficulties on almost items.

The study also concluded that students in the teaching approach attained medium grade on self confident. However students performed positive perception toward implemntation of direct-indirect teaching.

2. Implication and Suggestion

Mathematical critical thinking ability was one of difficult topic for being learned by students and for teachers to teach it. Students needed longer time for exercising various and challenging problems that motivated students to thinkmathematically.

The finding of students' self confidence were medium grades. These findings were rational because of the experiment was carried out for two months. Basically to improve self confidence or other mathematical affective learning outcomes needed a longer time, to become accustomed tohave self confident behavior, teachers should epitomize to have self confident behavior, and carry out integrated and continous teaching-learning process. mbelajaran matematika yang terintegrasi dan berkelanjutan.

References

- Ambarwati, D. (2011). *Mengembangkan Kemampuan Berpikir Kritis dan Kreatif Melalui Pendekatan Pembelajaran Langsung dan Tak Langsung*.MagisterThesis at Post Graduate Study of Indonesia University of Education. No publication.
- Aswandi, (2010). "Membangun Bangsa melalui Pendidikan Berbasis Karakter". In *Pendidikan Karakter. Jurnal Publikasi Ilmiah Pendidikan Umum dan Nilai*. Vol. 2. No.2. Juli 2010.
- Eggen danKauchak. (2012). *Strategi dan Model Pembelajaran*.Translation. Sixth edition. Jakarta: Penerbit PT Indeks Permata Putri Media.
- Ghozi, A. (2010). *Pendidikan Karakter dan Budaya Bangsa dan Implementasinya dalam Pembelajaran*. Article presented in Pendidikan dan Pelatihan Tingkat Dasar Guru Bahasa Perancis Tanggal 24 Okober s.d 6 November 2010
- Glazer ,E (2000). *Technology Enhanced Learning Environtments that are Conducive to Critical Thinking in Mathematics: Implications for Research about Critical Thinking on the World Wide Web*. [On Line]. Tersedia:<http://www.lonestar.texas.net/~mseifert/crit2.html>. [24 April 2006]
- Gokhale, a.A. (1995). "Collaborative Learning Enhances Critical thinking".*Journal of Technology Education*, Volume 7, Number 1 Fall 1995. Electronic Journal.
- Hakim, T. (2002).*Mengatasi Rasa Tidak Percaya Diri*. Jakarta : Puspa Swara.
- Hendriana, H. (2009). *Pembelajaran dengan Pendekatan Metaphorical Thingkinguntuk Meningkatkan Kemampuan Pemahaman Matematik, Komunikasi Matematik, dan Kepercayaan Diri Siswa Sekolah Menengah Pertama*.Disertation at Post Graduate Study of Indonesia University of Education.

- Hendriana, H. Rochaeti, E.E. Sumarmo,U.(2015). *Meningkatkan Beragam Hard Skill dan Soft Skill Matematika Siswa Sekolah Menengah melalui Beragam Pendekatan Pembelajaran*. Hibah Pascasarjana DIKTI tahun kedua (2015)
- Hendriana, H., Rahmat, U.S., Sumarmo, U. (2015). “Mathematical Connection Ability and Self-Confidence. (An experiment on Junior High School students through Contextual Teaching and learning with Mathematical Manipulative)” Article was published in *International Journal of Education*. Vol.8. No. 1. Desember 2014. pp.54-63. Graduate School, Indonesia University of Education.
- Jayadipura, Y. (2014). *Mengembangkan Kemampuan Berpikir Kritis dan Kreatif Matematis serta Kemandirian Belajar Siswa SMA melalui Pembelajaran Kontekstual*. Magister Thesis at Post Graduate Study of STKIP Siliwangi Bandung.
- Maya, R. (2005). *Mengembangkan Kemampuan Matematik Tingkat Tinggi Siswa SMA melalui Pembelajaran Langsung dan Tak Langsung*. Magister Thesis at Post Graduate Study of Indonesia University of Education. Not published
- Nugrohorini, S.G. (2013). *Meningkatkan Kemampuan Berpikir Kreatif Matematis dan Kemandirian Belajar Siswa SMP melalui Pembelajaran Tak Langsung dengan Resitasi*. Magister Thesis at Post Graduate Study of Indonesia University of Education. Not published
- Nurlaila.(2015). *Strategi Brain Based Learning untuk Meningkatkan Kemampuan Berpikir Kritis dan Berpikir Kreatif Matematis serta Menurunkan Kecemasan Matematis Siswa SMP*. Magister Thesis at Post Graduate Study of Indonesia University of Education. Not published.
- Polya (1973). *How to Solve It*. Second Edition. New Jersey: Princeton University Press.
- Ratnaningsih, N. (2007). “*Pengaruh Pembelajaran Kontekstual terhadap Kemampuan Berpikir Kritis dan Kreatif Matematik Siswa Sekolah Menengah Atas*”. Disertation at Post Graduate Study of Indonesia University of Education. Not published
- Rifki, M. (2008). *Pengaruh Rasa Percaya Diri Terhadap Prestasi Belajar Siswa di SMA Almaarif Singosari*. [Online]. Tersedia: <http://lib.uin-malang.ac.id/files/thesis/fullchapter/03160015.pdf>. (7 April 2014).
- Rohaeti, E.E. (2008). *Pembelajaran dengan Pendekatan Eksplorasi untuk Mengembangkan Kemampuan Berpikir Kritis dan Kreatif Matematik Siswa Sekolah Menengah Pertama*. Disertation at Post Graduate Study of Indonesia University of Education. Not published
- Sauri, S. (2010). *Membangun Karakter Bangsa melalui Pembinaan Profesionalisme Guru Berbasis Pendidikan Nilai*. *Jurnal Pendidikan Karakter*. Vol.2. No.2.
- Saputri, V. (2015). *Kemampuan Berpikir Kreatif, Pemecahan Masalah Matematik dan Self Confidence Siswa SMA melalui Pembelajaran Berbasis Masalah*. Thesis at Post Graduate Study of Indonesia University of Education. Not published

- Sinurat, R. (2014). *Meningkatkan Kemampuan Berpikir Kritis dan Kreatif serta Disposisi Matematik Siswa SMA melalui Pembelajaran Kontekstual*. Thesis at Post Graduate Study of STKIP Siliwangi, Bandung. Not published.
- Sumarmo, U et al. (2012). “Kemampuan dan disposisi berpikir logis, kritis, dan kreatif matematis: Eksperimen terhadap Siswa SMA menggunakan Pembelajaran Berbasis Masalah dan strategi *Think-Talk-Write*”. Article published in *Jurnal Pengajaran MIPA*, 17(1), 17-33.
- Sumarni, E. (2006). *Mengembangkan Kemampuan Berfikir matematik Tingkat Tinggi melalui Pembelajaran Langsung dan Tak Langsung pada Siswa SMP*. Thesis at Post Graduate Study of Indonesia University of Education. Not published
- Suparno, P (1997). *Filsafat Kostruktivisme dan Pendidikan*. Jakarta: Kanisius.
- Suprihatiningrum, J. (2012). *Strategi Pembelajaran. Teori dan Aplikasi*. Jogjakarta; Penerbit AR-RUZZ Media
- Suryadi. (2005). *Penggunaan Pendekatan Pembelajaran Tidak Langsung Serta Pendekatan Gabungan Langsung dan Tidak Langsung dalam Rangka Meningkatkan Kemampuan Berpikir Matematika Tingkat Tinggi Siswa SLTP*. Disertation at Post Graduate Study of Indonesia University of Education. Not published.
- TIM (2013). *Kurikulum 2013*. Jakarta: Depdiknas
- Wicaksono, D. (2009). *Pengaruh Kepercayaan Diri, Motivasi Belajar Sebagai Akibat dari latihan Bola Voli terhadap Prestasi Belajar Atlet di Sekolah*. [Online]. Tersedia: <http://staff.uny.ac.id/sites/default/files/penelitian/Danang%20Wicaksono,%20S.Pd.Kor.,%20M.Or/tesis%20.pdf>. (12 April 2014).
- Widyaningtiyas, R. (2015). *Pengaruh Pendekatan Pembelajaran Berbasis Masalah terhadap Kemampuan dan Disposisi Berpikir Kritis dan Kreatif Matematis Siswa SMA*. Disertation at Post Graduate Study of Indonesia University of Education. Not published