MATHEMATICAL COMMUNICATION ABILITY AND DISPOSITION (EXPERIMENT WITH GRADE-11 STUDENTS USING CONTEXTUAL TEACHING WITH COMPUTER ASSISSTED)

Yonandi[1] dan Utari Sumarmo[2]

[1]Sekolah Tinggi Teknologi, Garut
[2]Jurusan Pendidikan Matematika FPMIPA
Universitas Pendidikan Indonesia

ABSTRAK

Makalah ini melaporkan temuan suatu eksperimen dengan disain tes awal-tes akhir dan kelompok kontrol yang dilaksanakan dengan mengimplementasikan pendekatan kontekstual berbantuan komputer untuk menemukan kemampuan komunikasi, dan disposisi matematik siswa. Studi ini melibatkan 244 siswa kelas-11 dari tiga SMA dari level rendah, medium, dan tinggi. Instrumen studi ini terdiri dari tes komunikasi matematik, dan skala disposisi matematik. Studi menemukan bahwa pendekatan kontekstual berbantuan komputer memberikan peran terbesar dibandingkan level sekolah dan kemampuan awal matematika siswa terhadap pencapaian dan peningkatan kemampuan komunikasi dan pencapaian disposisi matematik. Kemampuan komunikasi matematik siswa tergolong cukup baik. Studi juga menemukan bahwa peran kemampuan awal matematika siswa tidak konsisten terhadap pencapaian kemampuan komunikasi dan disposisi matematik. Selain itu, studi menemukan tidak ada interaksi antara pendekatan pembelajaran dan kemampuan awal matematika dan antara pendekatan pembelajaran dan level sekolah terhadap kemampuan komunikasi, dan disposisi matematik siswa. Selama pembelajaran siswa menunjukkan disposisi matematik yang positif, seperti belajar dengan semangat, bersikap terbuka, jujur, tidak takut menyakatan pendapatnya, dan saling menghargai satu terhadap lainnya. Terdapat asosiasi antara kemampuan komunikasi, dan diposisi matematik.

Kata kunci: disposisi matematik, komunikasi matematik, pembelajaran berbantuan komputer, pembelajaran kontekstual

ABSTRACT

This paper presents the findings from an experiment with a pre test- post test experimental control group design conducted by using contextual teaching approach with computer assissted to investigate students' mathematical communication, and disposition. The study involved 244 grade-XI students of high, medium, and low school level in Tasikmalaya. The instruments of the study are mathematical communication test, and disposition scale. The study found that contexstual teaching approach with computer assissted tended to be more important factor than school level and previous mathematics ability on achieving mathematical comunication ability, and disposition, Besides that, the study found that the role of previous mathematics ability tended inconsistent on achieving the ability and disposition. The grade of students' mathematical communication ability was classified as fairly good. Likewise, the study found that there were no interaction between teaching approach and school level, and between teaching approach and previous mathematics ability on mathematical comunication and on mathematical disposition. During the lesson students performed positive mathematical disposition, such as enthusiastic in learning, open minded, honest, unafraid to express their ideas, and respect to each other. There was medium assosiation between mathematical comunication, and mathematical disposition

Keywords: computer assissted instruction, contextual teaching, mathematical comunication, mathematical disposition

INTRODUCTION

Mathematical communication ability and disposition were essential ability and affective aspect should be possessed by senior high school students. The importance of possession of communication ability was proposed by Lindquist (Lindquist & Elliot, 1996) namely mathematics as a specific language was an essence of teaching and learning and assessing mathematics. Sumarmo (2002) defined mathematical communication ability as an ability to express mathematical ideas and message in daily language or mathematical symbols. Mathematical communication ability enclosed some doing math among other were: a) to express situation, figure, diagram, or real thing into mathematical language, symbol, idea, and model, b) to explain mathematical orally or writtenly, c) to listen, to discuss, to write about mathematics, d) to read meaningfully a mathematics representation, e) to express an argument in his or her own language.

The importance of possessing mathematical communication ability was illustrated in the goals of mathematics teaching (KTSP, 2006) as well. The goal enclosed: a) to understand mathematics concepts, to explain relationship among mathematics concept and apply them accurately, flexibly, and efficiently in solving problem; b) to reason based on pattern and trait, to manipulate mathematics in generalization, proving, and explaining mathematics ideas and statement and in solving problem; c) to communicate ideas by using symbols, table, diagram, or others; d) to appreciate usefulness of mathematics in daily life, to have curiosity, attention, interest in learning mathematics, and to have persistent and self concept attitudes in solving problem.

Those affective aspect above were called mathematical disposition which described: desire, conciousness, tendency, and strong dedication for thinking and doing mathematics positively. Polking (1998), proposed that mathematical disposition enclosed some traits and or habits namely: a) self concept in using mathematics, solving problem, reasoning, and communicating; b) flexible in seeking mathematical ideas and trying alternative solution of problem; c) diligent, interest, and curious in doing mathematics; d) tend to monitor, to reflect their own performance and reasoning; e) to evaluate aplication of mathematics into other mathematics situation, and daily life; f) to appreciate the roles of mathematics culture and value, and mathematics as tool and language. Similar to Polking statement, Standard 10 of NCTM (2000) stated that mathematical disposition pointed out: self concept, expectation and metagognition, enthutiastiasm and serious interest in learning mathematics, persistent in facing and solving problem, high curious, and sharing ideas to the others.

Concerning those characteristics, mathematics was also called a usefull science that reflected in its roles as symbolic language and tool for persistent, consice, dense, accurate, precise and not ambigoius communicating (Wahyudin, 2003). That statement ilustrated that mathematical communication had important role as representation of student’s understanding on mathematics concept and an applied science. By mathematical communication students exchanged ideas and clarified their understanding mutually. Those communication process helped students to construct meaning and to obtain generalization. In attempting to explore and develop students’ mathematical communication ability, teachers should face student to various contextual problems and invite students to communicate their ideas.

Connected to mathematics learning, KTSP 2006 suggested that mathematics should be presented in contextual situation, started by introducing contextual problem and then step by step students are guided to understand mathematics concept and communicate it meaningfully. There were seven componens in contextual learning namely: constructivism philoshopy, inquiry, questioning, learning community, modeling, reflection, and authentic assessment (Depdiknas, 2002). Moreover, Zahorik (Depdiknas, 2002) stated that there are five elements should be considered in implementing contextual learning, those are: activating knowledge; acquiring new knowledge, understanding knowledge, applying knowledge, and reflecting knowledge.

A number studies, by using Think Talk and Write strategy (Ansyari, 2004), Survey, Question, Review, Write strategy (Sudrajat, 2002), transactional reading strategy (Sukmadewi, 2004, Sugiatno, 2008), and Methaporical Thinking approach (Hendriana

2009) reported that students obtained better grades on mathematical communication than students' grades of conventional classes. Some studies with yunior high school students by implementing contextual learning also reported similar findings on concept understanding and mathematical connection abilities (Rauf, 2004), mathematical communication and connection abilities (Putri, 2006), mathematical representation ability (Hutagaol, 2006), mathematical communication and problem solving abilities (Herman, 2006). Similar findings of some studies (Dewanto, 2007, Dwiyanto, 2006, Juandi, 2008) with tertiary students by using problem based learning also reported that students attained better grades on mathematical modeling, mathematical problem solving, and mathematical power than those abilities of conventional classes students.

In line with development of information and communication technology (ICT) implementation of computer software on learning activities not only computer as learning media but also for overcoming individual student's differences, learning mathematics concept, executing computation, and stimulating student's learning (Fletcher in Misnadi, 2005). Other computer advantages were that by using computer students were able to manage their learning speed to conform with their level of abilities (Glass, in Misnadi, 2005), slow learners were able to repeat a topic such away they could master the topic thoroughly, and fast learners could pursue enrichment topic so that they faced more challenced and they have opportunity to explore concept more deeply. According to the role of computer as a learning media Heinich (Kariadinata, 2006) proposed some advantages of computer such as: students were able to learn appropiate with their abilities and learning speed; students' learning activities were able to be controlled; students had facility for repeating their learning and they were assissted to obtain feed back; it was created effective learning climate either for slow leaners or fast learners; and feed back was able to program.

Considering the advantages of computer usage in learning process Bitter and Hafielif (Amalia, 2006) stated that computer was able operated potencially for improving the quality of learning mathematics. Some studies implemented computer aided instruction found that yunior high school students (Kariadinata, 2004, Yohanes, 1994 in Kariadinata, 2006), senior high school students (Amalia 2006, Herlan 2006, Syamsuhuda, 2004) obtained better mathematics grades compare to the grades of students taught by conventioan teaching. Other study reported that contextual learning accompanied with Cabri Geometry II program (Rusmini, 2008) improved students' mathematical reasoning ability of students from low level senior high school. Two studies by using computer as multimedia reported that students attained mathematical communication ability (Su and Lee, 2005), and high order mathematical thinking (Kariadinata, 2006) better grades than those abilities of conventional classes students. Likewise, a study by using computer aided instruction found that students teacher attained higher grade on high level mathematical thinking compared to ability of students taught by conventional learning (Darminto, 2008).

Findings of a number of studies above and analysis gave a suppositon that contextual learning accompanied with computer assissted instruction was predicted to be more effective than conventional teaching on attainning mathematics abilities. That rational encouraged researcher to conduct an experiment by implementing contextual learning with computer assissted to improve mathematical communication and problem solving of senor high school students. Considering the characteristics of mathematics as systimatics science it also was predicted that students' previous mathematics knowledge and school level would have a role on attainning students' mathematical communication, problem solving and disposition.

The purpose of this study was to analyze in deep the roles of contextual teaching approach with computer assissted, school level, and previous mathematics ability on the quality of students' mathematical communication ability and disposition. In adition to those purposes above, this study also intended to examine the existance of interaction among teaching approaches. school level, and previous mathematics ability on mathematical communication ability and students' mathematical disposition. Furthermore, this study aimed to investigate the existance of association between mathematical communication and disposition and to analyze the role of each other.

Mathematical communication ability and mathematical disposition were basic mathematics competence and affective domain should be possessed by high school students. The importance of possession of communication ability among others was proposed by Baroody (1993) and Lindquist (Lindquist & Elliot, 1996). Baroody (1993) proposed two important reasons that why teaching mathematics should be emphazised on mathematical communication. Fisrtly, mathematics is an essential language, it is not only an aid for thinking, inventing rules, solving problem, or concluding, but mathematics also is an unlimited value for declaring various idea clearly, accurately, and concisely. Secondly, mathematics and mathematics learning are the heart of social activities; for example, in teaching mathematics interaction between teacher and students, among students, and between learning material of mathematics and students are very important factor for improving students potency (Kadir, 2010). Others important role of mathematical communication was summerized by Asikin (Hulukati, 2005) namely: to help students to sharpend thier ways of thinking, as a tool for assessing students' understanding, to help students to organize their mathematical knowlegde, to help students to construct mathematics knowlegede, to improve problem solving ability, to improve reasoning, to promote self efficacy, and to improve social skill, and it is worthwhile for setting up an inclusive mathematical community.

Similar to those argument above, Lindquist (Lindquist & Elliot, 1996) proposed that mathematics as a specific language was an essential component of teaching, learning and assessing mathematics. Further, Sumarmo (2002) defined mathematical communication ability as ability to express conditon, problem, and or message of a dicipline and of daily life into mathematical language, symbols. or ideas. From some writters' (Sumarmo, 2002, NCTM, 2000) analysis, it was summerized that mathematical communication ability enclosed some mathematical activities such as: to express situation, figure, diagram, or real world occasion into mathematical language, symbol, idea, and model; to explain and to read meaningfully and to express, to understand, to interpretate, and to evaluate mathematical ideas or mathematics representation orally. writtenly, or visually; to listen, to discuss, to write about mathematics,; and to express an argument in his or her own language.

From those analysis above, mathematics is also called a usefull science that reflected in its roles as symbolic language and tool for persistent, consice, dense, accurate, precise and not ambigoius communication (Wahyudin, 2003). That statement ilustrated that mathematical communication has important role as a representation of student's understanding on mathematics concept and an applied science. By mathematical communication students exchanged ideas and clarified their understanding mutually. Those communication process helped students to construct meaning and to obtain generalization. In attempting to explore and develop students' mathematical communication ability, teachers should face student to various contextual problems and invite students to communicate their ideas.

The affective domain and cognitive domain of learning objectives in mathematics (KTSP, 2006) grow simultaneously and form positive attitude called mathematical disposition which described: desire, conciousness, tendency, and strong dedication for thinking and doing mathematics positively. Polking (1998), proposed that mathematical disposition enclosed some traits and or habits namely: a) self concept in using mathematics, solving problem, reasoning, and communicating; b) flexible in seeking mathematical ideas and trying alternative solution of problem; c) diligent, interest, and curious in doing mathematics; d) tend to monitor, to reflect their own performance and reasoning; e) to evaluate aplication of mathematics into other mathematics situation, and daily life; and f) to appreciate the roles of mathematics culture and value, and mathematics as tool and language. Similar to Polking's statement, Standard 10 of NCTM (2000) stated that mathematical disposition pointed out: self concept, expectation and metagognition, enthutiastiasm and serious interest in learning mathematics, persistent in facing and solving problem, high curious, and sharing ideas to the others.

Concerning mathematics teaching and learning, KTSP 2006 suggested that mathematics should be presented in contextual situation, started by introducing contextual problem and then step by step students are guided to understand mathematics concept and communicate it meaningfully. Berns and Ericson (2001) mentioned that contextual teaching is a teaching approach which help teacher to connect mathematics topic will be learned and a real situation and motivate students to make a connection between their knowlegde and its application in daily life. Basically, contextual teaching is based on constructivism philosophy that students should construct their knowlegde them selves through accomodation and assimilation. That statement supports rational that contextual teaching creates students' meaningfull learning and improves students' achievement. Likewise, Owens (2001) proposed that contextual teaching promises to improve students' learning interest, to motivate students' learning participation, and to give more opportunity for applying their knowlegde in solving dailly problems.

To conduct a contextual teaching, there are five components should be developed those are: problem based learning, learning in contexts, self regulated learning, authentic assessment, and learning community (Bern and De Stefano, 2001). In broader analysis, National Department of Education (2002), proposed seven principles should be considered for conducting contextual teaching. Those components are: constructivism philoshopy, inquiry, questioning, learning community, modeling, reflection, and authentic assessment. Whereas, Zahorik (Depdiknas, 2002) stated that there are five elements should be noticed in implementing contextual learning, those are: activating knowledge; acquiring new knowledge, understanding knowledge, applying knowledge, and reflecting knowledge.

In line with development of information technology, presently many teaching approach conducted by using computer assissted. Contribution of computer in teaching process among others are: a) Students are able to learn in accordance with their ability and rapidness in absorbing the presentation of information; b) Students' learning activities can be controlled; c) Students have facilities for repeating a program when they need; d) Students are able to get feedback directly; e) It is created condusive and effective learning situation, slow learner students are able to repeat the lesson and fast learner are able to pursue an enrichment lesson; f) Students can carry out a difficult computation and a complex graph faster than they use usual computation and encourage students to learn (Fletcher in Misnadi and Kusumah, 2005, Kariadinata, 2006). In teaching with computer assissted the role of teacher is more as an instructor, facillitator, and colleague than as a teacher.

The potency of computer as a teaching media is very great. There are many kinds of computer-based instruction among others are Computer-Aided/Assisted Instruction (CAI), Computer-Assisted Learning (CAL), Computer-based Training (CBT), computer conference, *e-mail*, *web site*, and multimedia computer. Coburn (Herlan, 2006), stated there are some teaching model of CAI design those are drill and practice, tutorial, game, simulation, discovery, and problem solving. By using relevant software, computer become an effective , komputer menjadi alat yang efektif dalam membantu kegiatan pembelajaran matematika. Some software used in mathematics teaching among others are: Macromedia FlashMX, Mathematica, Cabry Geometry, dan Geometry Skatchpad,

Various studies found that utilyzing computer in mathematics teaching memberikan hasil belajar yang lebih baik, and students performed positive appreciation toward teaching mathematics with media computer assissted siswa menunjukkan apresiasi yang positif terhadap pembelajaran (Bitter dan Hafielif in Amalia, 2004, Nuryadin in Amalia, 2004).

Some studies by using various learning strategies namely: Think Talk and Write strategy with yunior high school students (Ansyari, 2004), Survey, Question, Review, Write strategy involed senior high school students (Sudrajat, 2002), problem based learning in small group and yuinior high students (Afgani, 2004), transactional reading strategy with senior high school students (Sukmadewi, 2004), and with students mathematics teacher (Sugiatno, 2008), and Methaporical Thinking approach and involved senior high school students (Hendriana 2009) found that students obtained better grades on mathematical communication than students' grades of conventional classes.

Owens (2001) reported the findings of Washington State Consortium for Contextual that contextual teaching was able to improve students' interest, learning participation, learning attractiveness and connection and application abilities. Similar finding was reported by The Contextual and Consortium work together with Oregon University that: students performed to be pleasant in learning, students were responsible in self regulated learning, and the lesson were able to assisst students of all level of smartness, the teacher having important role in conducting the lesson and in compiling learning material, and students performed a good team work (Rauf (2004). Other studies by implementing contextual learning on mathematical communication reported similar findings as well namely: Putri, (2006) and Herman, (2006) with yunior high school students reported that students' grade of expriment class were higher than students' grade of conventional classes. Those findings indicated that learning situation on small group or contextual teaching gave students more oportunities to discuss and communicate each other so that those acitivities improved students' mathematical communication (Hendriana 2009), and mathematical representation as well (Sukmadewi, 2004).

Similar findings also reported by some studies involved tertiary students and implemented problem based learning (Dewanto, 2007, Dwiyanto, 2006, Juandi, 2008). The studies found that students taught by problem based learning attained better grades on mathematical modeling, mathematical problem solving, and mathematical power than those abilities of conventional students. Likewise, some studies implemented computer aided instruction found that yunior high school students (Kariadinata, 2004, Yohanes, 1994 in Kariadinata, 2006), senior high school students (Amalia 2006, Herlan 2006, Syamsuhuda, 2004) obtained better mathematics grades compare to the grades of students taught by conventioan teaching. Other study reported that contextual learning accompanied with Cabri Geometry II program (Rusmini, 2008) improved students' mathematical reasoning ability of students from low level senior high school. Three studies by using computer as multimedia reported that students attained better grades on mathematical communication ability, on limit of function (Su and Lee, 2005), and on high order mathematical thinking (Kariadinata, 2006) than than the grades of conventional students. Likewise, a study by using computer aided instruction found that students teacher attained higher grade on high level mathematical thinking compared to ability of students taught by conventional learning (Darminto, 2008).

METHOD

This study is an experiment control group design with pretest-postest involving 244 grade-11 students from two senior high schools of medium and high cluster in Tasikmalaya. The experiment was conductted at Post Graduate Program of Universitas Pendidikan Indonesia in 2009 up to February 2011 to investigate students' mathematical communication, and mathematical disposition by adopting contextual teaching approach with computer assissted. The instruments of this study were mathematical communication test, and mathematical disposition scale. The instrument and learning material were developed specifically to fit the objective of this experiment. The communication test consists of two parts and each part consists of 8 items. The mathematics ability test consisted of 20 items of essay form adopted from National Examination of 2004-2009. The disposition scale was compiled in Likert scale of four choices without neutral option. The scale consists of 40 positive and negative statements included, self confident, flexibility, persistent, enthusiastic, interest, curiosity, self monitor, apreciation, expectation, metacognition, and sharing ideas.

The following presented examples of item test and disposition scale

a. Item test of mathematical communication

A building complex has some blocks. In Melati block there are some houses having a number consisted of three different digits and the number is more than 649 and less than 860 and consisted of 2, 3, 4, 5, 6, 7, 8 and 9. How many houses are in Melati block?

1) Illustrate the problem in a chart form.
2) Then compile mathematical model of the problem, and solve it.

b. Sample statements of disposition scale.

No.	Statement	Response			
		SA	A	DA	SDA
1	I love to solve mathematics problem				
2	I believe to pass the mathematics test				
3	My mathematics teacher encourages me to do at my best				
4	I am proud of my friend's success				
5	I am unafraid to express my idea in mathematics class				
6	Learning mathematics is boring				
7	Learning mathematics promotes me to be confident				
8.	I am afraid to face mathematics test				

Note: SA: strong agree; A: agree; DA: disagree; SDA: strongly disagree

RESULTS AND DISCUSSION

1. Previous Mathematics Ability

In the beginning of the experiment students were asking to solve a mathematics test in reflecting previous mathematics ability. This study found that there was no difference on previous mathematical ability among students in all classes. Student's mathematics ability was classified as good so the researcher decided to carry out the experiment directly.

2. Mathematical Communication Ability

Table 1 illustrated that in pre-test there were no difference on mathematical communication ability among students in all classes. Students' mathematical communication was classified as low (about 23% of ideal score).

Mathematical communication of students taught by contextual teaching and computer assisted (CT-CA) performed better in grade (73.78) than the grade of students of contextual teaching (CT) (71.13) and both of them performed better than that of conventional students (64.76). This findings pointed that CT-CA was the most effective approach compare to CT and conventional approach (CN) on mathematical communication. In CT-CA students of high school level attained better grade (77.72) than the grade of students of medium school level (70.02) on mathematical communication. Similar findings were found in CT class and CN class, in succession it were found students of high school level attained grade (71.63 and 66.55) better than the grade of students of medium school level (70.67 and 63.14). Therefore, in those three approaches it was found that the higher the school level the higher the students' mathematical communication ability. This findings illustrated that school level was a good predictor for achieving mathematical communication ability (Table 2).

In deeper analysis (Table 3) in each teaching approach it was found that the higher the students' previous mathematics ability the higher students mathematical communication (in CT-CA: 77,59 and 71,29, in CT: 73,31 and 69,80, in CT-CA : 66,06 and 64,00). However, in medium school level there were no difference grade of students of low, medium, and high previous mathematics ability (in succession 72,73, 69,03, 69,00 in CT-CA and 73,35, 68,86, 68,67 in CT), and those grades were better than the grade of conventional students (66,06, 64,00, 63,75) on mathematical communication. Those findings illustrated that CT-CA and CT tended to be the more important role on improving mathematical communication compare to the role conventional teaching and previous mathematics ability. Implication of those findings was that teacher's effort tended to contribute stronger than the role the given condition (previous mathematics ability). The further analysis obtained that on mathematical communication, students with low previous mathematics ability taught by CT-CA and CT attained grade (74,00 and 69,00) was better than grade of students of medium and high school level taught by conventional teaching (64,00 and 66,06). Deeper analysis on Table 2 obtained that in medium school level there were no difference grades of CT-CA and CT students (in succession 70,02 and 70,67) and those grades were better than the grade of conventional students on mathematical communication. Similar findings, there were no difference grade of students in medium school level in succession of low, medium, and high previous mathematics ability (72,73, 69,03, 69,00 in CT-CA and 73,35, 68,86, 68,67 in CT), and those grades were better than the grade of conventional students (66,06, 64,00, 63,75) on mathematical communication. Those findings illustrated that CT-CA and CT tended to be the more important role on improving mathematical communication compare to the role conventional teaching and previous mathematics ability. Implication of those findings was that teacher's effort tended to contribute stronger than the role the given condition (previous mathematics ability)

Table 1. Mathematical Communication Ability (MCA) based on Teaching Approach, School level, and Previous Mathematics Ability (PMA)

Schl level	PMA	m	CT-CA				CT				CN			
		s	Pre test	Post test	<g>	n	Pre test	Post test	<g>	n	Pre test	Post test	<g>	n
High	Hgh	**r**	24,33	80,56	0,79	18	24,07	73,27	0,69	15	23,69	67,08	0,60	13
		s	6,61	4,03			5,80	6,28			5,22	7,62		
	Med	**r**	21,63	75,38	0,72	16	22,28	70,94	0,66	18	21,68	66,55	0,60	22
		s	4,75	5,83			6,26	5,33			5,38	5,71		
	Low	**r**	21,20	75,00	0,72	5	21,20	69,20	0,64	5	17,40	65,20	0,61	5
		s	4,21	5,15			2,49	6,18			6,58	8,73		
	Sub tot	**r**	**22,82**	**77,72**	**0,75**	**39**	**22,84**	**71,63**	**0,67**	**38**	**21,80**	**66,55**	**0,60**	**40**
		s	5,68	5,53			5,70	5,85			5,67	6,60		
Medium	Hgh	**r**	23,91	72,73	0,67	11	24,18	73,35	0,68	17	23,42	65,37	0,58	19
		s	6,55	1,90			5,05	4,50			5,82	8,49		
	Med	**r**	21,90	69,03	0,64	29	21,77	68,86	0,63	22	21,77	61,45	0,53	22
		s	4,05	2,80			5,09	4,84			5,59	6,79		
	Low	**r**	20,00	69,00	0,65	1	20,33	68,67	0,64	3	18,00	61,33	0,56	3
		s	0,00	0,00			1,53	4,04			7,21	11,59		

Schl level	PMA	m	CT-CA				CT				CN			
		s	Pre test	Post test	<g>	n	Pre test	Post test	<g>	n	Pre test	Post test	<g>	n
	Sub tot	**r**	**22,39**	**70,02**	**0,65**	**41**	**22,64**	**70,67**	**0,65**	**42**	**22,23**	**63,14**	**0,56**	**44**
		s	4,81	3,02			5,01	5,07			5,82	7,93		
Total	Hgh	**r**	24,17	77,59	0,74	29	24,13	73,31	0,68	32	23,53	66,06	0,59	32
		s	6,47	5,11			5,33	5,32			5,50	8,06		
	Med	**r**	21,80	71,29	0,67	45	22,00	69,80	0,65	40	21,73	64,00	0,57	44
		s	4,26	5,10			5,57	5,11			5,42	6,72		
	Low	**r**	21,00	74,00	0,71	6	20,88	69,00	0,64	8	17,63	63,75	0,59	8
		s	3,79	5,22			2,10	5,15			6,30	9,27		
	Tot	**r**	**22,60**	**73,78**	**0,70**	**80**	**22,74**	**71,13**	**0,66**	**80**	**22,02**	**64,76**	**0,58**	**84**
		s	5,23	5,86			5,32	5,44			5,72	7,48		

Note: Ideal score : 96; m : mean s : standard deviation

<g> normalized gain $\langle g \rangle = \frac{Posttes - pretest}{Idealscore - pretest}$

CT-CA : Contextual teaching with computer assistance
CT : Contextual teaching
CN : Conventional teaching

Table 2. Post Hoc Tamhane Test on Difference of Students' Mathematical Communication in all three Teaching Approaches for all Students

Teaching Approaches (I)	Teaching Approaches (J)	The Mean Difference (I – J)	Sig.	H_0
CT-CA	CT	2,650	0,010	Rejected
CT-CA	CN	9,013	0,000	Rejected
CT	CN	6,363	0,000	Rejected

Note: H_0 no mean difference

Table 3. Scheffe Test for Mean of Mathematical Communication based on Previous Mathematics Ability on all of three Classes

PMA (I)	PMA (J)	Mean Difference (I-J)	Sig.	H_0
High	Medium	-1,994	0,001	Rejected
High	Low	2,864	0,007	Rejected
Medium	Low	0,870	0,608	Accepted

Note: H_0 there was difference of mean among level of PMA

3. Mathematical Disposition

From Table 4 and Table 5 in total students the study found there was no difference mathematical disposition of students of CT-CA class (139,09), of students of CT (139,93), and of conventional students (124,51).

Table 4. Mathematical Disposition (MD) based on Teaching Approach, School Level, and Previous Mthematical Ability

School level	Level of PMA	CT-CA			CT			CN		
		Mean	SD	N	Mean	SD	n	Mean	SD	n
High	High	139,63	0,58	18	140,76	1,79	15	126,09	6,98	13
	Medium	138,36	1,83	16	140,54	2,04	18	126,40	6,03	22
	Low	138,37	2,22	5	138,99	1,37	5	126,15	7,95	5
	Sub total	**138,95**	2,28	39	**140,42**	1,91	38	**126,27**	6,40	40
Medium	High	139,37	1,89	11	139,41	1,84	17	118,88	4,64	19
	Medium	139,19	1,90	29	139,39	1,77	22	125,47	8,84	22
	Low	138,64	0,00	1	140,53	3,94	3	129,68	4,75	3
	Sub total	**139,23**	1,86	41	**139,48**	1,94	42	**122,91**	7,87	44
Total	High	139,53	2,31	29	140,05	1,91	32	121,81	6,65	32
	Medium	138,90	1,90	45	139,91	1,96	40	125,94	7,49	44
	Low	138,42	1,99	6	139,57	2,48	8	127,48	6,77	8
	Sub total	**139,09**	2,07	80	**139,93**	1,97	80	**124,51**	7,36	84

Note: Ideal score 160

Table 5. Post Hoc Tamhane Test on Mean Difference of MD based on Teaching Approach

Learning Approaches (I)	Learning Approaches (J)	The Mean Difference (I – J)	Sig.	H_0
CT-CA	CT	-0,837	0,029	Accepted
CT-CA	CN	14,580	0,000	Accepted
CT	CN	15,417	0,000	Accepted

Note**:** H_0 : no mean difference of MD

Deeper analysis (Table 8.) the study found similar findings, that in high and medium school levels study found that there were no difference mathematical disposition of students of of high, medium, and of low previous mathematics of CT-CA and of students of CT (in succession 139,63, 138,36, 138,37 of CT-CA, and 140,76, 140,54, 138,99 of CT). Those grades of students of CT-CA and of CT were better than the grade of conventional students (126,09, 126,40, 126,15) on mathematical disposition.

Table 6. Post Hoc Schefee test on mean difference of Mathematical Disposition (MD)based on Previous Mathematical Ability

PMA (I)	PMA (I)	Mean difference	Sig.	H_0
High	Medium	- 1,180	- 0, 596	Accepted
High	Low	- 1,246	0,827	Accepted
Medium	Low	- 0,665	0,999	Accepted

Note: H_0 no difference of mean MD among students' level PMA

4. *Interaction between Variables*

a. Interaction between variables to students' mathematical communication

Testing hypothesis of the existence of interaction between school level and teaching approach on students' mathematical communication was illustrated in Table 7. and the graph of the interaction was illustrated in Figure 1.

Table 7. Two Path ANAVA of Mathematical Communication on Teaching Approach and School Level

Source	Sum of Squares	Df	Mean Square	F	Sig.	H_0
Teaching Appr (A)	3528,286	2	1764,143	50,892	0,000	Rejected
School Level (B)	985,475	1	985,475	28,429	0,000	Rejected
Interaction AxB	463,639	2	231,820	6,688	0,001	Rejected

Note: H_0 : No different of mean (for A and B) and there was no interaction for AxB

Table 8. Two Path ANAVA of Mathematical Communication on Teaching Approach and Previous Mathematics Ability (PMA)

Source	**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	$\mathbf{H_0}$
Teaching Appr (A)	2202,102	2	1101,051	29,917	0,000	Rejected
Level of PMA (B)	868,378	2	434,189	11,797	0,000	Rejected
Interaction AxB	184,613	4	46,153	1,254	0,289	Accepted

Note: H_0 there was no mean difference among learning approach and among level PMA on CMA.

Further, Table 8 and Figure 2. in succession illustrated the testing hypothesis of the existence of interaction between previous mathematical ability and teaching approach on students' mathematical communication and the graph of the interaction. From Table 8 and Figure 2. the study found that there was interaction between previous mathematical ability (high, medium, low) and teaching approach (CT-CA, CT, an CN) to students' mathematical communication.

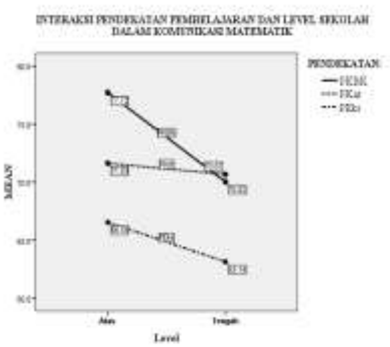

Figure 1
Interaction between Teaching Approach and School Level on Mathematical Communication

Figure 2.
Interaction between Teaching Approach and Previous Mathematics Ability on Mathematical Communication

b. Interaction between variables to students' mathematical disposition

Testing hypothesis of the existence of interaction between school level and teaching approach to students' mathematical disposition was illustrated in Table 9 and the graph of the interaction was illustrated in Figure 3.

Table 9. Two Path ANAVA of Mathematical Disposition (MD) based on Teaching Approach and School Level

Sources	Sum of Squares	Df	Mean Square	F	Sig.	H_0
Teaching Approach (A)	12280,433	2	6140,217	298,783	0,000	Rejected
School Level (B)	109,208	1	109,208	5,314	0,022	Rejected
AxB	140,275	2	70,138	3,413	0,035	Rejected

Note: H_0 no difference of mean of MD or no interaction between teaching approach and school level on students' MD

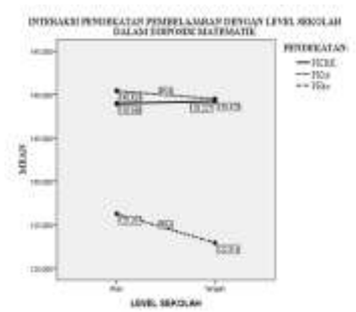

Figure 3. Interaction between Teaching Approach and School Level on students' MD

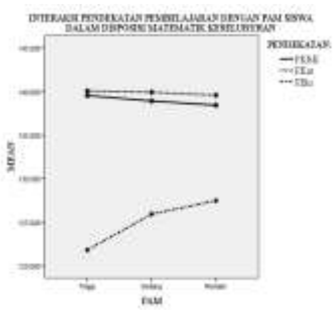

Figure 4. Interaction between Teaching Approach and Previous Mathematics on students' MD

Table 10. Two Path ANAVA of Mathematical Disposition with Learning Approach and Previous Mathematics (PMA)

Sources	Sum of Squares	Df	Mean Square	F	Sig.	H_0
Teaching Approach (A)	6674,201	2	3337,100	165,406	0,000	Rejected
Previous math (B)	77,321	2	38,664	1,916	0,149	Accepted
Interaction (A X B)	317,373	4	79,343	3,993	0,004	Rejected

Note: H_0 no mean difference of MD among learning approach and among level of PMA or no interaction between learning approach and previous mathematics on students' MD

Further analysis, Table 10 and Figure 4 in succession illustrated the testing hypothesis of the existence of interaction between previous mathematical ability and teaching approach to students' mathematical disposition and the graph of the interaction. From Table 10 and Figure 4 the study found that there was interaction between previous mathematics ability (high, medium, low) and teaching approach (CT-CA, CT, an CN) to students' mathematical disposition.

5. Association among Variables

Testing hypothesis of the existence of association between variables in contextual Teaching and computer assisted (CT-CA) were illustrated in Table 11.

Tabel 11. Association MCA and MD on CT-CA Class

Classification of MCA	Classification of MD			Total
	High	Medium	Low	
High	9	15	0	24
Medium	5	43	10	56
Low	0	0	0	0
Total	14	56	0	80

From Table 11 it was obtained there was association between mathematical communication and mathematical disposition, there was no student with low mathematical communication ability.

CONCLUSION AND RECOMENDATION

Students taught by contextual teaching with computer assissted performed higher grade on mathematical communication, than the grade of students taught contextual teaching without computer assissted and both of them performed higher grades than the grades of conventional students. The grade of students taught by contextual teaching with computer assissted, the grade of students taught by contextual teaching, and the grade of students taught by conventional teaching in succession were classified as good, fairly good and medium on mathematical communication abilty. However, students taught by contextual teaching with computer assissted performed similar grade to students taught by contextual teaching on mathematical disposition, and both of them performed higher grade of conventional students.

School levels (high and medium) had significant role on attainning students' mathematical communication ability but previous mathematics ability tended to have inconsisstent role on on attainning the students' ability. There were no interaction between teaching approach and school level, between teaching approach and previous mathematics ability on mathematical communication and on mathematical disposition. Students performed positive mathematical disposition, where during the lesson and they performed enthusiastic, open minded, honest, unafraid to express their ideas, and respect to other. There was medium assosiation between mathematical communication and mathematical disposition.

Contextual teaching with or without computer assissted has a big opportunity for improving students' mathematical communication ability and mathematical disposition. Thus, to improve mathematical communication and disposition, teacher should select and adopt innovative teaching such as contextual teaching with or without computer assissted, problem based learning (Afgani, 2004, Dewanto, 2007, Dwiyanto, 2006, Herman, 2006, Juandi, 2008), computer aided instruction (Amalia 2006, Darminto, 2008, Herlan 2006, Kariadinata, 2006, Syamsuhuda, 2004,) and others successful approaches.

Among teaching approaches, students' previous mathematics ability, and school level variables, the eliciting activities-model teaching approach took the best role on improving mathematical communication and disposition, It could be predicted that the other innovative teaching would have similar role to the improvement of students' mathematical abilities. It means that teacher effort has the most important role compare to the other given variables on improving students' mathematical communication ability.

The study also recomended to conduct further study on other mathematical abilities such as mathematical reasoning, connection, critical and creative thinking and to create a self evaluation programming system for students so that they can observe their learning progress.

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