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in Mathematics

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Integration of Autograph in Improving Mathematical Problem Solving and Mathematical Connection Ability Using Cooperative Learning Think-Pair-Share

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Abstract. The aim of this study was to investigate students' mathematical problem solving and mathematical connection ability in cooperative learning setting using Dynamic Software Autograph. This experimental study was conducted at high school in learning statistics. The collection of the data was done using observation sheets, documentation, attitude scale, and performance tests. Repeated measure tests were delivered to students for four times. The result of the analysis showed that: (1) Using Dynamic Software Autograph in teaching learning statistics with cooperative learning Think-Pair-Share improved students' problem solving and mathematical connection ability; (2) Students' activity during teaching learning processes continuously improved; (3) The result of analysis of the questionnaire showed that most students like learning statistics using cooperative learning with dynamic software Autograph; (4) Students were very active and showed positive attitude toward learning using cooperative learning Think-Pair-Share using dynamic software Autograph.

Keywords : Dynamic Software Autograph, Cooperative Learning, Mathematical Problem Solving, Mathematical connection

1. INTRODUCTION

The rapid advancement of sciences and technology has brought about many changes, challenges, and competitiveness in how people learn and adapt themselves in the process of teaching and learning. Numerous studies have shown the positive impact of integrating technological tool in the teaching and learning process of mathematics in the classroom. But, in reality, there are numerous problems encountered in its implementation in the classrooms. To overcome these problems, mathematics educators should keep up with the teaching challenges by preparing not only themselves but also their students to improve their competitiveness. In this era of information and technology, they need to prepare, understand, and apply their knowledge and skills in the workplace. In fact, there are a number of potential benefits of using the computer as a tool for instruction in an educational setting. Firstly, technological tools help to support cognitive processes by reducing the memory load of a student and by encouraging awareness of the problem-solving process. Secondly, tools can share the cognitive load by reducing the time that students spend on computation. Thirdly, the tools allow students to engage in mathematics that would otherwise be out of reach, thereby stretching students' opportunities. Fourthly, tools support logical reasoning and hypothesis testing by allowing students to test conjectures easily (Kurz, Midleton & Yanik, 2005). Instructionally, computers allow for a record of problem-solving processes to be recorded and replayed as a window into children's thinking, computer also offer interactive learning in promoting students' high order thinking skills and showing them the role of Mathematics in interdisciplinary setting in objective to value the connections between Mathematics and other disciplines. Technology indeed has changed the way classrooms operate, integrating multimedia during learning, online accessibility thus making teaching and learning more interactive and participatory (Martin, 2006).

In educational practices, the use of technology in Indonesia is still in the initial stage. Although data on the actual use of technology in schools have never been comprehensively surveyed, the use of computer is primarily for administrative purposes. It has not yet been widely implemented as an integral part of teaching- learning mathematics at schools. The teaching-learning process is still being dominated by conventional teaching that emphases on practice in manipulating expressions and practicing algorithm as a precursor to solving problem. Due to these problems may, as has been extensively discussed in the Indonesia's newspaper, most teachers focus almost exclusively on teaching how to solve the specific mathematics most likely to be found in the national examination. Therefore, their approach doesn't even attempt to foster true understanding of the Mathematics concepts and developing thinking. Most of teachers used expository in Mathematics instruction, spent time for problem solving only 32% from all time in class, teachers talk more than students, almost of the test use routine-problem and not challenging for student, most of the teachers teach depending with the textbook, and do not have the skills to make a activities, good questions or tests.

Enhancing the ability of the students in mathematical problem solving and mathematical connection can be implemented by using technology such a dynamic software as a tool to help students link the concrete and the symbolic of mathematics. The use of dynamic software can make this easier. One of the dynamic softwares introduced in mathematics classroom is Autograph, that has features to help students solve problems in statistics. The "drag" and various "zoom" options can be used as appropriate to get a clearer picture to make students get more'visible' with the statistical results and the free interaction of students with the computer makes the learning could be more opportunities to do exploration and investigation in developing their thinking.

2. Integrating Technology in Mathematics Learning

Technology becomes a more prevalent part of education culture with each passing year. Schools cannot ignore the impact of technology and the changing face of curriculum. The calculators, computer, and other technologies are as important tools for generating discussions in the mathematics classroom. The technology principle in Principles and Standards for School Mathematics states that *"technology is essential in teaching and learning mathematics, it influences the mathematics that is taught and enhances students learning"* (NCTM, 1989: 24). Wright in Alexiou-Ray, Wilson, Wright & Peirano (2003) reports higher student achievement, self concept, attitude and teacher-student interaction as a result of interactive learning has made possible via technology. Kerrigan in Alexiou-Ray, et.al. (2003) also has found the benefit of using mathematics software and websites to include promoting students' high-order thinking skills, developing and maintaining their computational skills, introducing them to collection and analysis data, facilitating their algebraic and geometric thinking, and showing them the role of mathematics in a interdisciplinary setting.

Resnick (2001) stated that teachers should maintain that new technology changing not only what students should learn, but also what they can learn. This means that concepts and ideas that might have been accessible can now be experienced and understood in the context of learning with information and communication technology. Technology not only influences how mathematics is taught and learned but also affects what is taught where a topic appears in the curriculum.

Introducing Dynamic Software Autograph

Dynamic software is often employed as a fertile learning environment in which students can be actively engaged in constructing and exploring mathematical ideas (Cuoco & Goldenberg, 1996).

Autograph is a Dynamic Software for teaching mathematics such as calculus, algebra and coordinate geometry, Autograph is a dynamic and very versatile software for teaching and learning secondary mathematics developed by Douglas Butler (2005). It is designed to help students and teachers visualize mathematics at secondary/college level, using dynamically linked 'objects'.

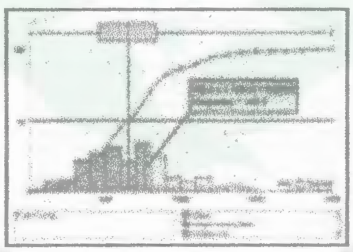

Figure 2. 1D for Statistics

Autograph leads the way in the use of dependent, selectable mathematics objects to help student get to grips with the principles of probability and statistics, coordinate geometry, in both 2D and 3D. Autograph is able to sketch curves (both implicitly and explicitly defined) solve simultaneous equations, plot derivatives, etc. Autograph is a new dynamic PC program operating in 3 modes, those are 1D for Statistics & Probability, 2D for

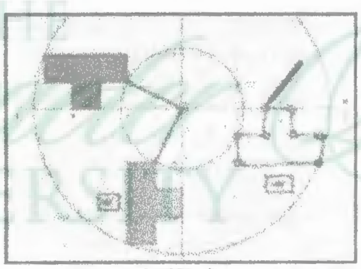

Figure 3. 2D Geometry

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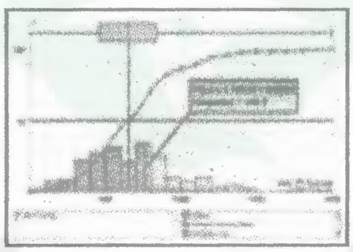

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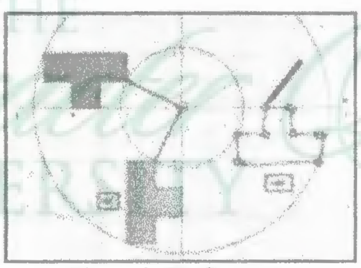

Figure 3. 2D Geometry

Graphing, Coordinates, Transformations and Bivariates Data and 3D for Graphing, Coordinates and Transformation in three dimensions.

Autograph has two levels of operation, '*standard*' and '*advanced*' operation. The 'standard' level has a greatly simplified interface and reduced set options for the user.

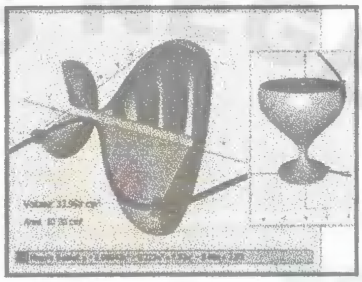

Figure 4. 3D Algebra

At the 'Advanced' level, more challenging problem and investigations can be explored. Autograph is the ideal solution for the instructor looking to bring mathematics to life. Whether through true-to-form animations or through student-driven exploration, its powerful features and point-and-click technology will engage all levels of students. By using technology, users can observe how functions, graphs, equations, and calculations work. It also enables users to change and animate graphs, shapes, and vectors already plotted to encourage understanding of concepts. In mathematics class the use of mathematical software enable students to visualize and further understand mathematical phenomenon in real life.

There is plenty of evidence now that teaching secondary and college level mathematics with dynamic software can be more effective, can be more efficient, and above all can be more enjoyable — for both teacher and student. Autograph leads the way in the use of dependent, selectable mathematical objects to help students come to grips with the basic principles of probability and statistics, and of coordinate geometry in both 2D and 3D.

The interactive features of Autograph allow students to become engaged in the mathematics through teacher-led lessons or in explorations where the answer are found by the students themselves. Teaching by integrating Autograph in schools might increase the effectiveness and the quality of teaching. As mathematics class needs lots of interaction, reasoning, observation the above view clearly indicates that interactive software like Autograph can be useful in teaching and learning mathematics effectively. Autograph "is an extremely useful educational tool for both mathematics teachers and students which help teachers to present the content for the whole class easily and students understand better due to its visual demonstration" (Tarmidzi, Ayub, Abubakar & Yunus, 2008:186).

The introduction of the computer into the school classroom has brought a new technique to teaching, the technique of simulation. In the context of teaching statistics, computer simulation enables students to generate data having the essential characteristic of variability and to follow processes run at a convenient speed which may be faster or slower than in the real instance. The student can now be placed in a decision-making role, a role in which he has to make statistical inferences based on data presented to him and then to take the appropriate actions. It is an essential feature of the interactive simulation that the next set of data generated and presented will depend on the student's previous decisions.

3. Mathematical Problem Solving and Mathematical Connection

Mathematical Problem Solving. Problem solving is an integral part of all mathematics learning. In everyday life and in the workplace, being able to solve problems can lead to great advantages. However, problem solving is not only a goal of learning mathematics, but it is also a major means of doing so. NCTM emphasizes that problem solving has a special importance in the study of mathematics. Furthermore, NCTM states that problem solving should underlie all aspects of mathematics teaching in order to give students experience of the power of mathematics in the world around them. The council sees problem solving as a vehicle for students to construct, evaluate and refine their own theories about mathematics and the theories of others. Unfortunately, from of all of the reform recommendations being made by the NCTM, making mathematical connections is among the more difficult to achieve, yet is so helpful in motivating students in the early grades. Mathematical connections can relate mathematical topics to students' daily lives and to other mathematical topics but are probably most important in relating mathematics to other curriculum areas. The NCTM standard stated two general types of connections, that is modeling connections between problem situations that may arise in the real world or in disciplines other than mathematics and their mathematical representations; and mathematical connections between two equivalent representations and between corresponding processes in each. Many countries emphasized the role of modeling and applications in mathematics education. It became a major objective that students should be able to apply mathematical problem-solving and reasoning skills and attitudes in real-life and scientific situations. It may be concluded that there is a strong relation between mathematical connection and the ability of the student to solving a problem.

Problem solving is one component of higher level thinking. To think effectively, students also need to develop their meta-cognitive skills of planning, monitoring and evaluating so they can plan, monitor and evaluate their academic work. Cooperative learning is an especially effective method of spontaneously activating meta-cognitive aspects of thinking, learning and problem solving.

Studies comparing cooperative learning with competitive and individualistic learning demonstrated that cooperative learning promotes higher achievement than the other two methods. Not only students solve problems more successfully and learn and retain concepts, but cooperative learning also results in more use of higher level thinking, more frequent discovery, generating new ideas and solution strategies, and more transfer of what is learned about problem solving in groups to individual problem solving situations (Johnson, Johnson & Holubec, 1994). These benefits are a result of students internalizing concepts and problem solving through their discussions and explanations of problem solving strategies and approaches with their peers. Giving explanations to other students requires deeper understanding than just putting an answer on a worksheet. Finally, many research found that cooperative group instruction shows significantly better results in mathematics achievement and problem solving skill.

Many studies in the field of educational technology have demonstrated how the personal computer assisted cooperative learning provides better results than traditional learning in a competitive, individualist setting. Personal computers are especially suited, among other roles, to that of initiating and sustaining cooperative and collaborative learning. Recent curriculum reforms suggest that students need to utilize distinct technological tools in their process of learning mathematics.

In this study, mathematical problem solving is defined as the ability of the students to use problem solving approaches to investigate and understand mathematical content, apply integrated mathematical problem-solving strategies to solve problems from within and outside mathematics, recognize and formulate problems from situations within and outside mathematics, and to apply the process of mathematical modeling to real world problem situation. All of this ability carried out with the following steps: (1) understanding the problem; (2) devising a plan for finding a solution; (3) implementing the plan; and (4) looking back at the answer.

Mathematical Connection. Mathematical Connections is the ability of the student to: (1) recognize equivalent representations of the same topics, (2) relate procedures in one representation to procedures in an equivalent representation, and (3) use and appreciate the connections between mathematics and other disciplines. The cooperative learning with the Think-Pair Share method can be describe with the activity of 2 students with one problem share their ideas or questions, each person speaks, listens and gives feedback, and then the students will asses individually.

Cooperative Learning Think-Pair-Share (TPS)

Cooperative learning Think-Pair-Share (TPS) was originally developed by Lyman (1981). Think-Pair-Share allows for students to contemplate a posed question or problem silently. The student may write down thoughts or simply just brainstorm in his or her head. When prompted, the students pair up with a peer and discuss his or her idea (s) and then listens to the ideas of his or her partner. Following pair dialogue, the teacher solicits responses from the whole group (Wikipedia).

The think-pair-share strategy is a cooperative learning technique that encourages individual participation and is applicable across all grade levels and class sizes. Students think through questions using three distinct steps: (1) Students think independently about the question that has been posed, forming ideas of their own and then may write some thoughts in response to the question.; (2) Students are grouped in pairs to discuss their thoughts and changing their ideas with others; (3) Students share their ideas with a larger group, such as the whole class to refine their ideas.

Some studies showed that students need many opportunities to talk in a linguistically rich environment. Researchers have found that students' learning is enhanced when they have many opportunities to elaborate on ideas through talk (Pressley 1992). The think, pair, share strategy increases the kinds of personal communications that are necessary for students to internally process, organize, and retain ideas (Pimm, 1987). In sharing their ideas, students take ownership of their learning and negotiate meanings rather than rely solely on the teacher's authority (Cobb et al. 1991). Additional benefits of using the Think-Pair-Share strategy include: (1) the positive changes in students' self-esteem that occur when they listen to one another and respect others' ideas; (2) Students have the opportunity to learn higher-level thinking skills from their peers, gain the extra time or prompting they may need; and (3) gain confidence when reporting ideas to the whole class. The think, pair, share strategy can be used in a variety of contexts. However, to be effective, students must consider a question or issue and they should derive some benefit from thinking about it further with partners, such as when there are multiple correct answers to a question.

4. METHOD

The purpose of this study was to investigate: (1) whether the implementation of the use of dynamic software Autograph in cooperative learning type think-pair-share can enhance students' mathematical problem solving and mathematical connections; (2) the level of enhancement in students' mathematical problem solving and mathematical connections with the implementation of the use of dynamic software Autograph in cooperative learning type think-pair-share; (3) the student activity during the use of dynamic software Autograph in cooperative learning think-pair-share; and (4) student perception toward the use of dynamic software Autograph in cooperative learning type think-pair-share.

The target population of the study was 188 students of Grade XI in 4 classes in a Senior High School, Medan Indonesia. One class of science was selected randomly from the 4 classes. The sample of this study was determined with random sampling technique, with the name of the class as object of the drawing. One class of 34 students was selected as a sample in this study consisted of 27% high, 50% medium and 23% low. The students in this study were taught and learned statistics and probability by cooperative learning Think-Pair-Share method using Autograph.

The design of this study was one group-within treatment design. A within-subjects design is an experiment in which the same group of subjects serves in more than one treatment. Three treatments were conducted to the students. Students were tested after 2, 4 and 6 treatments.
In this study, each student was provided with one computer installed with Autograph software. In this phase, the students were required to explore and be familiar with the software and its functions in learning statistics. In the second phase, students were introduced to the basic concept of Statistics topic followed by the` teaching and learning using the software. This phase involves instruction using the constructivist approach where students actively explore and discover concept of statistics using modular activity using Think-Pair-Share approach.

The instructional materials for this study consisted of four sets of 2-hour lesson plans for teaching and learning of Statistics. The lesson plan was developed based on the following topics: introduction to statistics, measure of central tendency: mean, median, mode, bar graph, line graph and circular graph. Modules were developed to enable the students to learn statistics using cooperative learning Think-Pair-Share helped with Autograph with variety of contexts in learning statistics. To be effective, the teacher encouraged students to consider a question or issue and they should derive some benefit from thinking about it further with partners, such as when there are multiple correct answers to a question.

Before the study, the instruments were pilot tested to obtain the reliability, validity and the difficult level of the test. These instruments then were administered by giving the pre-test and the treatments for 8 meetings. Prior to the data collection, the students were taught on how to launch and use Autograph, so that the students would be able to use Autograph in learning statistics. At the end of the treatment, pot test was administered and then the data was analyzed.

Before testing the hypotheses, the normality of the data of all the tests (mathematical problem solving and mathematical connection) was tested using *chi-square test.* After data analysis, it was found that all of the data were normally distributed. Testing the homogeneity of variance from the score of the pre-test and the post-test by using F-Test, it was found that the data were homogenous. Finally, ANOVA test was conducted to investigate the effect of using Autograph in enhancing the students' ability in mathematical problem solving and mathematical connections.

Two kinds of instruments were applied in this study, test and questionnaire. The test was used to measure the student's ability on the mathematical problem solving and mathematical connections. The questionnaire was used to find out students' perceptions on learning using dynamic software Autograph. The indicators of mathematical problem solving includes: using problem solving approaches to investigate and understand mathematical content; applying integrated mathematical problem solving strategies to solve problem from within and outside mathematics; recognizing and formulating problems from situations within and outside mathematics; and applying the process of mathematical modeling to real world problem situation. The indicators of mathematical connection: recognizing equivalent representations of the same topics; relating procedures in one representation to procedures in an equivalent representation; and using and appreciate the connections between mathematics and other disciplines. In evaluating the ability of mathematical problem solving and mathematical connections from the sample, analytic scoring rubrics was used in which the components of mathematical problem solving and mathematical connections were defined and scored separately based on the scoring purposes of these variables. These rubrics were divided into two folds, the scoring rubric for mathematical problem solving and mathematical connections. The questionnaire with five-point Likert Scale was used to investigate students' perception on the use of dynamic software Autograph. The observation sheets were used to know the student's activity during the learning process in using dynamic software Autograph in cooperative learning. The observation was conducted to observe the teaching learning process in the classroom and math lab. Three mathematics teachers acted as the observers.

Using Autograph 3.2 in Learning Basic Statistics

1. To launch Autograph, double click on the desktop Autograph 3.2 icon or you can launch Autograph from Start => Programs => Autograph 3.2

2. Select ADVANCED LEVEL from the Level Selector.

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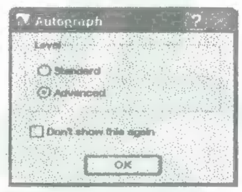
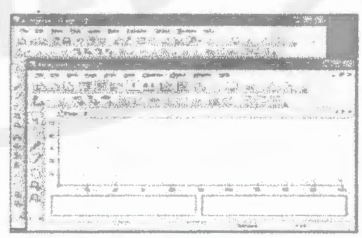
2	Select STANDARD OR **ADVANCED LEVEL** from the Level Selector	
4	The 1D Page : The Top Level Right Click MENU	
5	The **DATA KEY** (On the left) and the **OBJECT KEY** (on the right)	

<table>
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<td>

The Edit Grouped Data Set dialogue box

- with or without an underlying raw data set

CLASS INTERVALS - *choose one of the three options:*

♦ **Enter Min, Max and Class Width**

The convention adopted is **a ≤ x < b**. If the final value of the final class is needed tick

♦ **Integer Data**

Use this if the classes are all integers enter, e.g. Lotto frequencies

(1-49), or dice scores (1-6). Equivalent to a class width = 1.

DATA TYPE

♦ **Continuous:** classes will be plotted at

their exact value.

♦ **Discrete, by entered unit (e.g. 1):**

classes will be plotted shifted to the left

by the unit/2. Required for a Line Plot.

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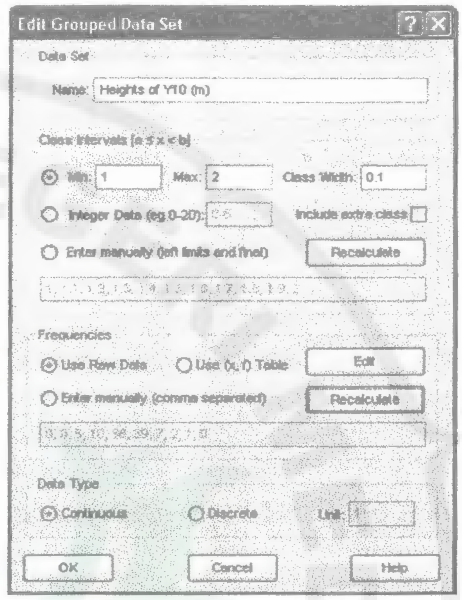

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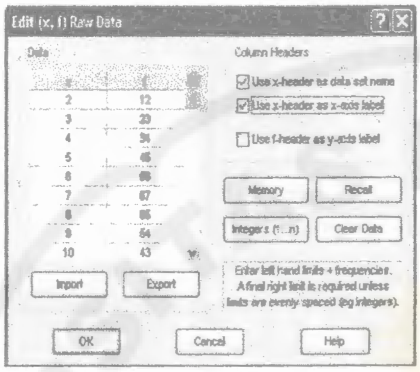


♦ **USE (x,f) TABLE**

This will enter classes and frequencies in column form. The 'x'column represents the start of each group, and the (optional) final value is the end of the last group.

These two columns can be pasted from a spreadsheet, and any text in the first row will become the column headers ("2-Dice scores" and "f" in the example). .

The headers can be edited (right-click option), and used as the data set name and x-axis label .

The Edit Raw Data Set dialogue box

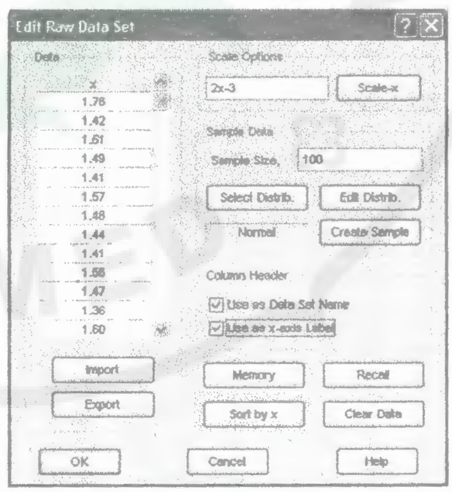
- can be grouped or remain ungrouped.

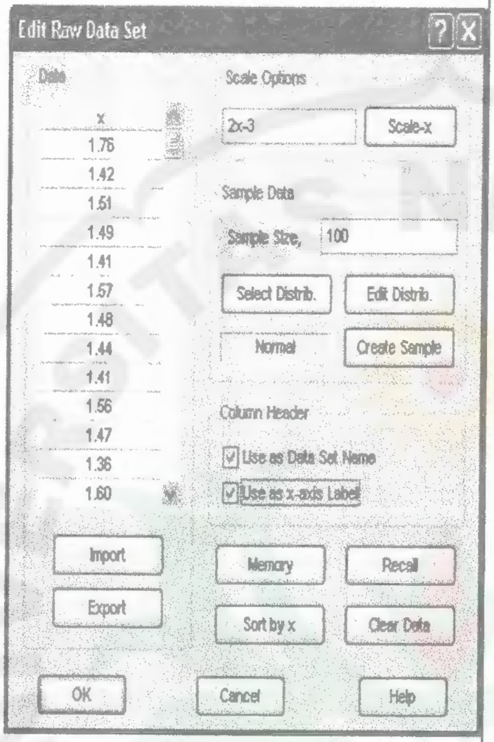
Either: Enter the data one at a time, separated by "Enter".

♦ Or: Click on the top cell and paste a single column of data from a spreadsheet. If the top row is text, this will be taken as the "column header".

♦ Or: use Import - Export

A single column of data can be imported from a saved CSV file (comma-separated value), which is compatible with Excel.





EDIT RAW DATA SET

♦ Either: **Enter** the data one at a time, separated by "Enter".

♦ Or: Click on the top cell and **paste a single column** of data from a spreadsheet. If the top row is text, this will be taken as the "column header".

♦ Or: use **Import - Export**

A single column of data can be imported from a saved CSV file (comma-separated value), which is compatible with Excel.

SCALE OPTIONS

Enter any f(x) formula here. Click "Scale-x" to scale the data.

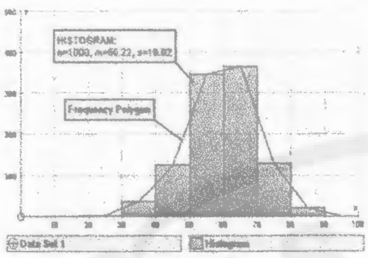
COLUMN HEADER

Use the header as the Data Set Name, and the x-axis label when plotted.

Use the right-click option to enter/edit the "column header".

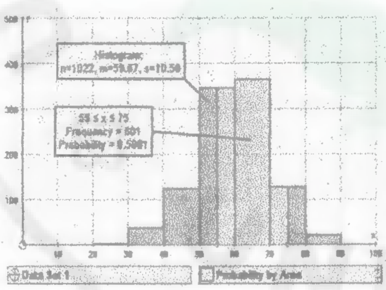
MANAGING THE RAW DATA

Use "**Memory**", "**Recall**", "**Clear Data**" and "**Sort by x**" as required.



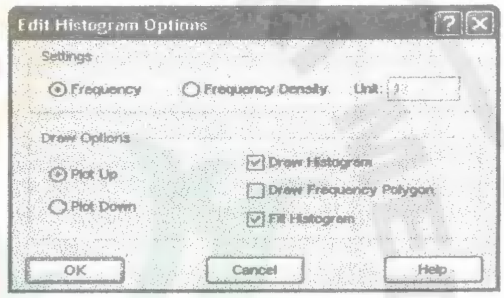
The Edit Raw Data Set dialogue box

- *can be grouped or remain ungrouped*



HISTOGRAM

A Histogram, plotting frequency or frequency density against 'x', can be created from any grouped data set (with or without underlying raw data).



Histogram "Probability by Area" calculation

In this example: the probability and frequency for the range $55 \le x \le 75$ are given. The yellow 'diamonds' can be dragged to vary the range dynamically.

5. RESULTS AND DISCUSSION

RESULTS

Pre-test. The data analyzed in this study were on students' mathematical problem solving and mathematical connection ability after using dynamic software Autograph. Students' activities and attitudes toward the teaching learning approach are also analyzed. The result of the pre-test was used to know the students' prior ability with the purpose to group students into high and low groups. The results of the pre-test of the groups are shown in Table below.

The results showed that the average scores and standard deviation of the pretests on math problem solving and math connection are 74 (9.19) and 66 (10.81) with the lowest scores 55 and the highest 84 for math problem solving, and the lowest score of 42 and the highest score 92 for math connection.

Tabel 1. Pretest score of Math Problem Solving and Math Connection

Pretest	Group	N	Min	Max	Mean	Sd
PM	1 (upper)	17	75	84	80.94	3.07
	2 (lower)	17	55	77	66.12	6.65
	Total	34	55	84	74.00	9.19
KM	1 (upper)	17	92	76	80.0	5.35
	2 (lower)	17	42	75	62.24	9.46
	Total	34	42	92	66.00	10.81

***Scores After Treatment*.** The results of analysis of the data on the second, the fourth and the sixth instructions on mathematical problem solving and mathematical connection are shown in Table 2 below.

Mathematical Problem Solving. Results of data analysis on student's problem solving ability in Table 2 shows that the average score of the upper level and the lower level students are increased. After 2, 4, and 6 times instructions the average scores on problem solving ability were increased from 82 to 84 and to 86 for upper level, while the average score on problem solving ability of students at the lower level are also increased from 70 to 75 and 79 on the 2nd, 4th, and 6th instruction.

Tabel 2. Data on Average Scores of Math Problem Solving and Math Connection

Instruction	Group	Math Problem Solving		Math Connection		
		Mean	Sd	Mean	Sd	N
2 times	Upper	82	3.25	76	10.16	17
	Lower	70	6.64	65	5.54	17
	Total	76	7.82	70	9.88	34
4 times	Upper	84	5.09	78	9.75	17
	Lower	75	6.95	69	7.07	17
	Total	80	7.47	74	9.51	34
6 times	Upper	86	4.22	80	7.25	17
	Lower	79	6.54	75	6.89	17
	Total	82	5.73	78	7.32	34

Hypotheses testing using test statistics parametric t-test was used to test the differences between the average scores on mathematical problem solving ability after 2, 4, 6 times of instructions with level of significant $\alpha = 0,05$ (two-tail test). The results showed that the use of Autograph keep increasing the students' math problem solving ability after 2, 4, and 6 times of instructions.

Mathematical Connection. Results of data analysis on student's mathematical connection in Table 2 shows that average score for the upper level and lower level students are increased. After 2, 4, and 6 times instructions the average scores was increased from 76, to 78, and to 80 for upper level, while the average score of students at the lower level are also increased from 65 to 69 and 75 on the 2nd, 4th, and 6th instruction. Hypotheses testing using test statistic parametric t-test was used to test the differences between the average scores on mathematical connection ability after 2, 4, 6 times of instructions with level of significant $\alpha = 0,05$ (two-tail test). The results showed that the use of Autograph keep increasing the students' mathematical connection.

6. DISCUSSION

The data collected from this study was analyzed to obtain an interpretation that can answer the research questions which described in the introductory section. The data included the score of the students in the tests, the observations and questionnaire results. From the results of all the tests, it can be concluded that the mean of students' mathematical problem solving in the treatment 1 which the implementation dynamic software just for presentation board for the teacher have no significantly difference with the mean of students' mathematical problem solving in treatment2 in which the implementation of the dynamic software Autograph was just used when the students work in pairing in the Think-Pair-Share setting. The significant difference occurred when the implementation of the dynamic software was involved in all of time during mathematical learning from treatment 1 to treatment 2 and treatment 3.

The effect of Treatment 3 was indicated by the students' mastery in learning. Before the mathematics learning by using the dynamic software Autograph, the students' mastery that passed the MCC (Minimum Competency Criteria) was only 44% or 13 among the 34 of students, and most of the students who passed the MCC were in the 'adequate' level. After the treatment 3 that is learning by using the dynamic software Autograph in all of times during the learning process, the students who passed the MCC was increase to 85,2 %, and most of the students were in the 'good' level. The enhancement in students mastery was about 41,2 % , and the number of the students who passed the MCC was twice of the number of students before.

From the results of the tests toward the students' mathematical connection, it could be concluded that the mean of students' mathematical connections in the treatment 1 in the implementation of the dynamic software just for presentation board for the teacher, there was no significant difference with the mean score of students' mathematical connections in treatment2 which the implementation of the dynamic software Autograph just use when the students are pairing in the Think-Pair-Share setting. The significant difference occurred when the implementation of the dynamic software was involved in all of time during mathematics learning.

The students' mathematical connections ability after the treatment 3 was greater than those of treatment 2, and greater than those of treatment 1 when the dynamic software autograph just used to presentation the subject matter by the teacher. The greatest effect was found for students' mathematical connections, with the implementation of the dynamic software in cooperative learning type think-pair-share when the use of the dynamic software autograph was involved in all times of mathematics learning.

The students' perception on the use of dynamic software Autograph related to the students' ability in Mathematical Problem Solving and Mathematical Connection indicated that most of the students answered Strongly Agree (SS) and Agree (S) for positive questions. In the other hand, answered were Disagree (TS) and Strongly Disagree (STS) for the negative question. The summary of the results are: (1) most of the students (88.62%) like to study mathematics; (2) most of the students (85%) want to learn mathematics seriously; (3) most of the students (88%) like the cooperative learning type Think-Pair-Share; (4) most of the students (93.21%) argued that the cooperative learning type Think-Pair-Share was useful in the mathematics learning; (5) most of the students like working with the Student's Worksheets and the manual book of Autograph; (6) most of the students like the dynamic software Autograph; (7) all of the students like to use the dynamic software Autograph in learning mathematics.

From the analysis of the observation sheets, it can be concluded that the student were in good activity during the mathematical learning with dynamic software Autograph (3.995 in scale of 5 or 79.95% in percentage). The lowest percentage was shown when the student asked to formulate thoughts and ideas and in writing their ideas as necessary to prepare for sharing with a partner was 73%. The highest percentage (88%) occurred when the students reading the Student's Worksheets in the core activity. During the introduction, the highest percentage (87%) was shown when the students listened about the aim of the subject of learning. The activity when the students listened to the motivation given by the teacher and answered the teacher's questions about the apperception have the same percentage, that is 78%. In the core activity, the lowest percentage was also the lowest percentage for these observations when the students formulating the thoughts and ideas, writing down ideas that is necessary to prepare for sharing with their partners. In the closing section, participation for making summary and conclusion was 87% and listening to the brief explanation for further subject was 75%.

7. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Based upon the findings derived from the data analysis of the investigation, the observation and questionnaire, it could be concluded that: (1) The cooperative learning type Think-Pair-Share with the use of the dynamic software Autograph enhanced the students' Mathematical

Problem Solving and Mathematical Connections; (2) The enhancements of the students' mathematical problem solving and mathematical connections with the use of dynamic software Autograph in cooperative learning type Think-pair-Share were shown by the students' mastery and the students' activity during learning processes; (3) With the use of dynamics software Autograph in cooperative learning type Think-Pair-Share, the students were more active and they did activities in better level; and (4) The students have a good perception about the use of the dynamic software Autograph in cooperative learning type Think-Pair-Share.

RECOMMENDATIONS

Based on the results of the study, it is suggested that (1) teacher can apply this learning model as an alternative in mathematics learning; (2) teacher has to carefully examined the components of a real-world mathematics instruction to assess their usefulness with other disciplines, as well as within mathematics; (3) the dynamic software Autograph can be used in mathematics instruction as a tool that helps students in learning and helps the teachers provide more active and enjoyable mathematics classroom environment (4) teachers need to be aware of the advantages and disadvantages of using this software in the subject-matter. Further study can be conducted with more populations and different mathematics topics.

REFERENCES

Alexiou-Ray, J.A., Wilson, E., Wright, V.H., Peirano, A.M. *Changing Instructional Practice: The Impact of Technology Integration on Students, Parents, and School Personnel.* Retrieved May 12, 2009 from: http://ejite.isu.edu/Volume2No2/AlexRay.htm

Butler, D & Hatsel, M. (2007). Autograph 3. *Getting Going with Autograph 3.* Eastmond Publishing Ltd, UK.

Cobb, P., Wood, T. and Yackel, E. 1991. 'A constructivist approach to second grade mathematics'. In von Glaserfield, E. (Ed.), *Radical Constructivism in Mathematics Education*, pp. 157-176. Dordrecht, The Netherlands: Kluwer Academic Publishers.

Cuoco, A., Goldenberg, E.P., & Mark, J. 1996. Habits of Mind: an organizing principal for a mathematics curriculum. *Journal of Mathematical Behaviour*, 15 (4), 375-402., retrieved on April, 21, 2009 from www.math.utep.edu/faculty/kienlin

Johnson, D.W., Johnson, R.T. & Holubec, E.J. 1994. *Cooperative Learning in the Classroom.* VA: Association for Supervision and Curriculum Development.

Kurz, T. L., Middleton, J. A., & Yanik, H. B. 2005. A taxonomy of software for mathematics instruction. *Contemporary Issues in Technology and Teacher Education.* [Online serial], *5*(2). Retrieved March 21, 2009. From: http://www.citejournal.org/vol5/iss2/mathematics/article1.cfm.

Lyman, F.T. 1981. The responsive classroom discussion: The inclusion of all students. In Mainstreaming Digest, ed. A. Anderson, 109-113. College Park: University of Maryland Press.

Martin, H. 2006. *Making Math Connection*: Using Real World Application with Middle School Students. Corwin Press.

National Council of Teachers of Mathematics. 1989. *Curriculum and Evaluation Standard for School Mathematics.* Reston, VA : NCTM.

National Council of Teachers of Mathematics. 1991. *Professional Standar for Teaching Mathematics.* Reston, VA : NCTM.

Pimm, D. (1987). *Speaking mathematically: Communication in mathematics classrooms.*London: Routledge Kegan & Paul.

Pressley, M., et. al. 1992. Encouraging mindful use of prior knowledge: Attempting to construct explanatory answers facilitates learning. *Educational Psychologist, 27*(1), 91–109.

Resnick, L.B., & Ford, W. W. 1981. *Psychology of Mathematics for Instruction.* Hillsdale, NJ. Lawrence Erlbaum.

Tarmidzi, Rohani A., Mohd. Ayub, Ahmad F., Abu Bakar, Kamariah, & Md. Yunus, Aida S., (2008). Instructional Efficiency Of Utilization Of Autograph Technology Vs Handheld Graphing Calculator In Learning Algebra. *International Journal of Education And Information Technologies*. 3(2).