The Enhancement of Mathematical Reasoning Ability of Senior High School Students Through Generative Learning in Riau Indonesia

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Abstract. In Generative Learning (GL), students are more active and can markedly improve mathematics learning outcomes, however in general it has not been realized as a whole. This study aims to achieve and enhance Mathematical Reasoning Ability (MRA) of Senior High School Students through GL. The school samples consist of three subdistricts in Riau i.e. Tebing Tinggi (low sago production) SMAN-1 Selat Panjang; Merbau (medium sago production) SMAN-1 Merbau; Tebing Tinggi Timur (high sago production) SMAN-4 Sei Tohor. In conventional learning (CL) of class sample and GL are conducted pretest and postest. Data collection is done by lessonplan, student worksheets, media, syllaby, MRA test, and observation sheets. Data are analyzed by using Mann Whitney, t-test, two-way ANOVA. Research results: the achievement of MRA of students through GL is greater than that CL (high: 8.08 > 5.86; medium: 8.43 > 6.09; low: 9.75 > 6.76); in summary (8.83 > 6.27). The enhancement of MRA of students through GL is greater than that CL (high: 0.65 > 0.46; medium: 0.68 > 0.48; low: 0.80 > 0.52); in summary (0.72 > 0.49) for each region. GL markedly enhance of MRA of students.

Keywords: MRA; GL; Enhancement; Sagu Plantation Region.

1. Introduction

Mathematical Reasoning Ability (MRA) is one of the competencies that must be achieved by students in learning mathematics from elementary through senior high school [1]. This is because through mathematical reasoning, students be able to: draw logical conclusions; provide an explanation of the models, pictures, facts, attributes, relationships, or patterns exist; estimate the answers and solution; using pattern of relationships to analyze the situation, or make an analogy, generalization, and formulate a conjecture; ask the opposite example; follow the rules of inference, checking the validity of the argument, prove, and draw up a valid argument; and arrange direct evidence, indirect proof and proof by induction [2].

Mathematical reasoning is an important part in mathematics, because of through mathematical reasoning students can solve mathematical problems. In addition, the topics of mathematics and mathematical reasoning are inter-related and can not be separated, because the topics of mathematics are understood through reasoning and mathematical reasoning is understood and practiced through learning mathematics [3]. Likewise [4] stated that a major characteristics of mathematical reasoning can not be separated from the activities of studying and developing mathematics or solve a mathematical problem.

Noting the importance of MRA of students in learning mathematics, than MRA of students should be achieved and enhanced through the efforts of learning approaches that can provide
opportunities and encourage students to exercise of MRA of students. One effort to enhance of MRA of student is through generative learning (GL). This is because the measures contained in GL can make students learn to become active in constructing knowledge and can enhance of MRA of students. Additionally, in GL students are given the opportunity to practice expressing ideas or ideas, with variations, such as through drawing, writing or mathematical models [5]; and teacher act more as a facilitator and mediator.

Province of Riau has an area of 111,228.65 km$^2$ consist of islands and the sea is divided into 12 districts/cities, have natural resources, including sago (Metroxylon sp). Sago is one commodity specific food security contained in Meranti Islands Regency and Bengkalis. Plantation area which is identical to the countryside, is one of the development areas of education development that can not escape learning innovations; one of which is GL. In Riau province, commodity sago (Metroxylon sp) is a plantation commodities other than coconut, rubber, oil palm, coffee, areca with an area of sago palm in Meranti islands reaches 44.67 ha [6], i.e. 2.98% of national sago plant area. This indicates that the economy of the countryside district dominated Meranti Islands of sago products.

Meranti Islands District is a regional extension of Bengkalis district with an area of 3707.84 km$^2$, consists of 9 subdistricts. In 2012, the district have 18 public senior high school and 21 private senior high school [7]. This is describes that the district government Meranti Islands is very concerned with education development. Education greatly influence successful or unsuccessful of development of a nation, the more advanced education, means that will positively impact the future of various areas of life; Similarly with mathematics education concerning of MRA.

The results show that MRA of high school students can be enhanced through GL on topic systems of linear equations and inequalities one variable [8]. From observation in the field, i.e: in Meranti Islands District that in general activity of learning mathematics is still dominated by teacher (conventional learning). This indicates that GL has not been properly socialized. For it has done research: The Enhancement of Mathematical Reasoning Ability of Senior High School Students Through Generative Learning in Riau, Indonesia.

Based on the background that have been described, the formulation of the problem in this research are as follows.

a. How the achievement of MRA of students who obtain GL compared to students who obtain CL; be reviewed of sago production region (high, medium, and low) in Meranti Islands District?

b. How the enhancement students of MRA who obtain GL compared to students who obtain CL; be reviewed of sago production region (high, medium, and low) in Meranti Islands District?

From the formulation of the problem, then the objectives to be achieved in this research, i.e: to achieve and enhance of MRA of students who obtain GL; with the outcome, i.e: the achievement and enhancement of MRA of students through GL.

2. Literature Review

2.1. Mathematical Reasoning

The term reasoning as a translation of the reasoning is defined as the process of reaching logical conclusions based on the facts and the relevant source [9]. According [10]; reasoning is a thought process that is done by drawing conclusions. The general conclusions can be drawn from the cases are individual, but can also be the opposite, of things that are common to the individual cases.

MRA is used in this study were (1) ability to express the problem situation by using pictures and facts in solving problems; (2) the ability to solve problem situation by following logical arguments; and (3) the ability to solve problem situations by following arguments logical and draw logical conclusions from the settlement obtained.
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2.2. Generative Learning (GL)

GL is learning that emphasizes active students in constructing knowledge. [5] states that measures GL consists of five phases, i.e: the orientation phase; the disclosure of ideas phase; challenges and restructuring; implementation phase; and the looking back phase.

3. Material and Methodology

This study is quasi-experimental research control group design with pretest and postest, which is described as follows.

\[
\begin{array}{ccc}
O & X & O \\
O & O & [11]
\end{array}
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In the implementation are used three school in Sago Plantation Region, i.e: high sago region in SMAN-4 Sei Tohor, Tebing Tinggi Timur Subdistrict; medium sago region in SMAN-1 Merbau, Merbau Subdistrict; and low sago region in SMAN-1 Selat Panjang, Tebing Tinggi Subdistrict. Determination of numbers of schools in purpose sampling, i.e: which is based on several considerations: qualification of school, the mileage to the location of the school, the readiness of schools and information from relevant agencies. From each school be selected two classes; one class for experiment and another class for the control. Experiment class was given special treatment (X), i.e: generative learning, while the control class was not given special treatment. Each study class was given pretest and postest (O) to measure of MRA of students. Score pretest and postest results are research data used to test hypothesis which proposed.

Sample locations are determined purposive sampling, i.e: which is based on consideration of the amount of sago production in Meranti Islands District and information from keyinformers are classified into three region: high sago production region, medium sago production region and low sago production region the academic year 2014/2015 in odd semester. Determination of class sample are based stratified sampling. In high sago region, school of research place: SMAN-4 Sei Tohor, with students of class X-IIS-2 as experimental group (24 students) and students of class X-IIS-1 as control group (25 students). The medium sago region, in SMAN-1 Merbau with students of class X-MIA-3 as experimental group (29 students) and students of class X-MIA-2 as the control group (28 students). The low sago region, in SMAN-1 Selat Panjang with students of class X-MIA-2 as experimental groups (32 students) and students of class X-MIA-1 as the control group (31 students).

Collection of data and information are used of materials: learning device (Lessonplan, Student worksheets, media, syllaby); and instruments of learning (MRA tests, observation sheet of activities of teachers and students). Before conducting the experiment, the devices and instruments of learning (research) validated and trialled.

To obtain the data in this study, a test instrumen was used for measuring of MRA of students before and after learning process. The test conceived and developed are based on instrument procedures which are good and true. Before it is used, the test is first validated and trialled. After the tests were trialled then the tests were computed instrument reliability and validity of terms. The results of calculation of the reliability and validity of 6 items MRA test (0.81; high, $\alpha = 0.05; N = 40; r_{table} = 0.31$); gained 4 items MRA which was declared as valid (just 3 items test are used because there is a material change conform with the curriculum by 2013). Thus, the MRA test can be used for research.

<table>
<thead>
<tr>
<th>Table 1.1. Classification Gain (g) according Hake</th>
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</thead>
<tbody>
<tr>
<td>The magnitude of $g$</td>
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<tr>
<td>---------------------</td>
</tr>
<tr>
<td>$g &gt; 0.7$</td>
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<tr>
<td>$0.3 &lt; g \leq 0.7$</td>
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<td>$g \leq 0.3$</td>
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Data were analyzed using the Kolmogorov-Smirnov test, Mann Whitney U test, Levene test, t-test (equal variances assumed), two-way ANOVA [12]; and normalized gain formula (N-
Gain, i.e: $g = \frac{postest \ score \ - \ pretest \ score}{ideal \ maximum \ score \ - \ pretest \ score}$ [13]; the results were interpreted based on the classification [14]; to determine the magnitude of enhancement average of MRA of students.

4. Results and Discussion

4.1. Pretest of Mathematical Reasoning Ability of Students

Before the treatment is done, the first conducted initial tests (pretest) in each region of research, both experiment class and control class to obtain data on the ability of students to the initial the learning material. From the result of pretest obtained that the average pretest of MRA of students class experiment and class control in sago plantation region (high, medium, and low); not much different (relatively equal); for details, presented in Diagram 1.1.

**Diagram 1.1:** The average pretest of MRA in each of research region, Meranti Islands Regency, 2014

Remarks: Pre_GL is the average pretest of experiment class
Pre_CL is the average pretest of control class

Diagram 1.1 show that the average pretest of MRA of students in high sago plantation region (SMAN-4 Sei Tohor) in the experiment class (0.71) relatively the same as the control class (0.70); and in the medium sago region (SMAN-1 Merbau) in the experiment class (0.69) is relatively the same as the control class (0.68); thus also in low sago plantation region (SMAN-1 Selat Panjang) for the experiment class (0.98) is relatively the same as the control class (0.97). On the whole in sago plantations region (high, medium, and low); both experiment and control class is the same (0.79). This indicates that the prior knowledge of students in experiment class and control class for each school sample are the same, so that the conduct of research in SMAN-4 Sei Tohor; SMAN-1 Merbau; and SMAN-1 Selat Panjang were statistically worth doing.

**Diagram 1.2:** The Average Postest of MRA of Students Experiment and Control Class

Each Research Region, Meranti Island District, 2014.

Remarks: Post-GL is the average postest of experiment class
Post-CL is the average postest of control class
4.2. The Achievement of Mathematical Reasoning Ability of Students

The result of analysis toward achievement (postest) of MRA of students each research location in groups of learning (GL and CL), obtained that the average achievement of MRA of students who receive GL is higher compared to average achievement of MRA of students who receive CL; for the details, shown in Diagram 1.2.

Diagram 1.2 show that in plantation region: high sago (SMAN-4 Sei Tohor) obtained the average achievement of MRA of students who receive GL (8.08) is higher compared to average achievement of MRA of students who receive CL (5.86); medium sago (SMAN-1 Merbau) obtained the average achievement of MRA of students who receive GL (8.43) is higher compared to average achievement of MRA of students who receive CL (6.09); and in low sago plantation region (SMAN-1 Selat Panjang) obtained the average achievement of MRA of students who receive GL (9.75) is higher compared to average achievement of MRA of students who receive CL (6.76). In summary in sago plantations region (high, medium, and low); obtained the average achievement of MRA of students who receive GL (8.83) is higher compared to average achievement of MRA of students who receive CL (6.27).

Diagram 1.2 also shows that in the plantation region: high sago, the average of scores achievement of MRA of students who receive GL is higher (2.22) compared to average achievement of MRA of students who receive CL; medium sago, average achievement of MRA of students who receive GL, is higher (2.34) compared to average achievement of MRA of students who receive CL; and in low sago plantation region, obtained the average achievement of MRA of students who receive GL (2.99) is higher compared to average achievement of MRA of students who receive CL. In summary in sago plantations region (high, medium, and low); the average of scores achievement of MRA of students who receive GL is higher (2.56) compared to average achievement of MRA of students who receive CL. In low sago plantation region have the average difference of achievement of MRA of students is higher compared to average achievement of MRA of students in high and medium sago plantation region. Difference average achievement of MRA of students in high and medium sago plantation region had average achievement that is almost comparable. For that of Diagram 1.2 can be concluded that the average achievement of MRA of students positively correlated with the condition of agroekosistem. This is in line with the data and information obtained and observed directly in the field; generally in high and medium sago plantation region; students participated in economic activities the family by working as wage labor in the cultivation of sago, whereas in low sago plantation region; students more access to use the time to learn.

![Diagram 1.3](http://www.estech.org)

**Diagram 1.3:** The Average Enhancement of MRA of Students in Sago Plantation Region, Meranti Island District, 2014

Remarks: N-Gain-GL is the average enhancement of MRA of students through GL.
N-Gain-CL is the average enhancement of MRA of students through CL.
4.3. The Enhancement of MRA of Students

The result of analysis toward enhancement (N-Gain) of MRA of students obtained that the average enhancement of MRA of students through GL in high sago plantation region of 0.65; medium of 0.68; low of 0.80; in summary of 0.72 and through CL in high sago plantation region of 0.46; medium of 0.48; low of 0.52; and in summary of 0.49; for the details, shown in Diagram 1.3.

Diagram 1.3 shows that the average enhancement (N-Gain) of MRA of students in high sago plantation region through GL and CL are low than the average enhancement of MRA of students in medium and low sago plantations region. This indicates that the homogeneity of tribes and agroekosistem of sago plantations are negatively correlated toward enhancement of MRA of students, where the results of observations and data obtained from the field that in high sago agroekosistem region, medium and low; the average enhancement of MRA of students through GL is higher compared to the average enhancement of MRA of students through CL; its meaning through GL can enhance of MRA of students.

5. Conclusion and Recommendations

Based on the results and discussion, we can conclude that the achievement and enhancement of mathematical reasoning ability of students who receive generative learning is higher compared to the achievement and enhancement of mathematical reasoning ability of students who receive convensional learning, be reviewed of sago plantation region (high, medium, and low) in Meranti Island District.

Based on Hake criteria (1999); the enhancement of mathematical reasoning ability of students in low sago plantation region through generative learning are classified high, whereas in high and medium sago plantation region however in summary; both through generative learnig nor convensional learning are classified medium.

It is recommended to mathematics teachers and key informen in order that generative learning can be used as an alternative of learning, because the learning is significantly enhance of mathematical reasoning ability of students; especially on the topic system of linear quations in two and three variables, and generally on the topic that containing story problem relating to everyday life that are contextual in nature.

References

[10] Rusminin., “Meningkatkan Kemampuan Penalaran dan Komunikasi Matematis Siswa SMP Melalui Pendekatan Pembelajaran Kontekstual Berbantuan Program Cabri Geometry II (Studi
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