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PBL BASED ON HUMANISTIC AND CONSTRUCTIVIST IN ORDER TO IMPROVE MATHEMATICS LITERACY CAPABILITY AND STUDENTS' CHARACTERS

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ABSTRACT

Mathematics literacy is an individual capacity to formulate, to employ, and to interpret mathematics in various contexts of daily life. This study is an R&D which aims to develop valid and practical learning devices of PBL based on humanistic and consructivist in order to effectively improve mathematics literacy capability and students'characters. The learning devices includes: syllabus, lesson plans, student worksheet, student book, and PISA-adapted test of mathematics literacy. The development model follows the Plomp model: initial investigation, design, construction, test, evaluation, and revision. The learning devices testing was done in grade VII of SMP 1 Kudus by using non-randomized pretest-posttest control group design. The result suggests that: the learning devices are considered valid by referring that the experts' judgement considered that the learning devices are very good. The learning devices are considered practical by referring the positive response of the students and teacher, as well as the teacher's capability to organize learning was in high category. The learning is considered effective in improving students' mathematics literacy.

Key Word: characters, humanistic-constructivist, mathematics literacy, PBL

INTRODUCTION

Assessment of mathematics achievement at the international level is an important indicator for the evaluation referred to in the education of a country (Yaclin, et al., 2012). Survey Trends International Mathematics and Science Study (TIMSS) in 2007 stated that Indonesia ranks 36 of 49 countries with the score still below the average of ASEAN. In the TIMSS 2011, 8th grade students' scores Indonesia ranks 38 of 42 countries with a score of 386, down 11 points from 2007 (Mullis, et al., 2012: 56). Study Programme for International Student Assessment (PISA), which measures the ability of 15 year olds in reading literacy, mathematics, and science, in 2012, in 2003 ranked Indonesia 39th out of 40 countries. PISA results in the next year are also not encouraging. In 2009, mathematical literacy scores of students Indonesia ranks 61 out of 65 participating countries. While the latest PISA results, in 2012, Indonesia was ranked 64 out of 65 survey participants countries (OECD, 2013a).

The PISA results reflect the ability of Indonesian students aged Junior High School in formulating, implementing, and interpreting mathematical phenomena in a variety of contexts are far below the average of OECD countries (OECD, 2013a). Stacey (2010) revealed that 76.7% of Indonesian students are under level 2. Students with a capacity of level 2 are able to use basic algorithms and mathematical context recognize that only requires the direct inference. Thus, the ability of students in Indonesia was not even able to implement basic algorithms and interpretation of the results of mathematical calculations in the context of the problems faced.

In an effort to improve the quality of education in Indonesia, teaching in schools is now more focused on learning using the constructivist approach, in which the teacher is not as key informants, but to guide and help students construct knowledge. In learning teacher must create activities that can build knowledge of learners. Based on the constructivist theory of knowledge is constructed through the perception and action. Students construct new knowledge by seeing, hearing, touch, feel and act through the formation process of perception and action in communication. Teaching math is generally dominated by the introduction of formulas and concepts verbally, without enough attention to the students' understanding. In addition, the learning process is almost always take place with the lecture method mechanistic, the teacher becomes the center of all activities in the classroom. Students listen, copy or imitate exactly the

same way the teacher without the initiative. Students are not allowed or encouraged to optimize his potential, develop reasoning and creativity.

Based on the results of Ohnemus (2013) found that the development of PISA math models have a potential effect on the ability of students' mathematical problem solving. Mathematical literacy as the aggregate of individual mathematical skills and knowledge that allows individuals to get involved and make an assessment of scientific mathematics in overcoming permsalahan in society. According to Haglund (2004), humanistic is one of the most promising approaches to improving mathematics education at all levels. The role of teachers in a humanistic learning is to be a facilitator for the students, providing motivation, awareness of the significance of learning in students' lives. Ojose (2011) explains that many factors explain a person's literacy. Mathematics content taught in schools should reflect the relevance to society.

Preliminary studies conducted by researchers at SMP 1 Kudus shows that teachers are still difficulties in implementing various innovative learning models and still implement a teacher-centered learning. Though the curriculum 2013 to encourage teachers to apply scientific approach to learning, one through Problem Based Learning (PBL). PBL is a learning model that presents a contextual problem that stimulates learners to learn. In classes that implement problem-based learning, students work in teams to solve real-world problems. PBL which has the characteristics of a student-centered (Savery, 2006), designed based on the real problems that the open-ended or ambiguous (Hillman, 2003), and encourages students to build a rich understanding of the mathematical concept of contextual through a series of questions that are constructive (Savery & Duffy, 1995). PBL excellence are: (1) PBL facilitates meaningful learning by encouraging students to solve a problem dealing with a situation in which the concept is applied; (2) students to integrate knowledge and skills simultaneously and applying it in a context that is relevant in situations of PBL; (3) PBL can improve the ability of critical thinking, foster students' initiative participants in the work, internal motivation to learn, and can develop interpersonal relationships in the working group. Padmavathy (2013) in his research concluded that PBL learning model is more effective in learning mathematics. By adopting this model in teaching, teachers can create creative thinkers, decision makers are critical, and a problem solver that is needed in the competitive world.

According to the observations of researcher and the discussions on the MGMP forum, math teachers only tend to apply the conventional assessment, ie oriented to understanding the concept. Problems that according to the teachers is a matter of solving the problem is basically just a matter of story that only requires students to substitute what is known in the formula that had them memorized. It is quite far from the intended spirit of solving problems in mathematics. In this study, researchers apply PBL in shades of humanistic and constructivist approach. The purpose of this study was to develop a device based humanistic constructivist math learning with PBL models which are valid and practical to improve the literacy skills of mathematics junior high school students effectively.

Mathematics Literacy

Mathematical literacy (OECD, 2013) is concerned with the ability of students to analyse, reason, and communicate ideas effectively as they pose, formulate, solve, and interpret solutions to mathematical problems in a variety of situations.

The PISA mathematics assessment has, so far, been designed in relation to the:

1. Processes: These are defined in terms of three categories (formulating situations mathematically; employing mathematical concepts, facts, procedures and reasoning; and interpreting, apply and evaluating mathematical outcomes – referred to in abbreviated form as formulate, employ and interpret) and describe what individuals do to connect the context of a problem with the mathematics and thus solve the problem. These three processes each draw on the seven fundamental mathematical capabilities (communication; mathematising; representation; reasoning and argument; devising strategies for solving problems; using symbolic, formal and technical language and operations; using mathematical tools) which in turn draw on the problem solver's detailed mathematical knowledge about individual topics.
2. Content: This is defined mainly in terms of four overarching ideas (quantity, space and shape, change and relationships, and uncertainty and data) which relate to familiar curricular strands such as numbers, algebra and geometry in overlapping and complex ways.
3. Contexts: This is defined in terms of the aspect of an individual's world in which the problems are

placed. The framework identifies four categories: personal, educational, societal and scientific.

Problem Based Learning (Pbl)

PBL is an approach that is centered on student learning (Savery, 2006; Savery & Duffy, 1995; Goodnough & Hung, 2008). Furthermore, Savery (2006) looked at PBL as a learning approach that empowers students to undertake a study, integrating theory and practice, and apply the knowledge and skills to develop solutions to problems defined. Hung (2006) revealed that PBL is an effective learning to condition students to be actively involved in meaningful learning.

PBL is an instructional method that challenges students to "learn how to learn", work in groups to find solutions to real-world problems. Given issue is used to bind the students curiosity in learning in question. The problem is given to students before the students learn concepts or materials relating to the problem to be solved. PBL model is done by the provision of stimuli in the form of problems then do problem solving by students is expected to increase the skills of students in achieving the learning material. Thus, PBL can be considered a model of learning approaches and teaching methods based on real problems.

In general, the problem is at the core of the PBL. Problems functioning as a knowledge manager, contextualize learning resources, stimulate thought processes and reasoning, as well as motivate students (Hung, 2006). To build problems that will be used in the PBL, teachers should understand the principles compose a quality problem, one is to use rules 3C3R, namely content, context, connection, researching, reasoning, and reflecting. The illustrations can be seen in Figure1 below

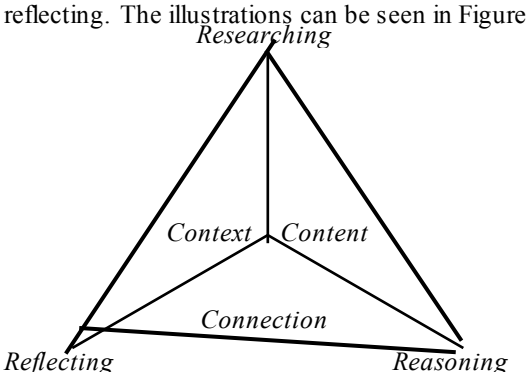

Figure 1. Rule Compilation of PBL Problem (Hung, 2006)

METHODS

This research includes research and development (R & D). Development model that is used to refer to the model modified Plomp, include: initial investigation phase, the design phase, the realization phase (construction), stage test, evaluation and revision until the final product is produced. Subject trials involving students of class VII of SMP 1 Kudus by using a non-randomized pretest-posttest control group design as presented in Table 1 below.

Table 1. Trial Design

Nonrandomized Control Group, Pretest-Postest Design

Class	Pretest	Treatment	Posttest
Experiment	T1	X	T2
Control	T1	X_1	T2

In the table, both experimental class and control class was given a pretest TKLM (T1). Furthermore, the experimental class treated with PBL form of humanistic and constructivist (X) and control class given expository (X1). At the end of the lesson, the class was given a post-test (T2).

The validation phase of learning device is done by providing a draft of the device and the validation sheet to 3 education experts and a practitioner learning. Further trials conducted to look at the practicality of the device by looking at the response of the students, the teacher's response, and the ability of teachers to manage learning. Data analysis of learning effectiveness in terms of mastery learning, posttest comparisons, test the effect of curiosity and creative character of students to the process of literacy mathematical literacy, as well as an increase in scores from pretest to posttest

RESULT AND EXPLANATION

Initial Investigation Phase

At this stage, the study of the development plan of PBL in a constructivist-based humanistic learning. Preliminary investigations on the development of learning tools include: (1) the analysis of students, (2) analysis of teacher, (3) analysis of the curriculum, (4) analysis of the task, (5) and analysis of environmental demands.

Design Phase

Based on the results of the study at the beginning of the investigation, researcher gains an understanding that learning device that needs to be developed referring to PBL in a constructivist-based humanistic learning. Device developed customized to the needs of learning, namely: (1) syllabus, (2) Lesson Plan, (3) Student Worksheet, (4) the student books, and (5) PISA oriented mathematical literacy test (TKLM). In addition to the main device, supporting device also arranged include: (1)

observation sheets of character curiosity and creative character of students following study, (2) the ability of teachers to manage learning, (3) student questionnaire responses, and (4) teachers' questionnaire responses.

Realization Phase

This phase is done by preparing a prototype device. Syllabus and lesson plans organized into 6 meeting. TKLM organized into 8 items. Each question requires the skills of students in the process of formulating the problem, implementing procedures, and interpretating solutions

Test Phase, Evaluation, and Revision

Recapitulation of the validation by the experts of the developed learning device indicates that the device learning is in the category of very good. Although the expert judgment can be considered very good, there are some input from validators that should be used as a material revision, such as technical writing, use of symbols, and editor of the sentence. The overall results of the validation study showed that the developed learning tools can be said to be valid.

The Result of Learning Device Test

Testing the device performed to the experimental class that is VII-H. Expository learning takes place in the control class that is VII-F. During this experiment, performed data retrieval process includes the data of curiosity and creative characters of the students, and observation data of teacher capabilities to manage learning. After a series of learning undertaken, the data retrieved in the form TKLM, student and teacher responses. In addition to data collection in the experimental class and control class, do also test item TKLM in class VIII-B. The trial is intended to mngetahui validity, reliability grains, grains difficulty level, and distinguishing items

Similarity Test of Preliminary Data

The data used to determine the initial ability of students taken from the pretest of TKLM. Prior to the test carried out, tested for normality and homogeneity first. Normality test performed with SPSS using the Kolmogorov-Smirnov test with significance level of 5%. The test obtains the Sig for the experimental class is 0.073. Because 0.073> 5% then H_0 is accepted, meaning that the TKLM pretest data of experimental class in normal distribution. Sig value for the control class is 0.200. Because 0.200> 5% then Ho is accepted. Furthermore, the both data sample tested its homogeneity of variance. Sig value on Levene's Test column is 0.064> 5% then H_0 accepted or the variants of two classes are same. Empirically, the average pretest score of the experimental class is 43.52 while control class is 42.97. Furthermore, the similarity test average of initial data as presented in Table 2 with the formulation of hypotheses:

$H_0 : \mu_1 = \mu_2$ (the mean of both classes are the same)

$H_1 : \mu_1 \neq \mu_2$ (the mean of both classes are different)

On the t test table, the Sig's t test was 0.756> 5%. Therefore, H_0 is accepted or the mean of the two classes do not differ significantly. In other words, both experimental class and control class set out in the initial conditions similar capabilities

Practicality Data Analysis of Learning Device

The device is said to be practical learning if after tested in experimental class get results: (1) the number of students who responded positively more than or equal to 80%; (2) the teacher gives a response of at least good; (3) the ability of the teacher to manage the learning of at least in the high category. Results of student response data showed that 84.2% of students give positive response. The average results of the questionnaire responses of teachers to the learning device is 4.75 or excellent category. The ability of teachers to manage learning data shows that the average teacher's ability to manage learning is 4.78. This score is high in the category. This indicates that the device can be said to be practical learning.

Effectiveness Data Analysis of Learning Device

Learning is said to be effective if: (1) the mathematics literacy skills of students in the problem of PISA-oriented achieve mastery learning, ie mean of mathematics literacy scores greater than or equal to KKM and the proportion of students who reach KKM greater than or equal to 70%; (2) the ability of students' mathematical literacy test device class higher than the class of conventional learning; (3) there is the influence of the character of curiosity and creative character during the learning of the mathematics literacy skills; (4) there is an increase in the character of curiosity and creative characters; (5) there is an increase in the literacy skills of students in learning math based constructivist humanistic PBL model in classroom testing the device.

Posttest data results need to be tested of completeness of mean and proportion. Normality Test Sig value on the experimental class is 0.200. Because 0.200> 5% then H_0 accepted, meaning that the posttest data of experimental class are normally distributed. Further homogeneity test by looking at the value of kurtosis that is 0.253. This value is quite small and close to zero, meaning that the data are homogeneous. The formula of the hypothesis:

$H_0 : \mu \leq 70$ (mean of mathematics literacy score ≤ 70)

$H_1 : \mu > 70$ (mean of mathematics literacy score > 70)

Empirically, the mean of posttest results of experimental classes was 85.5. Based on the table, obtained t = 6.258. Testing criteria derived from the t distribution list with df = 32-1 = 31, and the 1-α = 1-5% = 0.95. Reject Ho if t≥t_0.95. Because 6.258> t_tabel = 2.039, then Ho is rejected. This means the average mathematics literacy scores of students in the experimental class of more than 70.

Furthermore, classical completeness tests done to determine if the number of students who pass the study exceeded 70%. Empirically, the proportion of students who pass the study was 87.5%. The formulation of hypotheses to test classical completeness is:
H_0: π ≤ 70% (the proportion of students who achieve a complete individualized ≤ 70%)
H_1: π > 70% (the proportion of students who achieve a complete individualized > 70%)

Formula that used is $z = \frac{\frac{x}{n} - \pi_0}{\sqrt{\frac{\pi_0(1-\pi_0)}{n}}}$

Values Z_{table} obtained with the 5% significance level that is is $z_{0.5-\alpha} = z_{0,45} = 1.64$. Because z = 2.160> 1.64, then H_0 is rejected. Thus, it can be concluded that the proportion of students who achieve complete individually > 70%.

The influence test is used to determine that the independent variables of curiosity (X_1) and creative character of the student (X_2) have influences on the dependent variable (the ability of mathematical literacy (Y)). This Influence test using multiple linear regression. Furthermore, it should be formulated hypotheses:

$H_0 : \beta = \begin{pmatrix}\beta_1 \\ \beta_2\end{pmatrix} = 0$ (there are no influences of variable X_1 and X_2 through Y)

$H_1 : \beta = \begin{pmatrix}\beta_1 \\ \beta_2\end{pmatrix} \neq 0$ (there are influences of variable X_1 and X_2 through Y)

The regression equation in the analysis is $\hat{y} = -277{,}519 + 1{,}189x_1 + 0{,}581x_2$,, with the Sig = 0,000 <5%, so that H_0 is rejected. It can be concluded that there are significant influence of variables X_1 and X_2 toward Y. To determine the level of variable X_1 and X_2 to Y can be seen from the value of R^2 (R square) at the output of the Model summary obtained value of R square = 0.858 = 85.8%. That is, the variation of the variable Y can be explained by variables X_1 and X_2 together amounted to 85.8%. While the 14.2% remaining is influenced by other variables.

To test the mean difference, the hypotheses:

$H_0 : \mu_1 \leq \mu_2$ (mean of mathematics literacy skill of experimental class is less than or equal to control class)

$H_1 : \mu_1 > \mu_2$ (mean of mathematics literacy skill of experimental class is more than control class)

T test for independent samples, obtained by value of t = 6.495. With the 5% significance level and degrees of freedom 62, obtained t_{table} = 1.009. Because 6.495 > 1.009 then H_0 is rejected. Thus, the mean score of mathematics literacy in PBL based on humanistic constructivist learning is more than expository class. Empirically, the proportion of students who pass the study for the experimental class is 87.5% while the control class is 37.5%.

The proportion of different test applied with the hypothesis:

$H_0 : \pi_1 \leq \pi_2$ (the number of student in experimental class who reach minimum standart is less than or equal to expository class)

$H_1 : \pi_1 > \pi_2$ (the number of student in experimental class who reach minimum standart is more than expository class)

Then using the formula

$$z = \frac{\frac{x1}{n1} - \frac{x2}{n2}}{\sqrt{pq\left(\frac{1}{n1} + \frac{1}{n2}\right)}}$$

The result of $z_{tabel} = z_{0.45} = 1.64$ with a significance level of 5%. Because z = 4.132> 1.64 then Ho is rejected. Thus, the number of students who achieve mastery individual in the experimental class more than the number of students who achieve mastery individual in control class.

Test of character improvement in this study include improvement test of characters curiosity and creative character. Student character data obtained through observations made by the observer on humanistic learning konstuktivis with the model PBL for 5 sessions. Observations character curiosity and creative deeply conducted on 6 students who were selected through a ranking of the results of the pretest, ie two students of the under groups (low pretest value), two student of the middle groups, and two student of the top groups (high pretest value). Results were analyzed descriptively based on the number of each score indicators per meeting.

The increase from pretest to posttest scores of each student is calculated by using the formula of Normality Gain (g). Based on these calculations, 13% of students showed low gain scores, 53% of students showed gains were moderate, and 34% of students

showed a high gain scores. The average increase occurred in the experimental class of 41.969 points, while the control class of only 21.344 points.

Researchers conducted a test of mean difference between the score of pretest and posttest on the experimental class and control class, with the hypothesis:
$H_0 : \mu_{B1} \leq \mu_{B2}$ (average increase in value of pretest-posttest of trial class of device is less than or equal to control class)
$H_1 : \mu_{B1} > \mu_{B2}$ (average increase in value of pretest-posttest of trial class of device is more than grade control)

Test criteria derived from the t distribution list by $dk = (n_1 + n_2 - 2) = (32 + 32 - 2) = 62$ and (1 - α). By using a significance level of 5%, reject Ho if $t \geq t_{1-0,5} = t_{0,95} = 1,999$. Because t = 5.530> 1.999, then Ho is rejected. Thus, the average increases of pretest-posttest in trial class devices more than the control class.

The result showed that: (1) the ability of the mathematical literacy of students in a matter of TKLM achieve mastery learning, which is an average score of mathematical literacy skills over 70 and the proportion of students who reach KKM greater than or equal to 70%; (2) the ability of mathematical literacy class students test device was higher than the control study class (3) there is the influence of the character of curiosity and creative character during the learning of the mathematics literacy skills; (4) there is an increase in the literacy skills of students with learning math based constructivist humanistic model of PBL in a class test devices; and (5) there is an increase in the character of curiosity and creative students during learning. This shows the real success of the model of applied learning. This success is inseparable from the role of learning tools that have been implemented in learning. Researchers found that the success because of all the potential that is utilized by teachers to support the improvement of students' mathematical literacy skills.

Based on the above test overall, it can be concluded that the humanistic learning-based constructivist with PBL model is effective in improving students' mathematical literacy skills. The study's findings also corroborate the findings of previous studies as presented in the previous chapter. Stacey (2010) mentions through the operationalization of the concepts of mathematics and science literacy through PISA has voiced a vision of education that prepares future of all citizens to lead productive and satisfying lives. While Padmavathy (2013) in his research concluded that PBL learning model is more effective in learning mathematics.

There are various viewpoints of analysis that can be discussed in terms of the achievement of this learning effectiveness. The first viewpoint found between the experimental class has a precision of focus material to the assessment. The bill was given to the student assessments are problems oriented mathematical literacy PISA covers various contexts of everyday life. The material taught in the experimental class is always associated with contexts close to the students. In addition, students are also familiarized with the problems of mathematical literacy. Thus, students who take learning very well be able to do the assessment given. Different things happen in the control class. Learning happens in the classroom learning reflects the usual controls applied in Junior High, namely applying expository. The learning does not promote the formation process to the students to think independently. Students see math as finished goods are presented by the teacher. Master told anything formally to the students. Students are not familiar with the context and simply apply the formulas that they memorize..

The second viewpoint found experimental class has a precision of treatment with the goal. The main objective of learning is ultimately improve the literacy skills of mathematics. To achieve these goals, it takes a typical treatment, ie PBL in a constructivist-based humanistic learning. The learning has unique characteristics that can make students more active and creative in learning. The third viewpoint found experimental class learning device is supported by adequate and interesting. Learning device has vital position in support of learning. The chosen approach of teachers in teaching students needs a device as a means of implementing it. The fourth viewpoint, teachers monitor the progress of the learning process experimental class carefully each meeting. One analysis done is test the influence of character of curiosity and creative character of the students during the learning process of mathematical literacy skills. In five meetings held, carried out observations of the character of curiosity and creative character in students.

Data of character curiosity and creative students of observations obtained during the learning process using observation sheet instruments created the character of students and researchers have been validated. Assessment based on the observation sheet scoring guidelines and the observation sheet in accordance with the observations made during the process of learning takes place. Results of the analysis of the character of curiosity and creative students in learning to students' mathematics literacy skills of students expressed no

linear relationship. This shows that the higher the characters shown students the higher mathematics literacy to be achieved. Silver suggests there is a relationship between creativity and problem solving ability. Aslant research results (2011) about the moral education and character explains the stages of the application of moral education and character are important in the lives of students are in the classroom, school and in their social interactions. There are several factors that affect student achievement, among others, the nature curious, creative nature and desire to always go forward, the desire to gain the sympathy of parents, teachers, and friends, a desire to improve failure, the desire to gain a sense of security when it learned the lesson, and the reward or punishment as an end rather than learning.

Additionally there is an increase in both character and creative curiosity for learning with PBL humanistic progress. Having observed deeper in 6 selected students, a significant improvement would occur in the bottom group of students and the middle group. This is because the two groups with low and middle ability have gained self-confidence, daring, and tend to like learning with PBL thereby triggering an increase in the character of curiosity and creative themselves. While the top group with high-ability students tend also found an increase in both characters just are not very significant, because since the beginning of the meeting of this group has a high enough score.

T test results against different mean difference between pretest and posttest experimental and control classes showed an increase literacy math grade students experiment better than the control class. Based on the calculation of the gain scores, classroom experiments also showed the data showed that 13% of students score low gain, 53% of students showed gains were moderate, and 34% of students showed gains high scores Based on the calculation of the following gain score, the data experimental class and control class is presented in the following diagram.

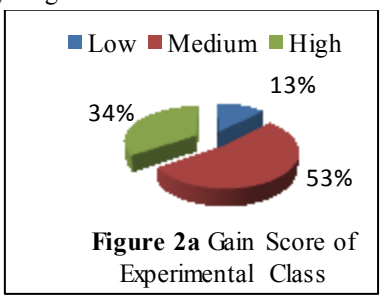

Figure 2a Gain Score of Experimental Class

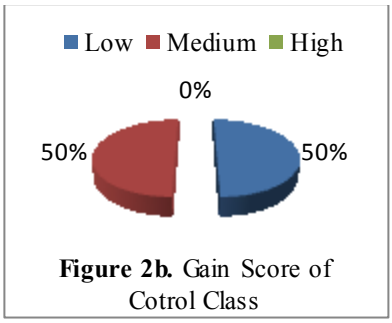

Figure 2b. Gain Score of Cotrol Class

The results showed that the experimental class showed better performance improvement. Results of the analysis of the character of curiosity and creative students in learning to students' mathematics literacy skills stated that there is a linear relationship. This shows that the higher students characters shown the higher mathematics literacy to be achieved..

CONCLUSION

Based on the research that has been described in previous chapters, a conclusion can be stated as follows.

(1) The humanistic math based constructivist learning with PBL models valid with the assessment scores are in the very good category

(2) The device is considered practical, indicated by (a) the number of students who responded positively more than 80%, (b) the teacher gives a good response, and (c) the ability of teachers to manage learning in a higher category

(3) The learning effectively improve the literacy skills of mathematics, indicated by:

(a) The ability of mathematical literacy students achieves standard minimum.

(b) The mathematical literacy ability of the students in the experimental class is higher than the expository class. Empirically, the posttest mean of experimental class was 85.5 with the proportion of students who pass the study is 87.5% while the posttest mean of expositiry class was 64.31 with the proportion of students who pass the study is 37.5%.

(c) There is the influence of the character of curiosity and creative students together amounted to 85.8% in the following study through the mathematics literacy skills.

(d) There is an increase of curiosity and creative character of students during the lesson.

(e) There is an increase in students' mathematical literacy skills of 41.969 points on a class test device from the pretest and posttest. The average increase occurred in the experimental class also improved compared with the

increase in the control class which only amounted to 21.344 points.

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