The Influence of Inductive-Deductive Approach Based on Modified Definition in Algebra Structure Learning Toward Student's Proving Ability Viewed Based on College Entrance Track

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Abstract
This study aim to analyze proving ability (PA) and students who learn by using inductive-deductive approach based on modified definition (IDABMD) and compared to students who learn by conventional approach viewed from college entrance track. The method which is used in this study in experiment quasi with population are whole students of Mathematic Education Study Program, FKIP, University of Halu Oleo (UHO) and sample in this study is 79 students of Mathematic Education Study Program, FKIP UHO, Academic Year 2011. From this study, the conclusion are obtained: (1) There is proving ability enhancement of students who take free-test track and students who take SNMPTN test track. (2) The enhancement of proving ability of students who get IDAMBD is better than students who get CV whether they are students of free-test track as well as students of SNMPTN test track. (3) There is no interaction between learning approach and college entrance track in algebra structure learning.
Keywords: Proving Ability, Inductive-Deductive Approach, Modified Definition, College Entrance Track

1. Introduction

Aspect of proving activity is important thing in mathematic education, especially in Algebra Structure learning which is most of its material is the form of proving task related with lemma, theorem, and proposition. The importance of this aspect congruent with Mariotti (2006) opinion that the condition today is different with ten years ago, it seems there is general agreement about the fact that the development of proof (and proving) definition is important aspect in mathematic education. Thus, it seems there is tendency to insert proof and proving in mathematic education curriculum. As explained in NCTM (2000; Marioti, 2006) that reasoning and proving is not special activities which is maintained for particular times or special topics in curriculum but should become natural part of class discussions, whatever the topic which is leaned.

NCTM 2003 increasingly assert how crucial and important this proving activity in mathematic learning in secondary education level, which of course will effected on mathematic education in higher education level. As has recommended explicitly by NCTM (2003) in standard of part two namely *Knowledge about Reasoning and Proof.* It explained that student is hoped to posses the ability of reasoning, building and evaluating mathematic argument and develop appreciation to mathematical calculation and investigation, with indicators: (1) recognize reasoning and proof (proving) as an fundamental aspect of mathematic, (2) make and investigate mathematical conjecture, (3) develop and evaluate mathematic argument and proof (proving), and (4) choose and use various kind of reasoning and proving method.

According researcher observation (Samparadja, 2012), factors which influence student's proving ability, in addition approach which is used, also their understanding about definition and the interpretation of symbols displayed explicitly in definition and theorem. The approach which is used in proving activity so far is deductive approach, that is approach which used deductive method. This method is method of drawing conclusion set out from general rule which its truth has been guaranteed (definition, theorem/lemma and theorem proving) to bridge the premise toward conclusion, so a mathematical statement is obtained.

The application in learning related with proving task which only use deductive approach still lack of something. Kusnandi (2012) said that proof from lemma, theorem, and corollary which is presented in textbook is developed deductively from premise toward conclusion which is often uneasy to be able to understand it comprehensively, especially for beginning students in learning to prove.

According (Hudojo, 2001) there is some weakness in mathematical learning by deductive approach. The weakness of deductive approach in mathematic learning (proving activity) can be completed by strength of inductive approach. This inductive approach can activate students in proving activity for instance process induction toward a lemma, theorem and *initial guide* in constructing proof.

Mariotti (2006) state that proving activity in addition has validation purpose, that is confirm the truth of a statement by checking logical truth from mathematical argument, proving also should contribute more broadly to student knowledge construction. If this can be happened, proof perhaps keep on meaningless and aimless in the eyes of students. Alternative approaches had been suggested for a long time and important point which has been emerged from contributions of different researches concerning with the need of proof to be acceptable from mathematical point of view but also acceptable by students.

Based on that opinion, it is important to strive for new approaches in proving activity (especially reading proof and constructing proof) so that approach become meaningful for students, and effected on the enhancement of their proving ability.

According Burney (2008), inductive-deductive approach in learning is sequential combination of inductive approach and deductive approach. Steps of learning refer to learning which contain stages of that method combination in design and learning scenario, namely: (1) orientation of example/special case, (2) observation and invention of pattern (property), (3) tentative hypothesis in the form of theory/conjecture, (4) theory justification/confirmation (proving) deductively.

In proving activity, according Samparadja observation (2012), factor which influence student ability in proving is elucidate mathematical statements, whether it is axiom, theorem, and proof statement which all related with definition. Elucidation of definition is strongly influential in elucidating proving tasks which contain relation among axiom, theorem and proof. Definition itself is tightly related with semantic (narration) and symbolic.

Textbook which become reference in algebra structure lead to difficulty for students who are in average is beginning prover, when confronted with elucidation of proving task because this task is based on some definitions which have high abstraction, and sometimes can lead to multi interpretation for students. Students face obstacles when they make a mistake in elucidating about definition. Thus, related with proving, it can be said that students should elucidate and understand that definition firstly in order to be able to construct or read the proof correctly. But in fact, much narration and symbolization related with definition which is implied in mathematical statement in reference textbook of algebra structure learning still in unclear order, so it is result in ambiguity which make student feel difficult to understand it.

Good definition elucidation will strongly influential in elucidating proving task which related between mathematic foundation and axiom with theorem and proof. This is in accord with Lay (2009), that the making of definition in simple form or definition modification will also make goof elucidation of students when doing mathematic proving.

From explanations above, that one of student's obstacle in doing proving is definition which is displayed in high abstraction level but can result in wrong elucidation, definition which has double meaning (ambiguous), and symbol usage in inconsistent definition. Those definitions lead to cognitive conflict in students. Certainly it will influence their ability in proving the statement, theorem and properties in algebra structure. Whereas, students should be guided by explanation of good definition before they are demanded to generate good and correct answer. Therefore, it is important to do reordering of definition and symbols usage, in order that students do not feel confused in understanding definition, in doing symbol interpretation and when doing proving.

2. Method

This study is experiment quasi research. One class of experiment class receive algebra structure learning with inductive-deductive approach based on modified definition (IDABMD), while another class as control class receive algebra structure learning by using conventional approach (CA). Research design use design which consist of two learning strategy (IDABMD and conventional) and two groups of college entrance track (free- test and SNMPTN test track). In addition, pre-test and post-test group design is used. The design is described as follow:

Experiment group	Pre-test	**Treatment**: IDABMD learning	Post-test
Control group	Pre-test	**Treatment:** Conventional learning	Post-test

Figure 1. Research Design

Population in this study is all students of Mathematic Education Study Program. Sample in this study is all students who are taking algebra structure course in Odd Semester academic year 2013/2014. Sample is divided into two groups by using combined technique namely purposive sampling and cluster random sampling. Purposive sampling technique used when students who are become subject of study are classified based on register number (odd and even) and higher education entrance path, then followed by cluster random sampling where first group is taken as control class and second group as experiment class. Odd register class consist of 35 people and even register class consist of 37 people.

The instrument of proving ability test consist of the same pre-test and post-test. Quantitative data is students answer result data related with proving ability test which is analyzed by using following stage:

1. Analyzing data descriptively and calculate normalized gain value for pretest and posttest. In this stage, the formulation of normalized gain (g) is used which is adapted from Hake:
$$g = \frac{G}{G_{max}} = \frac{Sf-Si}{SMI-Si}$$
G is actual average gain, G_{max} is maximum average which is possible, Sf is final score (post), Si is initial score (pre), and SMI is ideal maximum score.
G is classified into three parts, that is; high g if g > 0.7, medium g if g > 0.3 and low g if g < 0.3 (Hake, 1999).
2. Grouping the result of proving ability (PA) test into three categories, namely: high PA if $X > \overline{X}$ + stdev; medium PA if $\overline{X}$ + stdev $\geq X \geq \overline{X}$ – stdev; low PA if jika $X < \overline{X}$ – stdev; where X = score of student's Proving Ability, $\overline{X}$ = average score of PA, stdev = standard deviation (Adapted from Arikunto, 2012).
3. Assumption test in the form of normality and homogeneity of data variant. This is needed before using parametric statistic analyzes in hypothesis test.
4. Testing the research hypothesis, whether by using parametric statistic analysis and also non parametric statistic analysis. Statistic test which is used in study comprise t test, Mann Whitney U test, and two way ANOVA.

3. Results

Data of students' proving ability which is analyzed consist of pretest and posttest data, and N-gain. Pretest data is obtained before treatment or before algebra structure learning is implemented, whereas posttest data is obtained after treatment is finished or after whole process of algebra structure learning in some course meeting is finished. N-gain data is the result which refer to Hake formulation (1991). Data recapitulation of proving ability (PA) in mean value range between 0 until 100 is showed in Table 1.

Table 1. Description of AP Data and N-gain of Both Learning Class Related with College Entrance Track

College Entrance Track	Descriptive Statistics	Algebra Structure Learning Approach					
		IDABMD			CA		
		PA Pretes	PA Postes	N-gain	PA Pretes	PA Postes	N-gain
Free-test	N	17	17	17	12	12	12
	Mean	21.539	58.553	0.469	20.192	40.962	0.251
	Stdev	5.9809	14.2536	0.1842	6.6744	8.4710	0.1496
SNMPTN	N	20	20	20	23	23	23
	Mean	20.462	63.846	0.545	25.518	51.370	0.337
	Stdev	6.8543	9.2680	0.1128	11.1201	14.9124	0.2161

Description: N = number of students, Stdev = Standard Deviation

Table 2 show significance test result of student proving ability based on learning approach in each college entrance track, by using significance degree α = 0.05.

Table 2. Significance Test of Enhancement Difference of Student Proving Ability Two Classes of Learning for Free-Test Track

College Entrance Track	Learning Approach	N	Mean	Stdev	t	df	Sig.	Annotation
Free-test	IDABMD	17	0.469	0.1842	10.504	16	0.000	Significant
	CA	12	0.251	0.1496	5.822	11	0.000	Significant
SNMPTN	IDABMD	20	0.545	0.1128	21.599	19	0.000	Significant
	CA	23	0.337	0.2161	7.476	22	0.000	Significant

Table 2 inform that value of sig. < 0.05 for each test result, therefore for each testing conclusion is obtained: there is significant enhancement of student’s proving ability for each learning approach class whether free-test and also SNMPTN entrance track.

Table 3 and 4 below show significance test result of enhancement difference of student’s proving ability based on learning approach in each college entrance track, using significance degree α = 0.05.

Table 3. Significance test of enhancement difference of Student's Proving Ability Two Classes of Learning for Free-Test Track

College Entrance Track	Learning Approach	N	Mean	Mean Difference	t	df	Sig.	Annotation
Free-test	IDABMD	17	0.469	0.218	3.379	27	0.002	Significant
	CA	12	0.251					

From table 3, it appear that value of sig. < 0.05, therefore it can be concluded that the enhancement of proving ability in free test track of students who learn by using IDABMD is better significantly compared to students who learn by using Conventional Approach.

Table 4. Significance Test of Enhancement Difference of Student's Proving Ability Two Classes of Learning for SNMPTN Track

College Entrance Track	Learning Approach	N	Mann-Whitney U	Wilcoxon W	Z	Sig.	Annotation
SNMPTN	IDABMD	20	95.000	371.000	-3.287	0.001	Significant
	CA	23					

Based on Table 4, it appear that value of sig. < 0.05, therefore it can be concluded that the difference enhancement of students on SNMPTN track who learn by using IDABMD is better significantly compared to student who receive learning by Conventional Approach.

To see the influence of learning approach and college entrance track factors toward the enhancement of student proving ability therefore ANOVA two- way test is done (using $\alpha = 0.05$), whose test result is summarized in Table 5.

Table 5. Interaction Test Between Learning Approach and College Entrance Track Toward Enhancement of Student's Proving Ability

Source	Sum of Squares	df	Mean Square	F	*Sig.*	Annotation
College Entrance Track	0.110	1	0.110	3.632	0.061	Not significant
Approach	0.768	1	0.768	25.393	0.000	Significant
Interaction	0.000	1	0.000	0.014	0.906	Not significant
Error	2.058	68	0.030			
Total	15.102	72				

Based on Table 5, for learning approach, value of sig. < 0.05 is obtained, which mark that there is significant difference of student's proving ability enhancement because the difference of learning approach given. For category of college entrance track and interaction between approach with category of college entrance track, value of sig. > 0.05. It means that there is no significant difference of student's proving ability because the difference of college entrance track or because interaction between learning approach factor with college entrance track. Therefore, there is no interaction between learning approach and college entrance track factor toward enhancement of student's proving ability. Thus, interaction between learning approach and college entrance track is not influential toward the difference of student's proving ability. The difference of student's proving ability enhancement only caused by learning approach difference factor. It means that by ignoring college entrance track factor, learning approach make difference for student's proving ability enhancement.

That there is no interaction between learning approach and college entrance track in influencing the difference of student's proving ability is explained in following diagram.

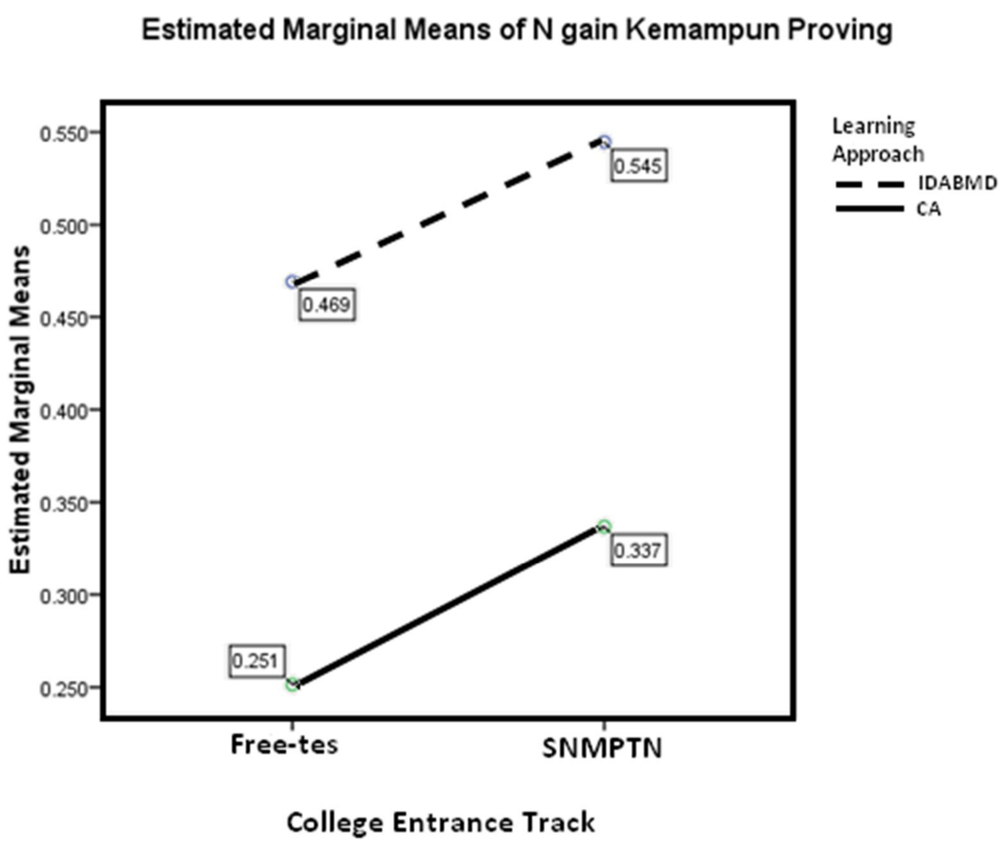

Figure 2. Interaction of Learning Approach and College Entrance Track Factor Related with Enhancement of Student's Proving Ability

Figure 2 show that students who receive learning with IDABMD approach obtain achievement result of proving ability which is better compared to students with Conventional Approach. From figure 2 also it can be concluded that enhancement difference of student's proving ability between two learning approach tend to be the same for two college entrance track. This is showed by value of this enhancement difference that is 0.218 for free-test track and 0.208 for SNMPTN track.

4. Discussion

There are two college entrance tracks which become focus in this study namely free-test track and SNMPTN track (test). Free-test track is track of selection which is passed through by students to enter college without taking the test. Generally, they who pass through free-test track is selected based on their academic achievement during senior high school, vocational secondary school, or special school. Thus, they who capable to enter college through free-test track are students who have high achievement or have best academic ability in their school, of course they excel another students in their school.

SNMPTN test track is a track which is followed by students to enter college through test sequences. Students who capable to pass through this track are they who have test score which exceed boundary threshold which has determined by authority of higher education.

Based on the strengths of students who follow free-test track, thus it is possible to make hypothesis that students who pass through free-test selection track have better achievement when they have taken the courses in college compared to students who pass through SNMPTN test track selection. But based on result of statistic descriptive when two group of students from both college entrance tracks is given learning treatment by the same approach, vise versa result is obtained. The group of students with IDABMD, the enhancement of proving ability of students who take SNMPTN test track is higher than students who take free-test track. As for group of students with Conventional Approach, proving ability enhancement of students who take SNMPTN test track is also higher than students who take free-test track. This is possible, because compared to students of free-test track, students who pass through free-test track should struggle hard in study to face academic potential test, subject competency test and some particular tests to enter college. Students who pass through SNMPTN test track should have high competitiveness because quota provided is limited while the number of students who take selection is much more than quota provided. Therefore, it is clear that students who pass through SNMPTN test track have been tested their perseverance and motivation though that test. It can be said that their perseverance and motivation is higher because of their struggling to enter college pass through intricate way, not as easy as students who take free-test track. This motivation and perseverance are continually brought when they actually take a course in college. If refer to combination of student groups (IDABMD and CA), in fact group of students who take SNMPTN test track have proving ability which is higher (as much as 0.434) than students who take free-test track (as much as 0.379).

But if looking at difference of proving ability based on learning approach, that is when students are given the different treatment, proving ability enhancement of students who pass through free-test track and receive IDABMD is higher than group of students who receive CA. It is similar for students of SNMPTN test track, students who receive IDABMD is higher than group of students who receive CA. Based on inferential analysis result (in Table 3 and 4), this difference is significant, that is proving ability enhancement of students who receive IDABMD is higher significantly if compared to proving ability enhancement of students who receive CA. Referring to pretest result, each groups (before treatment) tend to have same proving ability. Because of that, this enhancement difference is caused by learning approach factor. Treatment difference result in student's proving ability difference.

5. Conclusion

Based on result of study which is suggested in earlier chapter, some conclusions are obtained as follow:

1. There is proving ability enhancement of students who take free- test track. This enhancement is included in medium category for free-test track students who receive IDABMD and included in low category for free-test track students who receive CA.
2. Proving ability enhancement of free-test track students who receive IDABMD is better than free-test track students who receive CA.
3. There is proving ability enhancement of students who take SNMPTN track whether who receive IDAMBD as well as who receive CA in algebra structure learning. Proving ability enhancement of students who take SNMPTN track whether who receive IDAMBD as well as who receive CA fall in medium category.
4. Proving ability enhancement between SNMPTN track students who receive IDAMBD is better than students who receive CA.
5. There is no interaction between learning approach and college entrance track toward enhancement of student proving ability in algebra structure learning.

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