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# Improving Senior High School Students Learning Autonomy through Generative Learning

**Nahor Murani Hutapea**

Mathematics Education, Faculty of Teachers Training and Education
University of Riau, 28293, Indonesia
Email: nahorm.hutapea@lecturer.unri.ac.id

**Abstract.** Autonomy in learning is an ability required by each individual to cope all life challenges. A person with higher learning autonomy could study better and is capable of observing, evaluating and managing his study effectively and efficiently, and saving the time to accomplish given tasks. However, students' learning autonomy (SLA) has in fact not yet well-developed up to senior high school level. Generative learning (GL) is considered able to elicit the development of SLA. This research aims to examine students' autonomy in learning through the implementation of GL. The type of this research is quasi experiment with pretest and posttest control group design. The research used a set of learning autonomy scales as its instrument. The research result shows that GL could better enhance SLA compared to conventional learning; perceived from a whole: 0.58 > 0.51, perceived from the school category: 0.65 > 0.58 (superior), 0.57 > 0.51 (moderate), 0.51 > 0.44 (low) and students' early mathematics skill (EMS): 0.74 > 0.69 (high), 0.60 > 0.54 (medium), 0.35 > 0.31 (low). Both control and experimental classes have moderate learning autonomy improvement. Meanwhile, in terms of EMS, those obtaining GL treatment improved moderately, and the control class has a poor increase.

**Keyword**: *Generative learning, Improvement, Learning autonomy,*

## 1. Introduction

The content standard of the school-based curriculum reveals that students must possess a set of mathematical competence manifested in their learning outcomes after learning process has taken place. The mathematical skill and competencies expected to be reached by primary and secondary students are: (1) concept understanding; (2) reasoning; (3) communicating; (4) problem solving; and (5) capable of appraising mathematical use in daily life (Kafrawi et al., 2016).

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High learning autonomy is required to own that series of mathematical skill and competencies. Through a prominent learning autonomy, students will be able to: (1) analyze mathematical learning necessity, formulate purposes, and design learning program; (2) choose and implement appropriate learning strategy; (3) control and evaluate one selves – whether or not the applied strategy correctly done, check the outcomes (process and product) as well as reflect on the given feedback (Hutapea, 2012). Furthermore, Muntalvo (2004) declares that through a prominent learning autonomy: (1) students believed that learning was proactive process, (2) students could motivate themselves, and (3) students used various strategies to obtain the learning outcomes that they wished.

The importance of learning autonomy in studying mathematics is supported by a research study result of Hargis, stating that individual with a greater learning autonomy manages to study better and capable of monitoring, evaluating and organizing his learning, also conserving the time in completing every assignment (Sumarmo, et al., 2017). For its significance, a learning with encouraging approaches that could assist students to enhance their learning autonomy needs to be endeavored.

The facts show that generally (1) learning activity is still dominated by teachers, (2) the students have not yet actively involved in the learning, (3) there is lack of chances for students to relate the studied materials with context in daily life so that the students are ignorant to its application. Consequently, the students have shown no initiative in learning math. There is also fewer chances given to reflect on what have been studied, which then results in the incapability to evaluate the learning. An implication of this is that the students will not realize the value of evaluating the learning process and results.

Herlina et al., (2012) stated that the learning process carried out in school did not encourage children to develop thinking skills but it is more directed to the ability to memorize information, so that learning is not meaningful and results in students becoming passive. When the students are inactive, the learning autonomy cannot be improved and in doing a task, students will tend to merely copy the algorithm and procedure explained by the teachers, for instance. This type of learning is also known as conventional learning method (Hutapea, 2013).

Resolving students passivity, teachers need to wisely create a learning situation where students could actively participate in delivering idea, responding and evaluating peers' point of views, solving problems creatively, associating learning materials with real context in daily life, altering ones' perspective that difficulty is a challenge, and reflecting on the studied materials. One of the learning that could help to boost students'

active involvement and develop learning autonomy is generative learning (GL).

The steps in GL facilitate students to be more enthusiastic in constructing knowledge and therefore could build learning autonomy. Autonomy in learning can only be reached when students have the chance to relate studied materials with daily life situation. Once the students are capable of connecting the learning with everyday context, they will be encouraged to scrutinize the knowledge and study independently.

Teachers are persuaded to prepare a context that can trigger cognitive conflict of students. The given setting may urge them to change the cognitive structure while designing ways to solve the problems. This kind of technique will transform students' perspective of difficulty so that they will begin to identify necessity to learn, look for relevant sources and apply the upright learning strategy (Paris, 2004). Tasks that have been done or are being completed at the moment can be evaluated through a reflection opportunity given to the students. That kind of given context has a significant impact to students' ability to continuously evaluate every learning process and outcome (Pape et al., 2003).

Furthermore, GL stages afford a chance for students to respond and solve obstacles innovatively. Teachers play a role as a facilitator and mediator to encourage students to solve their own problems and to convey mathematical concepts through mathematical problems resolution. Hutapea (2008) reveals that GL implementation on basic materials of angle and line could increase outcomes of students grade VII B in Senior High School Beerseba, Pekanbaru.

Student learning autonomy (SLA) is a salient factor determining the success of GL implementation and student learning outcomes. This is reasonable for learning with problem solving circumstance needed to prompt student autonomy. Students in superior school category is assumed to have higher autonomy in learning compared to those in moderate school level; this scheme goes the same to students in moderate school who have higher autonomy than those from low school category. Students from prominent school are more capable of managing time and controlling oneself in pondering, planning, implementing as well as evaluating learning strategy and doing reflection (Sumarmo, 2004). This is in line with research result of Darr (2004), affirming that autonomy learning ability has high correlation to student learning success.

Based on those elaboration above, the researcher is interested in investigating the effect of GL application towards SLA, observed from the students school category (superior, moderate, and low) and students' early mathematics skill (high, average, and poor) with the purpose of developing

SLA, either for those obtaining GL and those who are treated with conventional learning (CL).

## 2. Methodology

This research is a quasi-experiment with pre-test and post-test control group design, illustrated as follows:

O X O
O O (Ruseffendi, 2005).

There were three different categories of school in this research; superior, moderate, and low category. Of each school, two classes were chosen; one class for the experiment, and another for control. The experimental group was treated as (X), which is GL; while the control group receives no special treatment. Every experimental class was given pre-test and post-test (O) to gauge SLA. The scores of both tests are research data used to test the proposed hypothesis.

The population of the research was all senior high school students of Pekanbaru registered in academic year of 2010/2011. There are several rationales for the chosen population: in general, the learning autonomy of senior high school students is higher than those in junior high school; and on the ground of previous study, the application of GL model in secondary educational level (junior and senior high schools) causes positive impacts to students' activeness, their behavior and learning results. The sample of this research was taken by using stratified sampling. This was selected because the sample taken from different groups would represent the characteristics of each population. The sample is senior high school students sitting at grade X at the level of superior, middle, and lower schools in Pekanbaru.
The sample was determined based on the National Exam data of senior high school of 2009/2010. After the data was ranked, the school category classification was settled using such criteria as : (1) superior school: total score of national exam > $\bar{X}$ + SD; (2) moderate school: $\bar{X}$ – SD ≤ total score of national exam ≤ $\bar{X}$ + SD; (3) lower school level: total score of national exam < $\bar{X}$ – SD. Once the grouping was done, based on certain considerations and calculation, the superior school category was eventually represented by SMAN 5, moderate school was represented by SMAN 7 and SMA Nurul Falah as the representative of lower school category.

In data and information collection, a set of teaching and learning tools used were: lesson plan, students' activity sheets, media, syllabus; and teaching and learning instruments: questionnaire and observation sheets of students' and teachers' activity. The whole teaching and learning instruments were validated and tested prior to the experiment. The SLA data were gained using a closed questionnaire to measure the autonomy rate increase before

and after the learning (Amirullah, 2018). The questionnaire was arranged and developed based on ten aspects of learning autonomy: (1) learning initiative; (2) recognizing needs for studying; (3) determining studying purpose; (4) regulating and controlling the learning; (5) regulating and managing cognition, motivation, self-behavior; (6) viewing difficulties as challenges; (7) seeking and utilizing relevant learning resources; (8) choosing and implementing the appropriate learning strategy; (9) evaluating learning processes and outcomes; and (10) self-efficacy. The learning autonomy scale consists of 74 statements with four answer options, namely: SA (strongly agree), A (agree), DA (disagree), and SDA (strongly disagree). The N or neutral option is not used to prevent hesitation on students.

Prior to the scale use, a trial was initially conducted limited to 5 students outside the equivalent research samples. This functions to understand the level of language readability and to gain a glimpse if the statements of the questionnaire can easily be understood by students grade X. After being revised, based on the restricted trial test, the scale was tested to 40 students grade X in the Senior High School 5 Pekanbaru, to comprehend the validity of each statement item as well as to calculate score for each option (SA, A, DA, SDA) of each statement. The given score on every option of the statement is determined on the ground of respondents' answers distribution or determining the scale value with normal deviation.

The enumeration of reliability and validity of 74 items of SLA (Cronbach's Alpha = 0,88; high; $\alpha = 0,05$; N = 40) results in 52 valid items. Thus, the SLA scale can be used for the research. Data were analyzed using distinct type of test: one sample t-test, independent sample t-test, Kruskal-Wallis and Brown-Forsythe with SPSS 17 program (Uyanto, 2009); and the normalized Gain formulation (N-gain) is: g=(post test score-pretest score)/(ideal maximum score-pretest score) (Meltzer, 2002), whose result is interpreted based on classification from Hake (Murni, 2013); to find out the magnitude of SLA increase average.

Table 1. Gain classification (g) according to Hake

| ***g* scale** | **Interpretation** |
|---|---|
| $g > 0,7$ | High |
| $0,3 < g \leq 0,7$ | Average |
| $g \leq 0,3$ | Poor |

## 3. Results and Discussion

The descriptive analysis result of students' learning autonomy based on the school level and learning group is presented in Figure 1.

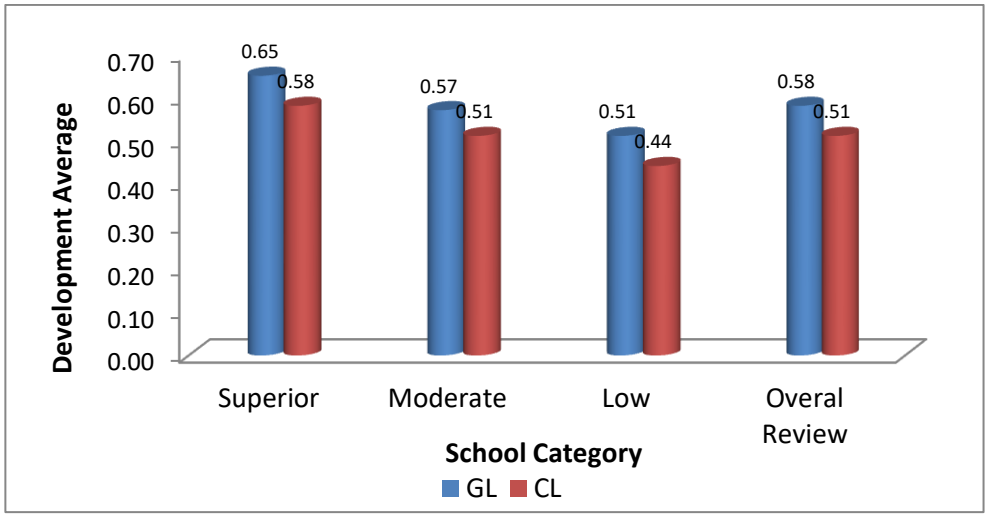


Figure 1: The average of students' learning autonomy increase of each school rank and learning group.

Figure 1 depicts that SLA increase is higher on those getting GL than students taught using CL, perceived from the entire school category (superior, moderate and low level). It is indicated by the learning autonomy average in general: GL=0,58>0,51=CL, superior school: GL=0,65>0,58=CL, moderate school: GL=0,57>0,51=CL, and lower school category: GL=0,51>0,44=CL. According to Hake, that growth in general observed from the school category for both students with GL and CL treatment, is at an average level.

Moreover, a test was conducted to assess students' autonomy intensification to both learning methods employed (GL and CL). The sample was normally distributed; with significant value (2-tailed) of GL is 0,32>0,05= α, and CL is 0,58>0,05= α; Ho is approved using t-test. The result was that autonomy significant surge of all students with two different treatments was detected. Nevertheless, students with GL still have higher autonomy compared to the ones with CL.

Further, another test on the increase difference of autonomy in both learning styles was accomplished (variant homogeny data, sig.value (2-tailed): GL=CL= 0,70>0,05=α; Ho is approved) by using equal variances assumed. There was a significant difference of growth on both learning methods; that is students taught using GL considerably have higher average of autonomy than those studied using old-fashioned mode. This is indeed a result of distinctive learning processes.

The result of SLA data descriptive analysis for each category of early mathematics skill is illustrated in Figure 2.

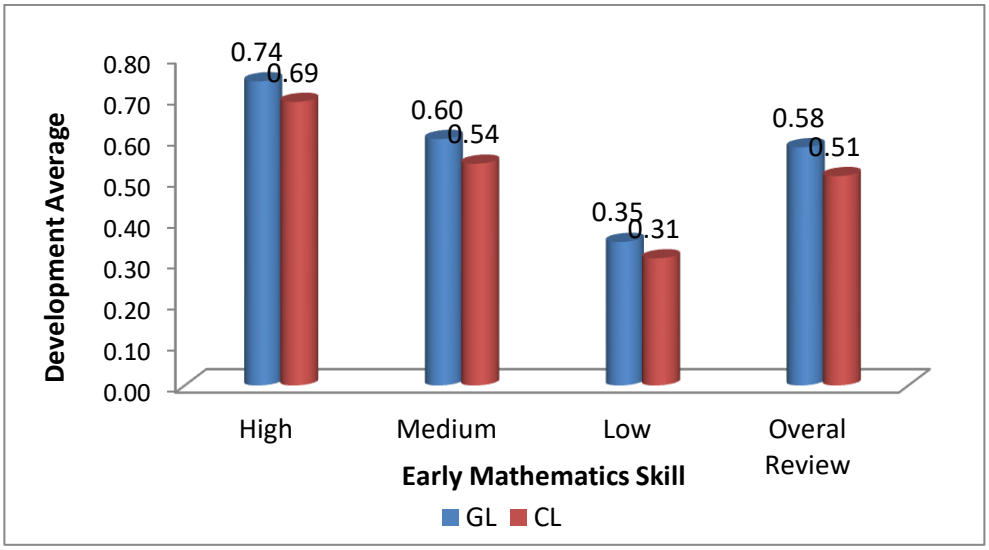


Figure 2: The average of students' learning autonomy increase of each early mathematics skill category on both learning methods

Figure 2 shows that SLA increase of those treating with GL is higher than students with CL, both in overall review and in each category of early mathematics skill (high, medium, and low). The average for overall review is GL=0,58>0,51= CL; high category: GL=0,74>0,69=CL; medium as GL=0,60>0,54= CL, and lower category for GL=0,35>0,31=CL. According to Hake, the overall increase of SLA and students' early mathematics skill are categorized at a high and moderate level, both for those with GL and CL; the low early mathematics skill of student obtaining GL is categorized as moderate, while low early mathematics skill of student acquiring the CL is categorized as low.

SLA increase test was then conducted for each category of early mathematics skill on both types of learning (sample was not normally distributed; significant value (2-tailed) for the high early mathematics skill by GL was 0,04<0,05=α); whereas the others are bigger than α so that Ho is not acceptable) using Kruskal-Wallis test which yields a significant increase of early mathematics skill of students with high, moderate, and low level of early mathematics skill receiving GL. It goes the same to those taught using CL. It all can be noticed from the significant value (1-tailed) that is smaller than 0.05 and thus Ho is declined.

Moreover, to examine the improvement difference of SLA on each early mathematics skill category, another test to both experiment and control groups (data variant is not homogeny, sig.value (2-tailed): GL=CL=0,01<0,05=α; Ho is declined) was completed using Brown-Forsythe statistical test. The test yields a different increase on students' autonomy of each early mathematics skill category. Students with high,

moderate, and low score of early mathematics skill gaining GL treatment have a significant increase average compared to those receiving CL.

This research was analyzed based on the learning, school category and early mathematics skill. Therefore, the discussion about research outcomes related to SLA in mathematics will be presented on the basis of those three aspects. Learning autonomy is an individual's behavior comprising of: learning initiative; diagnosing learning necessity; determining learning goals; controlling the learning; organizing cognition; motivation; self-attitude; perceiving difficulty as a challenge; seeking and using relevant learning resources; choosing and implementing the righteous learning strategy; evaluating learning process and result; and self-efficacy.

Generally, the data analysis result (either viewed from the learning, school category, or early mathematical skill) shows that SLA is better with GL compared to the CL. The average score of SLA improvement gained (either reviewed from the school category or early mathematics skill) indicates that students taught using GL have learning autonomy improvement quality for 0.58 (> 0.51), which is higher than those of taught by regular and CL. Based on Hake (Murni, 2013) criteria, the development of SLA of both groups is at a moderate place. Learning autonomy is a dynamic process and fluctuative depending on students' responses when studying a particular context. This is consistent with Knain and Turmo's point of view (www.pisa.no/nordisk-pisa2000/kap.8.pdf) that learning autonomy is a dynamic practice where students build their own knowledge, skill and attitude while scrutinizing specific setting. In other words, when students respond the given stimulus, there is a highly probability to advance or renew SLA.

Through GL, students are given a chance to create an impression about studied materials by relating it to everyday context. This strategy allows the students to gain the values that studied materials have their application with daily life activity and therefore may provoke them to study them deeper, thus emerging learning initiative. This implies that student initiative can only be stimulated when they are capable of connecting the learning materials with real life circumstance.

In GL process, teacher should prepare a context that could help arising cognitive conflict for students. Cognitive conflict is likely to encourage students to change the cognitive structure in solving a problem within the given context. This is expected to change students' perspective that obstacle is in fact a challenge, not a problem. Hence, students will initiate to analyze learning requirements, search for and take advantage of applicable learning sources, and apply the appropriate learning strategies.

Another important feature of GL is that students have the opportunity to cogitate things that they have learned. They can also expose or evaluate tasks currently being accomplished. That scheme impacts the students to always evaluate each process and result they have been working on. Those are the reasons believed to cause students with GL have above average autonomy. Yet, it is not sufficient to implement this type of mathematics learning concept merely in several meetings. It needs to be sustained in the teaching and learning process.

The t-test result of the two average value of SLA designates a major increase to both learning (students with GL have greater autonomy compared to their CL). GL provides an ultimate and a significant contribution to autonomy in learning contrasted to the old-fashioned learning method. Developing and implementing learning autonomy require self-confidence and motivation. Motivation and monitoring during the process are believed to prompt the increase of learning autonomy. The notion is corresponding to Paris et al., (2004) viewpoints that thinking awareness, strategy use and viable motivation are the primary characteristics of learning autonomy. Thus, Zimmerman (Tillman et al., 2000) also states that autonomous students are those having self-confidence and high intrinsic motivation.

Sumarmo et al. (2017) describe learning autonomy mostly as an influence of building one's own mind, feeling, learning strategy and behavior directed to a bigger learning purpose. Consistent motivation is deemed as the learning and success determining factor. If a student does not have motivation in learning, it will clearly engender a problem to himself because learning is a full of hurdle process of obtaining academic capability. The hurdle can take place in the form of lack of motivation. Therefore, monitoring the motivation to achieve something as an individual activity can start from taking the initiative, completing and finishing learning activities. This monitoring is carried out without any interference from others.

Based on the statistical test, it can be concluded that the category of school brings noteworthy influence to the SLA increase average. It is proved by the improvement mean of SLA on each school category and as a whole. It does not matter if the students' early mathematical skill is at a high, medium, low, or even mixed level, those students taught with GL still outperform the autonomy of their peers receiving CL. A further difference test for each early mathematical skill group yields similar results.

Briefly, the statistical test result has designated that early mathematical skill influences the increase of SLA significantly. A study conducted by Zimmerman et al., (1986) confirms the inference. They affirm that autonomous learning ability has a high correlation to the success of learning. It implies the higher the category or rank of a school and the

students early mathematical skill, the better the learning autonomy develops.

## 4. Conclusion

From the research result and discussion, it is concluded that there is indeed an increase of learning autonomy after generative and conventional approaches are applied. However, students getting GL treatment have developed learning autonomy better compared to their peers with CL, as observed from: all students; students' school category (superior, moderate, and low category); and students' early mathematics skill (high, medium, and low). On the basis of Hake standard criteria, the overall increase of SLA, school category and early mathematics skill category (either obtaining through GL or CL) is categorized as moderate. Nevertheless, the SLA increase on a low rate of early mathematics skill of students having GL is classified to a moderate, while those having CL have low classification.

Mathematics teachers are suggested to take advantage from the GL and utilize it as a teaching alternative to develop SLA. During the implementation, factors like school category or level must be considered. For a moderate school category, the learning materials consisting of structural stages like steps written at the challenge and restructuration (learning autonomy, discussion, and implementation), reviewing steps (evaluating the model's shortcomings), and generalization stage are needed by the teachers in assisting students' learning progress. As for superior school category, students are given freedom to complete the problems written on the students activity sheet. It is useful to afford a chance for the students in exploring and enhancing their own strategy. Lastly, school with low category requires hints on every stage in form of questions or important notes to draw students' motivation. This mode simplifies teachers' job in facilitating and coaching the students when they do not comprehend the issue to complete the problem solving of the mathematical connection.

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