THE EFFECTS OF THE INSTRUCTIONAL STRATEGIES (PROBLEM SOLVING, DIRECT INSTRUCTION) AND ACHIEVEMENT MOTIVATION ON THE BIOLOGY LEARNING OUTCOME OF GRADE TEN STUDENTS

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Abstract

Problem-solving is an alternative learning strategy which is considered more effective and efficient for students engaged in the learning of Biology. This strategy has a couple of strengths in the teaching –learning process in which it makes the school learning more relevant to life and actively engages students in the learning process. This study aimed at testing the effects of the problem-solving strategy on students' learning outcome. It also aimed at testing if there was any effect of the achievement motivation on students' learning outcome. Furthermore, this study was intended to test if instructional strategy interacted with the achievement motivation on students' learning outcome. This study employed the factorial non-equivalent control group design in which109 ten grade students in the science program of Sekolah Menengah Atas Negeri 9 Malang were used as the subject of the study. Based on the data analysis, the conclusion of the study result was as follows: (1) there was discrepancy in the score acquired by the group receiving problem-solving (PS) and the other group instructed in direct instruction (DI). The use of problem-solving strategy was significantly better than direct instruction that yielded a significant value of (F=6.943; p=0.010); (2) the score discrepancy was noticeable between students with high achieving motivation and students with low achieving motivation. Students' motivation, either high or low impacted on the learning outcome indicated by the significant value of (F=10.999; p=0.001); (3) There was no difference in the score representing the interaction between students instructed in problem solving (PS) and students taught in direct instruction (DI) based on the high or low extent of motivation students had that was indicated by the significant value of (F= 0.010; p=0.922). Ho was then accepted and it was concluded that there was not a significant difference in the average score of the interaction between the instructional strategies and the extent of achievement. In other words, the effect of the interaction between the instructional strategies and the extent of the achievement on the average score of students' learning outcome was not evidently different.

Key words: *instructional strategies, problem solving, direct instruction, learning outcome*

INTRODUCTION

The advance of science and technology constantly demands human adjustment to the changes resulted by conducting a wide range of innovations in every aspect including the education. The developments are progressively made in terms of the theories and concepts that they are increasingly effective and appropriate to come up with a quality modern learning.Shambaugh & Magliaro (2006) argued that the current learning process consists of five elements, namely: (1) organizing knowledge in memory, (2) solving problems, (3) developing learners, (4) learning how to learn, dan (5) living and learning in the world. The concept implies that learning should by all means result in a capacity to resolve problems and be aimed at the interest of living in the future instead of meeting the school interest.

One of the cases found by Malik (2010) concerning the learning of science is that many students taught in traditional manner acquired a science concept for mastery as it is rather than for knowing how to apply it in such a way that it might benefit them in a real life setting. As a result, the

students' interest dwindled. Meanwhile, Santrock (2004) put greater emphasis on the significance of the concept mastery as the key aspect of learning and one of the learning objectives. Trianto (2009) agreed that concept comprehension is paramount in teaching -learning process that it influences attitude, decision making, and manners in problem solving.

Several finds point out that the conventional learning strategies can lead to the enhanced conceptual thinking particularly in terms of the science learning. Peter et al. (2001) stated that traditional Biology learning is identical to content memorization as a means of thinking which can affect students' comprehension of the material because memorization impacts the students' ability to connect the concept with the actual condition.

The employment of the appropriate strategy in line with the motivation contributes to the improved students' achievement. This is supported by the research result of Aydin & Coskum (2011) which points out the impact of students' motivation to achieve on their learning outcome. Furthermore, Boser (1993) and Mayer (1998) similarly maintained that the development of problem solving instruction will impact the students' learning outcome.

This research is conducted at SMAN 9 Malang. It aims to prove the influence of the problem solving-direct instruction and students'motivation on grade the Biology learning outcome of grade ten students.

Research Problem

1. Is there any significant influential difference between the application of problem solving and direct instruction on Senior High School students' learning outcome in Biology?
2. Does developing the achievement motivation make any significant difference in Senior High School students' learning outcome in Biology?
3. Is there any interaction between the instructional strategy and achievement motivation toward Senior High School students' learning outcome in Biology?

Research Objectives

1. To investigate influential difference between the application of problem - solving and direct instruction on Senior High School students' learning outcome in Biology.
2. To investigate the difference the achievement motivation can make in Senior High School students' learning outcome in Biology.
3. To test the interaction between the instructional strategy and achievement motivation toward Senior High School students' learning outcome in Biology.

Research Hypotheses

1. There is significant influential difference between the application of problem - solving and direct instruction on Senior High School students' learning outcome in Biology.
2. There is significant difference the achievement motivation can make in Senior High School students' learning outcome in Biology.
3. There is the interaction between the instructional strategy and achievement motivation toward Senior High School students' learning outcome in Biology.

THEORETICAL BACKGROUND

Learning Strategy

Strategy is defined as "a plan of operation achieving something, or series of activities designed to achieves a particular educational goal" *(*Joyce & Weil, 1980). While Dick and Carey (1985) stated that learning strategy is a set of learning material and procedure simultaneously utilized to generate learning outcome in students. Whereas, Sanjaya (2006) defined the learning strategy as a planning comprised of a sries of activities designed to achieve certain educational purposes. It implies two things; firstly the learning strategy constitutes an action plan. Secondly, the strategy organized to achieve certain objectives.

Selcuk research (2013) pointed out that the learning strategy employed in the classroom impacts on the learning outcome because the effective transfer of the learning objectives is made possible through the employment of appropriate learning strategies that students achieve the expectation.

Problem Solving

According to Anderson in Schunk (2008), one of the cognitive processes which takes place during the learning is problem solving that is considered as key process in learning especially in such domains as mathematics and science. Marzano specifically maintains that "the ability to solve problems is prerequisite for human survival. Moreover, many situations we encounter in our daily lives are essentially problem-solving situations." While Dahar (2011) concludes that when students are able to resolve a problem, they attain a new capability and are engaged in an effective thinking behavior.

From the various syntaxes of problem solving elaborated above, the one used in this research is the modification of the Florida Education (2010) comprised of understanding the problem, devising a plan to solve the problem, implementing a solution, reflecting on the problem because it suits the Biology.

Direct Instruction

Sanjaya (2006) asserted that direct instruction is a learning strategy focused on the teacher's verbal delivery of the material to a group of students in order that they can have an optimal command over the material given.

Direct instruction is a strategy employing demonstrations and lively explanations combined with the exercises and feedbacks from students to help them acquire knowledge and actual skills required for further learning (Jacobsen et al. 2009). From the various syntaxes of the direct instruction explained above, the one used in this research is the adapted syntax of Arends (2008) because of its suitability to the Biology learning.

Achievement Motivation

McClelland (1985) maintains that the important motivation in education is the achievement motivation which propels one to strive to attain a success or choose an activity oriented toward a success or failure. Djiwandono (2002) argues that students with achievement motivation tend to succeed in carrying out the tasks in school, on the contrary, students who do not experience success in achievement something will tend to lose motivation and turn their attention to other activities.

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Table 2.1 characteristics of high and low achievement motivation (Degeng, 1989)

High Achievement Motivation	Low Achievement Motivation
1. loves to the assignment he chooses on his own	1. loves to do assignment decided by someone else
2. desires the least possible assignment	2. it is not a big deal to have much assignment
3. makes best efforts as he can	3. efforts made depends on the amount of assignment
4. perseveres and ignoring others	4. "care" so much about others
5. realistic	5. idealistic
6. competitive	6. avoid competition
7. evades evaluation	7. loves evaluation
8. success for self-contentment	8. success for honor
9. tries and takes risk	9. shy away of risk
10. the outcome associated with the efforts made	10. the outcome associated with his fate, ability, and difficulty

McClelland classifies achievement motivation into the need for Achievement encompassing four dimensions such as 1) goal oriented-realistic attainable goals, 2) challenge, 3) performance, 4) work hard (strive). The writer utilizes modified questionaires from the research conducted by dari penelitian Aydin & Coskun (2011) and Pieper (2008).

Intellectual Skills as the Learning Outcome

Widoyoko (2009) argues that the test is one of ways to assess someone's capability indirectly through his response to stimulus or question. The relationship between the evaluation and intellectual skills as the learning outcome refers to Gagne's assertion expanded by Gredler (2011) comprised of four skills: (1) learning to discriminate that is responding to the chracteristics specifying objects differently (2) obtaining concrete concept and definition is identifying objects or activities as a part of conceptual group (3) learning about the rules pertains to the abstract classification and examples and response to a set of circumstances with a working situation representing the relationship. (4) learning about the higher rank of rules (problem solving) is to select the subordinating rules of the memory to resolve a problem and apply the proper order thereof. These intellectual skill characteristics are used in analyzing the students' learning outcome.

The Relationship between Learning Strategy and Achievement Motivation toward the Learning Outcome

Mentzer & Becker (2009) discovered that problem solving strategy correlates positively with students' cumulative index. Students scoring high in science tend to be able to resolve a problem. On the contrary, students with low cumulative index are less able to solve a problem. Gok and Silai

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(2010) found that problem solving strategy encourages students to do more worksheets and leave nothing undone.

The results of the researches point out that employing problem solving strategy and achievement motivation positively impacts the students' learning outcome.

METHOD
Research Design

This research used quasi experimental design which is well-suited for which it is impossible to randomly assign participants to all groups (Salkind, 2006). The quasi experimental design employed is nonequivalent Control-Group Design (Tuckman, 1999). The researcher used intact group. Such a design is selected due to the impossibility to change the existing classes.

Factorial design used in this research 2 x 2 focused on (1) the main influence of problem solving and direct instruction as the control variable on the learning outcome, (2) the influence of different achievement motivation on the learning outcome in which students with the high achievement are distinguished from low achievement motivation (3) the interaction between the learning strategy and achievement motivation toward the learning outcome.

The research procedure conducted on the subject of the research includes the administration of pretest, the assigning of treatment and the giving of post test after the meetings are done.

Research Variables

There are 3 variables emphasized in this research: (1) the independent variable consisted of two dimensions, problem solving and direct instruction. (2) Variabel Moderating variable is the achievement motivation including therein the high achievement motivation and the low achievement motivation. (3) The dependent variable is the learning outcome.
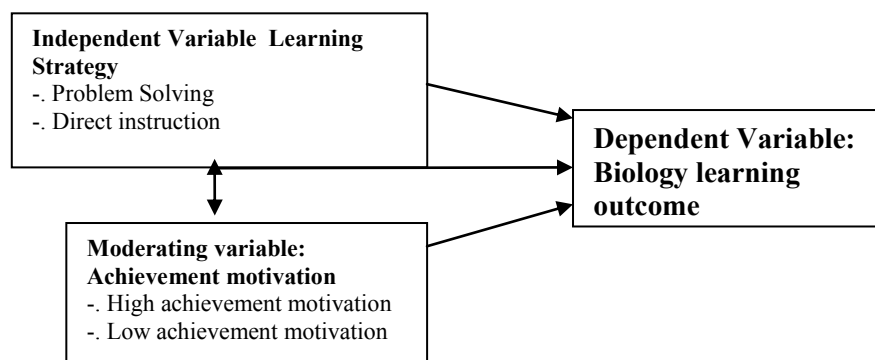

Figure 3.1 Relationships among the Variables

Indicator: ──────▶ The direction of Influence
◀────── The direction of Interaction

Research Instrument

This research employs two instruments, (1) instrument which is used to measure students' high or low achievement motivation as te moderating variable and (2) instrument which is used to measure the learning outcome of Biology as the dependent variable.

The reliability of the instrument is tested with Alpha Cronbach 0.935 which proves realiable for it is > 0.6. Based on the assumption test in terms of the facto analysis, the achievement motivation

assumption test has KMO (Kaiser-Meyer-Olkin) index value of 0, 918 which is greater than 0.5 exhibiting its qualification for having adequate sample size.

The achievement motivation instrument which has been tested in terms of its validity and reliability goes through the rotation test of the matrix component. The test result forms 4 components (strive, performance, challenge, goal oriented) with equivalent cumulative variant value of 81.21%.

Data Analysis Technique

The analysis technique deemed appropriate for the variables used in this thesis is the two way Analysis of Variance (2 x 2 ANOVA). Before conducting the data analysis to test the hypothesis, the qualification test is done by running the normality and homogeneity test.

The data to be assessed using the normality and homogeneity test is the students' learning outcome in Biology. The data collected will be tested using the normality test and the data distribution assessed using Kolmogrov-smirnov and the homogeneity variance test using *Levene's Test of Equality of Error Variances*. All the data analysis and testing are conducted by using program IBM SPSS Statistic 20.0

RESULT AND DISCUSSION
Result
1. Research Subject Description

The subject of this research is grade ten students at SMA Negeri 9 studying Biology. The general description of the learning outcome is determined on the basis of the descriptive analysis result of the research subject that numbers 109 students divided into 54 students instructed in problem solving and 55 students in the control group taught using direct instruction.

The distribution of grade ten students as the research subject given achievement motivation questionnaire is classified into high achievement motivation and low achievement motivation. The classification of high and low achievement motivation is analyzed using T test, the results indicate that there are as many as 48 people (44.0%) classified as having low motivation, and 61 people (56.0%) high motivation.

2. Pretest Results Description

The pretest data results of students instructed using problem solving strategy and the students taught using direct instruction analyzed using t-test statistics. The pretest scores of students taught using problem solving strategies have mean = 27.65 and SD = 10.104 less than the mean pretest scores of students taught using direct instruction strategies (mean = 30.27 and SD = 9.855).

The variance test displays the Lavene test value of 0.189 with a significance value (p) 0.665 (p>0.05). It can be inferred that the intellectual skill outcome of Biology students is homogeneous or assumed to have equal variance.

The results of independent t- test shows significant values of 0.173 (P> 0.05), for the outcome of intellectual skills of high school students (pretest on bacteria) between the group instructed in problem solving (PS) and the group taught using direct instruction strategy (DI). It means that the biology learning outcome in terms of the bacteria pretest indicates that there is no significant difference (p> 0.05) between the PS and DI groups. Thus, Ho is accepted signifying that both groups had equal ability

3. The Post Test Result Description

The post test result of the students studying Biology indicates that the mean value of the instruction using problem solving (PS) with high achievement motivation (mean ± SD = 76.74 12:41) is greater than the value of the instruction problem solving (PS) with low achievement motivation (mean = 68.65 ± SD 10.96). The mean value of using direct instruction (DI) with high achievement motivation (mean ± SD 70.27 12:02) is greater than the average value of using direct instruction (DI) with low achievement motivation (rerata 62.64 ± SD 13.48).

Based on the results above, it can be inferred that students with high achievement motivation show greater intellectual skill outcome (mean 73.6 ±12.55) than those with low achievement motivation (mean 65.5 ±12.58). The difference between the instruction using two strategies is quite significant. To find out the difference of the two learning strategies employed, the two way analysis of variance is required.

Data Analysis

a. Data Assumption Test

The normality testing data using the Kolmogorov-Smirnov test indicates a significant value 0.382, and 0.784 (p>0,05) for the High School Biology learning outcome in terms of pretest and post test on Bacteria that Ho is accepted. The conclusion is that there is normal distribution of the Biology learning outcome.

Homogeneity obtained has a significant value (p) of 0.877 based on Lavene test which is greater than alpha 0.05. It can be concluded that the data result of the High School Biology learning outcome (post test on bacteria) of the treatment group PS-MBr, PS-MBt, DI-MBr, and DI-MBt is relatively homogeneous.

b. the Hypothesis Test using Two Way Analysis of Variance 2x2

Hypothesis is determined in this way where H_0 is accepted when the significance value obtained is > alpha 0,05, H_0 is rejected when the significance value obtained is < alpha 0.05.

Table 4.1 Summary Table of ANOVA Result

Tests of Between-Subjects Effects

Dependent Variable: the intellectual skill outcome of High School Biology students (bacteria posttest)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2807.184[a]	3	935.728	6.211	.001
Intercept	519564.629	1	519564.629	3448.704	.000
Learning strategies	1046.063	1	1046.063	6.943	.010
Achievement Motivation	1656.985	1	1656.985	10.999	.001
Learning Strategies Achievement Motivation	1.439	1	1.439	.010	.922
Error	15818.780	105	150.655		
Total	553006.000	109			
Corrected Total	18625.963	108			

a. R Squared = .151 (Adjusted R Squared = .126)

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Based on the result of the variance analysis in the table 4.1 the learning strategy indicates a significance value of 0.010 (p<0,05) that Ho cannot be accepted. It can be concluded that there is significant difference between the instruction using problem solving strategy (PS) and direct instruction strategy (DI).

Comparing the means of Senior High School students' learning outcome and their achievement indicates a significance value of 0.001 (p<0.05) that Ho is rejected. And, thus it can be concluded that there is significant difference between the high achievement motivation and low achievement motivation.

Comparing the means of the interaction between learning methods and students' achievement motivation indicates significance value of 0.922 (p>0.05) that Ho is accepted. And, it can, therefore be concluded that there is not any significant difference in the interaction result between the learning strategy and the extent of achievement motivation.

c. Multiple Comparisons

The difference between the means of Senior High School students' learning outcome in Biology (post test on bacteria) as a result of the influence of the treatment group is evident in the following table 4.1
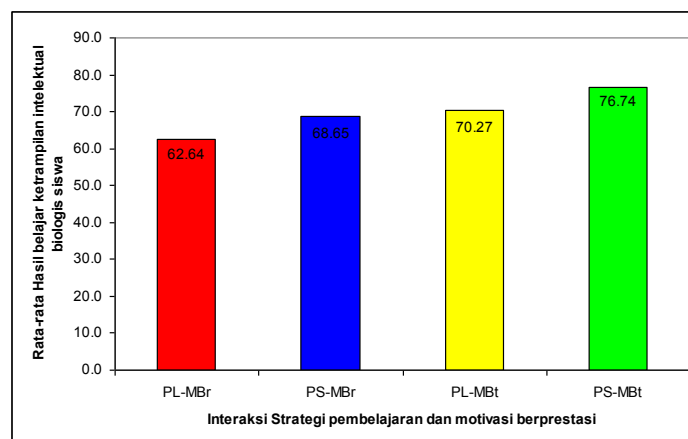

Table 4.1 the comparison between the means of learning outcome obtained by the Senior High School students in each and every treatment group in the post test on bacteria

The table above shows the magnitude of influence that each treatment group has on the mean of Senior High School students' learning outcome in Biology post test on bacteria.

DISCUSSION

The researcher tried to compare and measure up the results of the research against the knowledge (theories and research results) which had been obtained and assign the meaning to or interpret the possible implication.

a. The Effects of Learning Strategies on the Learning Outcome

The hypothesis result indicates that there is difference in students' learning outcome in Biology between the treatment group instructed with problem solving strategies and the group of students taught using direct instruction at SMA Negeri 9 Malang. This means that the application of problem solving strategies affects the acquisition of outstanding learning outcomes as compared to the direct instruction strategies. The result of effective learning is influenced by learning strategies used, although learning materials and test questions given are the same with equal facilities available as well (Mayer, 1998; Gok & Silay, 2010; Ifamuyiwa, et al. 2012).

The application of problem solving shows a comparative edge as it has a positive impact on student learning outcomes evident in the research conducted by Gok & Silay (2010) that the learning employing problem solving strategy proves to be more effective than the conventional learning. In similar veins, Anakpua, B and Okoli, O (2012) maintained that the use of problem solving strategies significantly impacts the students' learning outcomes, compared with conventional methods.

The results of this study support other conclusions made concerning the impact of problem solving on student learning outcome that students improve their the ability (skills), have the courage to confront problems and confidence to solve the problem (Anakpua and Okoli, 2012; Shah , 2010). Students therefore can work better and enhance their academic the ability. Likewise, Caliskan (2010) argued that the problem solving strategy has significant impact on student learning outcomes and leads to students' developed skills in problem solving. This research and some supporting theories consistently point out significant differences in the learning outcome which may come as a result of the problem solving strategies used.

b. The Effects of the Achievement Motivation on Student learning Outcome

The second hypothesis presented concluded that the means of Senior High School students' learning outcome and achievement motivation showed a significance value of 0.001 (p<0,05) that Ho is accepted. The conclusion is that there is a significant difference in the means of learning outcome obtained by students with high achievement motivation and students with low achievement motivation.

The achievement motivation is a great influence. Ames & Archer (1988) argued that the learning outcome is distinguished for students with high achievement motivation from students with low achievement motivation because the motivation surely impacts.

Singh (2011) also discovered that students with high achievement motivation show higher expectation of their academic achievement as their ultimate goal. Zhang's research in Junqing Fu (2011) endorsed the importance of developing achievement motivation which impacts the learning outcome.

Based on the explanation above it can be concluded that the results of this study consistently support the previous results of other studies concerning the important role the achievement motivation plays on academic learning outcomes. Hence, the achievement motivation of students is worth consideration.

c. The Influence of interaction between problem solving-direct instruction strategy and achievement motivation on student learning outcome

The testing results of the hypotheses presented in this research indicate the p-value 0.922 (p>0.05) in table 4.1 that Ho is accepted because there is not any significant difference found. It can be

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concluded that there is no interaction between the learning strategies used and the extent of achievement motivation.

The absence of interaction between the two variables (learning strategies and achievement motivation) points out that both of them share equal influence as stated by Hair et al. (1995).

Theoretical and empirical supports point out that the equally strong influence of the learning strategies and achievement motivation results in the weak interaction between learning strategies and achievement motivation. This study has made findings which are in conformity with statement of DeCaro, et al. (2013) that the strong influence available tends to weaken interaction. Ifamuyiwa et al. (2012) conducted a study on the use of problem solving strategies in high school math and the results showed that there was no interaction between the treatment and sexes on mathematics learning outcomes.

CONCLUSION AND REMARK

Conclusion

There are significant differences in learning outcomes obtained by students taught using problem solving strategies and direct instruction strategies.The same is true with the learning outcome obtained by students who show high achievement motivation and low achievement motivation. No interaction is found between learning strategies and achievement motivation in terms of student learning outcomes.

Suggestions

The application of problem solving strategies to high school Biology learning is a viable alternative since students are trained to critically think that they may develop greater capability to solve the problems confronting them.

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