

# A Comparative Study of Guided Discovery Learning and REACT Strategy Toward Problem-Solving Skill and Self-Regulated Learning on Fifth Grade Students

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**Abstract:** Guided Discovery Learning and REACT Strategy conclude to constructivism learning methods focus on students center. Consider problem-solving skills is one of the mathematics learning objectives; it needs to know which one is more effective between Guided Discovery Learning and REACT Strategy. The study aimed to compare the effectiveness of Guided Discovery Learning and REACT strategies on problem-solving abilities and self-regulated learning. A Quasi-experimental research and research population were students of State Elementary School students in East Jakarta. Samples were taken using a cluster sampling technique. The research instruments are an essay test for problem solving-skill and questionnaires for self-regulated learning. The data were processed by Mancova. The findings of the study indicate that: 1) Guided Discovery Learning and REACT methods adequately improve problem-solving and self-regulated learning; 2) Guided Discovery Learning is more effective increasing problem-solving skill than REACT strategy; 3) There was no differences effect between GDL and REACT Strategy on increasing self-regulated learning

**Keywords:** *guided discovery learning, problem-solving skills, REACT strategy, self-regulated learning*

## INTRODUCTION

Problem-solving is a cognitive process to find solutions, answers or to achieve goals that no method or way to solve the problem (Krulik & Rudnick, 1982). Problem-solving is the process of using prior knowledge, abilities, and understanding to respond to new situations (Intaros, Inprasitha, & Srisawadi, 2014). Problem-solving in mathematics allows students to face the problem that can be overcome by utilizing the combination of knowledge (declarative, procedural, and conditional) efficiently in well-defined contexts (Căprioară, 2015).

Problem-solving has three dimensions: context, content, and schema (Savin-Baden & Major, 2004). The context related to the implied problem, the solution to find out. Content is a scientific discipline involved in various conditions such as mathematics in real life or integrated mathematics to science or social studies. Schema is the structure, concept, or principles contained in the problem. The mathematics problem for elementary school students should be packaged in the context of everyday life and integrated with several ideas in mathematics.

The problem-solving process involves three interrelated aspects called Problem Solving Triad encompassing problem representation, prior student's knowledge, students' understanding of the problem, and problem structure (Sutton, 2003). Representation of the problem includes students mentally process and present the information contained in the problem in the form of visual representation. Representation of problems and prior student's knowledge direct students to problem understanding and structure of the problem.

Prior student's knowledge depends on the learning process. The student who learns in active engagement has higher problem-solving skills than the student who learn traditionally and

heuristics (Puran et al., 2017). An active learning student has the characteristic freely organizing knowledge, ideas, choosing strategies, and evaluating their opinions in the way they like. Student's independence in active learning is essential to improve their understanding of concepts and mathematical thinking ability. So, the teacher must facilitate students in physic activities in order students engage in mental activities and develop progressive thinking to find problem solutions.

On the other hand, Self-Regulation Learning (SRL) refers to students' self-generated thoughts, feelings, and actions that are systematically designed to affect the learning of knowledge and abilities (Zimmerman 2000). Self-Regulated Learning (SRL) refers to strategic and metacognitive behavior, motivation, and cognition aimed toward a goal (Hadwin, Järvelä, & Miller, 2011). Learning independence is self-regulation in terms of organizing thoughts, emotions, encouragement or tastes, and the appearance of tasks (Vohs and Baumeister, 2004). It is widely accepted that SRL has a crucial role in school achievement. Children and young people with higher levels of SRL are more likely to succeed academically than students with low SRL (Kramarski et al., 2013).

Self-Regulation Learning (SRL) is a fundamental element for all academic enterprise and success. In line with, the main cause of student failure in learning is the constraint of SRL (Cubukcu, 2009). Moreover, students who have high SRL have self-initiated, confident, strategic, task well, but students who have low SRL are anxious, low self-esteem, have higher approval requirements, and are more easily influenced by extrinsic factors(Cubukcu, 2009)[8]. The environment has a role in influencing SRL. Under an SRL perspective, learners are viewed as active participants in the learning process. Learners are assumed to construct their meanings, goals, and strategies from the information available in the "external" environment as well as information in their minds (the "internal" environment)(Pintrich, 2004). SRL generates thoughts, feelings, and activities that repeatedly adjust to the stimuli that individuals receive from the environment (Vávrová, Hladík, & Hrbáčková, 2012).

Problem-solving is one of the skills needed in the 21st Century, and SRL has a contribution to student achievement, it is necessary to develop both in elementary school students. One effort to improve problem-solving skills and SRL is to organize students working together in groups (Cooper et al., 2008; Rajabi, 2012). If students get a chance to work together, then the prospect of SRL will be better. Everybody has an average intelligence, the ability of understanding, learning, and mathematics attitudes in different levels. Thus, every educational system must provide a situation which is suitable for teaching and learning mathematics and students motivation (Adams et al., 2007)

Furthermore, Kubukcu (2009) explains that students who have high SRL, start themselves, be confident, be strategic, respond well to assignments. Whereas students who have low SRL are anxious, have low self-esteem, have higher approval needs, and are more easily influenced by extrinsic factors. SRL produces thoughts, feelings, and activities that repeatedly adjust to the stimulus received by individuals from the environment (Vávrová, Hladík, & Hrbáčková, 2012).

Every student has to develop their SRL, but it depends on the opportunities that are given to the students. The lack of opportunities given by the teacher such as exploration, observation, trial and error, and find solutions cause low SRL. Instead, providing a chance will give a positive impact, students will create their learning style and discover how to solve problems using reasoning or experiments, which ultimately raises self-confidence and responsibility.

One effort to improve problem-solving skills and to learn independence is to arrange students to collaborate (Cooper et al., 2008; Rajabi, 2012). The teaching model which meets these criteria is the Guided Discovery Learning (GDL) and REACT Strategy. According to

Willke & Strait, GDL exposes students to situations, questions, or tasks that enable students to discover concepts creatively (Pranoto et al., 2017). Students take an active part in the GDL learning process begins with questions followed by experiments, drawing conclusions, and evidence they find (Bamiro, 2015). This strategy is based on the scientific approach that provides a learner the opportunity to investigate, and the process must take place in appropriate circumstances and under the ongoing guidance of the teacher (Saleh, 2018). The role of teachers is to help students by asking questions that lead students to find concepts or solve problems in the form of learning problems learned. GDL appropriate for primary school students because it allows the students to see and understand the concept (Yurniwati & Hanum, 2017).

On the other hand, REACT strategy based on a context-based approach, five essential aspects are: Relating, Experiencing, Applying, Cooperating, and Transferring (Ültaye et al., 2015). It assists teachers and students in making associations between concepts regarding the subject and the context derived from real-life experiences (Bilgine et al., 2017). REACT strategy based on the contextual environment that the learning takes place naturally in the form of students' work and experience activities, not the transfer of knowledge from teacher to student (Sitiatava, 2013). In the REACT method, students' experience is used as a preliminary knowledge to be associated with new information that they want to give to students. Also, students will be guided to apply new concepts in solving problems. Not only the cognitive ability but also social interaction among students will be built through group activities.

In this context, the study aimed to compare the effectiveness of GDL and REACT strategies on problem-solving abilities and self-regulated learning. The research question is:

1. Are GDL and REACT strategy improved student's problem-solving skills and Self-Regulated Learning?
2. Which is more effective in improving problem-solving skills between GDL and REACT Strategy?
3. Which is more effective in improving SRL between GDL and REACT Strategy?

## **METHOD**

This study, a randomized pre-test-post-test comparison group design and conducted on 5<sup>th</sup> Grades students in South Jakarta, Indonesia. The research sample taken by the Cluster Random Sampling technique consists of 56 students comprised of 28 students experimental group and 28 students control group.

There are two kinds of data, problem-solving skills, and SRL. Mathematics problem-solving skills tested by essay and the indicator are: 1) problem-solving in mathematics content; 2) problem-solving in real-life context; 3) Apply a variety of strategies to solve the problem. There are 40 items questionnaire for SRL, and the indicator is: a) the will to learn mathematics; b) believe that mathematics useful; c) curiosity ; d) self believe.

Accurate instruments can be obtained through a calibration process with validity and reliability test. Problem-solving instrument validity tested by Product Moment Correlation and  $r_{\text{count}} > r_{\text{tabel}}$ , so all of the item is valid. Its reliability tested by Cronbach Alpha and get  $r_{\text{count}} = 0.71$ , and it means the instruments have a high level. SRL instrument validity attains 5 of 30 item drop, and its reliability attained higher category, tested by Cronbach Alpha.

Experiment group treated by GDL and control group treated by REACT strategy in fraction domain. The student in experiment group learning through four phases: introduction, open-ended phase, convergent phase, closure, and application (Jacobsen, Eggen dan Kauchak:2009). In fraction addition, the teacher introduces the situation in daily life. For example, mothers have  $1\frac{1}{4}$  m ribbon and will be joined by  $\frac{1}{2}$  m ribbon. How long are all of the ribbons? In the open-

ended phase, students use teaching aids to answer the questions. Students combine the two ribbons and measure their length. The measurement results obtained by the length of the band is 175 cm. Then students convert units of cm to m and find  $1\frac{3}{4}$  m. Convergent phase, students in groups work on fraction addition problems using teaching aids. Later in the closure and application phase, a class discussion is held to find conclusions and principles of working on the addition of fractions.

Control group learned using REACT Strategy through 5 stages relating, experiencing, applying, cooperating, and transferring. In the relating stage, students mention daily events related to fractions subtraction, such as giving chocolate bars to friends, eating a piece of cake, etc. In the experiencing stage, students explore the story problem by using teaching aids. Then proceed with the phases of applying and cooperating, solving problems individually or group. Finally, students practice problem-solving.

**FINDINGS**

Sebelum dilakukan uji hipotesis dilakukan uji normalitas dan homogenitas data. Problem-solving skills and SRL pre-test were homogenous (P-value = 0.856 using Box's Homogeneity of Covariance Matrices Test) and normal (P-value = 0846 using Shapiro-Wilk Multivariate Normality Test). It means that both groups of data meet the requirements of hypothesis analysis.

***1<sup>st</sup> Research Question***

The average score of problem-solving skills and SRL on the experiment group higher than the control group (Table.1). GDL and REACT Strategy can improve problem-solving skills and SRL. But it still needs a statistics test to prove it. Mancova Test with Wilks' Lambda criteria is done to find the difference of pre-test and protest between GDL and REACT.

**Table 1.** Data Description

	REACT				GDL			
	PS		SRL		PS		SRL	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
N	24	24	24	24	24	24	24	24
Mean	26.5	55.0	94.1	97.5	26.5	65.3	102	104
Median	25.0	54.0	93.5	99.5	26.0	66.5	103	104
SD	9.81	11.4	12.4	15.0	8.30	7.50	13.5	12.1
Min	10.0	35.0	70.0	71.0	10.0	50.0	71.0	75.0
Max	48.0	80.0	114	124	47.0	77.0	121	124

Table 2, shows that the pre-test score P-value = 0.316 means there is no difference in problem-solving skills and SRL between GDL and REACT. But post-test obtained P-value = 0.002 means there are differences in problem-solving abilities and SRL. Because of the difference of effectiveness, One-Sample T-Test is done, which is univariate test statistic to see which learning is more effective on each dependent variable.

**Table 2.** Mancova Test

	Value	F	df1	df2	P-value
Pre-test	0.915	2.08	2	45	0.136
Post-test	0.758	7.20	2	45	0.002

Table 4, GDL group obtained P-value <0.01 it means GDL effectively improve problem-solving and SRL. Also, on the REACT Strategies group obtained P-value < 0.01 then REACT improved problem solving and SRL.

**2nd research Question**

Furthermore, to know which is more effective improve problem-solving or SRL between GDL and REACT Strategies hence done by using independence test sample T-Test

**Table 3.** On- Sample T-Test

		Statistic	df	P-value
GDL	Problem- solving	15.6	23	<0.01
	SRL	42.6	23	<0.01
REACT	Problem- solving	37.0	23	<0.01
	SRL	42.1	23	<0.01

Problem-solving skills obtained P-value <0.001 in this case, problem-solving is more effectively improved with GDL than in REACT Strategy (Table.4).

**Table 4.** Independence sample T-Test

		statistic	df	P-value	Cohen's d
Problem Solving	Student's t	-3.70	46.0	< 0.001	-1.07
SRL	Student's t	-1.76	46.0	0.084	0.509

**3rd Research Question**

Base on Table 4, the P-value of SRL is 0.084, so it can be concluded that there is no difference in the effectiveness of SRL between learning with GDL or with REACT Strategy. In this case, the effect of GDL on SRL is as good as the influence of REACT Strategy .

**DISCUSSION**

Based on Manova Test and One-Sample T-test, it is known that GDL and REACT Strategies provide a positive effect on problem-solving skills and SRL. The effectiveness of problem-solving on GDL is due to investigation activities and investigative processes when students attempt to find concepts. Structured activities are starting from understanding the problem, doing exploration such as observation, experiment using learning aids before they make conclusions and generalizations (Yeo & Yeap, 2010). The advantage gained by students in GDL is students gain a conceptual understanding of complex problems. Conceptual understanding is a crucial requirement for understanding problems and devising strategies to solve problems. Therefore GDL improves students' problem-solving abilities, as it provides opportunities for students to understand concepts (Puran et al., 2017).

As well as REACT strategies, students begin by associating new concepts with events in everyday life. Then do physical activity with learning aids to conduct exploration and investigation. The activity aims to keep students close to the context of everyday life. In the application, stage, students apply the concepts and information gained in meaningful contexts through project, laboratory, text, or video. Collaboration trigger communication among member groups, sharing knowledge and questions answer. At the end of the stage is the transfer of student's knowledge of each other through oral presentation, report, or product. REACT strategy has been very successful in becoming an alternative to concept formation because of the context and visual facilities of everyday environments that motivating students' learning (Ültaye et al., 2015).

There are differences in the effectiveness of both methods of problem-solving skills and SRL. From the test results, independence sample T-Test for SRL obtained P-value =  $<0.01$ , so the problem-solving ability increased significantly in DGL than REACT. Improvement problem-solving skills in DGL occur because of the influence of GDL, especially in the convergent phase. At the convergent phase, students discuss the problem and how to solve a problem using learning aids and communicate in mathematics notations. For example pairing fractions and percent in groups, each group trying to find the pair of fractions and percent as much as possible. Students try to pair various possible matches in a variety of ways, ranging from trying to change each fraction on the number card to form a percent fraction or vice versa. The learning environment was conducive, and the students seemed to be actively discussing. At the time of the learning process, many groups have been able to find more than five ordinary fraction pairs and percent with discussions. Also, in closure and application phase, students present group findings in the form of answers mathematics problems. Presentation of problem answers from different groups develops students' insights on problem modeling and problem-solving strategies.

The last hypothesis about the effectiveness of DGL and REACT strategy in improving the SRL obtained P-value  $<0.01$  means there is no significant difference of influence between GDL and REACT Strategy on SRL. It happens because GDL and REACT using concrete material or model to provoke students to discover and understand new concepts. This is following research founding that learning aids improved self-regulated learning and mathematics achievement (Leidinger & Perels, 2012).

## **CONCLUSION**

Based on the research findings, it can be concluded that the DGL and REACT strategy has a significant effect on problem-solving and SRL. This is due to DGL and REACT Strategy having similarities in several ways, including involving active students, using teaching aids, learning happening in groups, and using contextual questions. Another finding is that GDL is more effective at improving problem-solving than REACT strategy. In learning by applying GDL, students' curiosity is more challenged in the open-ended phase. They use more creative teaching aids. Likewise, in the convergent stage of communication that occurs among students is more productive. In the development of SRL, there is no significant difference in improving the SRL with GDL or with REACT Strategy. DGL and REACT strategy are both exciting and fun. This study suggests the teacher pays attention to affective domain students, specially SRL.

This study recommends that teachers, especially in mathematics, not only focus on the cognitive domain but also pay attention to affective domains such as SRL. SRL has a positive influence on the learning process so that the quality learning process will have a positive impact

on student learning outcomes. Research related to affective domains in mathematics is still limited, so it is recommended for future researchers to research more about affective domains.

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