TA'DIB JOURNAL, 25 (1), 2022, (January-June)

ISSN: 1410-8208 (*Print*) 2580-2771 (*Online*)
Available online at https://ojs.iainbatusangkar.ac.id/ojs/index.php/takdib/index

The Implementation of REACT Strategy in Training Students' *Higher Order Thinking Skills* (HOTS)

Received: 28-12-2021; Revised: 22-02-2022*; Accepted:* 28-03-2022

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Abstract: This study aims to investigate the implementation of REACH strategies in training students' *Higher Order Thinking Skills (HOTS)* on critical thinking aspects. This research was a qualitative study. research type of research was descriptive research by using a qualitative approach. The research informants were student of the Mathematics Department of Mathematics and Science Faculty of Pamulang University. Techniques used in data collection were observation, interview and documentation. The results of data analysis showed that REACT strategies can be used to improve HOTS skills in students' critical thinking. Moreover it encouraged students to be active in participating in lectures. Students gave a very good response regarding the use of REACT strategies. This strategy must be used continuously for better learning outcomes, especially *the Higher Order Thinking Skill*, it can be exemplary achieved not only in critical thinking but also in the creative thinking.

***Abstrak**: Penelitian ini bertujuan untuk mengetahui implementasi strategi REACH dalam melatih* Higher Order Thinking Skills (HOTS) *siswa pada aspek berpikir kritis. Penelitian ini merupakan penelitian kualitatif. Jenis penelitian penelitian ini adalah penelitian deskriptif dengan menggunakan pendekatan kualitatif. Informan penelitian ini adalah mahasiswa Jurusan Matematika FMIPA Universitas Pamulang. Teknik pengumpulan data yang digunakan adalah observasi, wawancara dan dokumentasi. Hasil analisis data menunjukkan bahwa strategi REACT dapat digunakan untuk meningkatkan keterampilan HOTS dalam berpikir kritis siswa. Selain itu juga mendorong mahasiswa untuk aktif mengikuti perkuliahan. Siswa memberikan respon yang sangat baik mengenai penggunaan strategi REACT. Strategi ini harus digunakan terus menerus untuk hasil belajar yang lebih baik, khususnya Higher Order Thinking Skill, dapat menjadi teladan yang dicapai tidak hanya dalam berpikir kritis tetapi juga dalam berpikir kreatif.*

Keywords : Relating Strategy, Experiencing, Applying, Cooperating, and Transferring, HOTS

INTRODUCTION

The objective of mathematics learning is to train thinking skills, opinion skills, communication skills and the ability to contribute to solving mathematical problems contained in everyday life (Genc & Erbas, 2019; Muhtadi et al., 2018; Sari et al., 2018). These abilities are needed by the students to make them able to solve every mathematical problem and be able to provide solutions to these problems.

Learners are expected to be able to find solutions to complex problems in their lives. To have this ability, it needs to be honed early,

the predilection for mathematics needs to be cultivated.

When one talks about predilection in learning mathematics, he/she finds the fact that not all learners who like mathematics. Not a few of them say that mathematics is boring learning, mathematics provides less benefits in real life. Mathematical topics are only limited to calculations without anything to do with everyday life. Mathematics is boring, mathematics is difficult to understand and mathematics can only be understood by certain people (Larkin & Jorgensen, 2016; Laurens et al., 2018).

The difficulty of mathematics is felt by some students because mathematics contains many abstract concepts (Dreyfus, 2002), coupled with learning systems that generally require learners to memorize and put less emphasis on understanding concepts, it makes mathematics seems less interesting.

The results showed that mathematics learning was less desirable by learners, and mathematics had a perception that "less good" by learners, such as seem like boring subject. The students have the perception that mathematics can only be accessed by certain people (Arquitectura et al., 2015; Larkin & Jorgensen, 2016; Laurens et al., 2018).

In essence, learning mathematics is learning about concepts, learning about concept structures, and learning about finding relationships between concepts, therefore it is not surprising that learning Mathematics is abstract learning, because objects or symbols in mathematics are not in real life (Hendriana, H., Prahmana, RCI, & Hidayat, 2019)

The results of other research related to the mathematical learning system also mentioned that mathematics learning in Indonesian only emphasizes memorization and it has not been followed by understanding the concepts that can be applied in real life. In general, learning in Indonesian only emphasizes memorization and it is not accompanied by a deep understanding that can be applied in real situations (Nuari, et al. 2019)

Furthermore, in terms of the use of teaching methods used by educators, it has also not varied or learning still uses conventional methods, which makes learners passive in learning. As a result, the results of learning it self become low or not optimal.

The low of students result in mathematics are seen when they are given questions that require a high level of thinking skills. Anderson explained that there are three high-level capability indicators, namely, analyzing, evaluating and creating(Krathwohl & Bloom's, 2016).

The low mathematical ability of students seen after they are given questions related to critical thinking skills, questions that demand mathematical ability are given to first-year students who will take real analysis and abstract algebra courses. The results of the mathematical ability are seen in table 1.

Table 1. Student completeness in HOTS based questions

No	Indicators	Completeness of Solving HOTS / TA Based Problems		
		2018 /2019	2019/ 2020	2020/ 2021
1	Analyze	56%	58%	55%
2	Evaluate	55%	53%	52%
3	Created	52%	50%	50%

Source: Mathematics Department FMIPA Unpam

From table 1, the test are given to students give the results that they have not been maximized, starting from analyzing indicators (able to distinguish important and unimportant things, able to organize information obtained from various sources, and can connect the existing parts in one concept or problem), evaluate (can check existing facts and be able to criticize things that are not right or out of context) to create (create hypotheses or thoughts with certain criteria plan problem solving steps and produce new products). From the acquisition of these values, it is necessary to make special exercises so that the expected mathematical abilities can be obtained to the maximum.

If the data in Table 1 is observed, it can be seen that there is still a low level of students' high-level thinking ability, from the three indicators have not given good results. From the answers obtained by students are still constrained in terms of analyzing incoming information, identifying or formulating questions, there is still weakness in making

generalizations of an idea. The low mathematical ability is caused because the previous learning still focuses on low thinking skills or *Lower Order Thinking Skills* (LOTS).

For students who major in mathematics in the first year should have a high level of mathematical ability (HOTS). Where the ability to think high or often referred to as HOTS is defined as the ability to think critically, reflectively, logically, metacognitively, and creatively (Melliana Christie Nugroho, 2021), further according to Budiarta in windy et al explained HOTS can be interpreted as the ability of complex thinking processes that include parsing materials, critiquing and creating solutions to problem solving problems. (Windy Lara S. Samosir , Eko Kuntarto, 2020). Munir & Hartono (2016) further suggest that the use the use of HOTS would be interesting, engaging, and motivating in learning.

In the implementation of *Higher Order Thinking Skills*, educators are not enough to use only books and usual learning media. Educators need to prepare a variety of lesson materials that can cultivate students' critical thinking skills (Windy Lara S. Samosir, Eko Kuntarto, 2020). In addition to the use of teaching books, educators' creativity in using models or media in order to improve the mathematical ability of learners is also required.

The level of high-level thinking ability, namely C4, C5 and C6 (Melliana Christie Nugroho, 2021), Anderson explained in more detail related to high-level thinking ability indicators, namely: (1) *Analyze* (C4), the ability to analyze incoming information in order to identify and distinguish the cause and effect of a scenario that is difficult to determine or formulate problems; (2) *Evaluation* (C5), i.e. students can use standards that meet existing standards to evaluate solutions, ideas and methods to ensure their effectiveness/benefits; (3) *Create* (C6), i.e. students can design problem solving and organize elements and parts into an unprecedented new structure. (Krathwohl & Bloom's, 2016)

According to Conklin, W., & Manfro, J. in Erfan and sutrio the main characteristic of high-level thinking is being able to think critically and being able to think creatively (Muhammad Erfan, 2018; Sutrio et al., 2018)

One aspect that must be possessed by students at a high level of ability is the ability to think critically. Where the ability to think critically of one's ability to analyze an idea using logical reasoning (Hidayah et al., 2017), then Yasushi Gotoh (2016) also explained that critical thinking is, "(Hidayah et al., 2017)*Critical thinking as the set of skills and dispositions which enable one to solve problems logically and to attempt to reflect autonomously by means of Metacognitive regulation on one's own problem-solving processes*." (Yasushi Gotoh, 2016), meaning a set of skill owned by learners to solve problems logically.

For students majoring in mathematics or mathematics education who require a high level of thinking skills, in addition to helping in solving every mathematical personal that is so complex, it will also help students easily accept concepts from courses that *require* critical thinking skills, such as abstract algebra courses, real analysis, complex analysis and others, then train High-level thinking skills must be trained from the first semester.

Recognizing the importance of high-level thinking skills in mathematics learning, it is necessary to use learning strategies that can provide opportunities and encourage students to practice these abilities. The need for new methods or strategies in learning will increase students' interest in learning, so as to increase the motivation of students in practicing their mathematical skills.

Learning steps that are considered new for students will increase students' interest in learning, therefore to optimize the achievement of basic competencies (Berlyne, 1960 in Ismawati, 2017) (Ismawati, 2017). One strategy based on contextual learning that can be applied in lectures is the strategy *of relating, experiencing, applying, cooperating, and transferring* or abbreviated as REACT.

REACT strategy is the implementation of contextual learning approach through its stages, namely *relating* (hooking), *experiencing* (experiencing), *applying* (applying), *cooperating* (working together), *transferring* (moving) (Ismawati, 2017; Sari et al., 2018). According to CORD in teaching based on contextual strategies compiled aimed at encouraging students to get involved in the classroom (Ismawati, 2017).

Learning with REACT strategy will provide many learning experiences for the students, because this strategy is better known as lifelong learning; learners learn by actively exploring the information and technology needed, both individually and in groups to build knowledge; learners not only master the content of their subjects but they also learn how to learn (Kurniasih, 2012; Sari & Darhim, 2020). Learning with the concept of providing experience, application, and working together in finding concepts and able to motivate learners in improving, training and developing abilities Mathematically.

According to Wena in Mala REACT learning strategy developed from contextual approach or *Contextual Teaching and Learning* (CTL) is a learning concept that helps educators relate learning materials with real-world situations of learners (Mala et al., 2019)

Many research results state that REACT strategy has a positive impact on mathematical ability, such as, having an influence on the ability to understand concepts (Anas & A, 2018; Junedi & Ayu, 2018; Malini et al., 2020; Novri et al., 2018). Other studies also mention that REACT strategies have an effect on improving mathematical reasoning skills (Kurniawati et al., 2021). Furthermore, *the study of quasy* experiments showed that REACT strategies are more effective than conventional learning from aspects of mathematical learning achievement, problem-solving ability, connection ability, self-efficacy, and motivation (Irjayanti & Heri, 2015)

It is important to use strategies in learning because by using strategies facilitate the learning process so that it can achieve maximum results (Mala et al., 2019). Thus, the purpose of this study is to describe how the implementation of REACT strategies to develop high-level thinking skills or *Higher Order Thinking Skills* (HOTS) that focus more on critical thinking skills. Indicators of critical thinking ability in this study are focusing in questions, considering the credibility of a source, making and determining the results of consideration, inducing and considering the results of induction, defining terms and considering a definition and determining an action.

METHOD

This research is descriptive research with a qualitative approach, research aims to describe how the application of REACT strategies in training high-level thinking skills. The population of this study is a student of the Mathematics Department of Mathematics and Science Faculty of Pamulang University. Sampling is using purposive sampling techniques. Population gained learning using REACT strategies. In this study, researchers acted as lecturers in the learning process while the first author was a validator and observer.

Data collection techniques are carried out by surveys, interviews and documentation. The survey was conducted after the lecture took place. The observation sheet used to see the conditions that occur during the lecture process, the instrument is arranged based on the characteristics of react strategy.

REACT strategy (*Relating, Experiencing, Applying, Cooperating, Transfering*) is contextual-based learning. Contextual learning is a learning concept that can help teachers in connecting the concepts learned with the real world and encourage students to construct a relationship between knowledge owned and daily life.

The instruments used in the research were developed through these five stages, namely 1) *relating,2*) *experiencing* (experiencing), 3) *applying* (applying), 4) *cooperating* (cooperating), and 5) *Transferring* (transferring).

The observation sheet that has been filled by the observer is evaluated to see what

aspects must be improved. Interview techniques are carried out with the aim of knowing the obstacles experienced by students during the lecture process, and then documentation is done to document all activities which has been carried out, in the form of photos or videos of lectures

The learning tools used in this study are RPS, Syllabus, and Teaching Module. RPS uses REACT strategy, so that students can build their knowledge, in this RPS is also emphasized to train and develop high-level skills or HOTS. in addition, the material in this study is trigonometric comparison in trigonometry courses.

RESULTS AND DISCUSSION

The learning process by using REACT strategy is a learning process consisting of connecting, experiencing, implementing, cooperating, and transferring (Sari & Darhim, 2020), the implementation of REACT strategies designed to train high level thinking skills. In its implementation, learning runs smoothly and gets a positive response from students. This can be seen from the activeness of students in every lecture activity. The activeness of students can be seen from the high learning motivation, actively discussing in groups, actively asking questions, and students are more enthusiastic in doing the questions that given.

The initial stage of the lecture lecturers conveyed several questions to students, almost all students can answer these questions based on their daily experiences, because of the delivery of mathematical problems. Starting from real or contextual problems will be easily responded to by students (Crawford, 2001), although there are some students who have not been able to answer and respond. In the initial activity, lecturers can design responsive experiences and learning in building students' knowledge with things they know, so as to form a deeper understanding. In response to the questions given by lecturers, almost all students are able to do so. This can increase motivation, passion, interest and can increase confidence (Furner & Berman, 2005).

At the stage of linking activities, lecturers provide examples related to problems in everyday life, to find the concept of trigonometric comparison starting from the problems of life until the student can form a triangle and determine the comparison of the triangle. The last, students were able to find a trigonometric comparison concept. This is important because it will restore the initial knowledge of students who have been previously owned (Kurniasih, 2012), through this step, the next problem presentation activity can be done with accommodation which is to cause new problems by considering the knowledge that has been done by students (Sari & Darhim, 2020). Furthermore, related activities are revealed in the submission of questions, such as:

Figure 1. Example of Problem 1

From problem 1, students are asked to describe the type of building formed from the problem.

After the student forms a right triangle from problem 1, then the student is asked to determine the comparison of the sides of the triangle. Here is the shape of the triangular building formed from the problem 1.

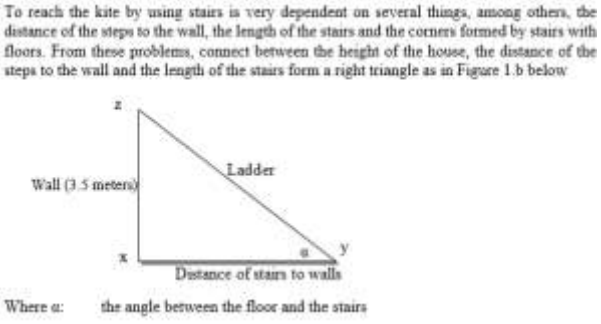

Figure 2. Building a right triangle of problem 1

Then, students are given a stimulus to mention all the comparisons from the sides of the triangle, such as stairs to walls, walls versus floors and so on.

This problem is given to make students can find a comparison that they can finally find the concept of trigonometric comparison, The value of comparing the sides of the right triangle in problem 1 named trigonometric comparison value consisting of 6 (six) kinds of namely: sine (sin) is the front side per oblique side, cosine (cos) is the side per oblique side, tangent (tan) is the front side per side, sec (sec) is the opposite of cosine, cosecant (csc) is the opposite of sinus and cotangent (cot) is the opposite of tangent.

In this activity, students are required to be able to analyze, evaluate and create. The process of creating students through the application of trigonometric municipalities.

Student involvement in responding to questions from lecturers is a form of mathematical disposition (Polking, 2019). Questions that can be answered by most students start from life experiences or knowledge that they already have designed to stimulate student involvement in lectures. Involvement is seen in a strong curiosity to know something or to solve a problem, for example when the lecturer gives a question or problem (such as a picture 1). Questions from students are answered by *scaffolding* in the form of questions close to students (Kurniasih, 2012).

During the learning process, students are equipped with modules, the use of this module aims to make it easier for students to find mathematical concepts. CORD in Pramata sari (2020) mentions that learning by giving special treatment is learning in the context of exploring, and discovery (Sari & Darhim, 2020), these activities are seen at the time of involvement of students or learners in every activity carried out in the classroom, including various instructions through assignments in the modules.

The learning process that focuses students makes a connection between the concepts learned with real life, as well as encouraging students to connect knowledge that is learned. It is related to real-life applications (Djadjuri, et al., 2015). REACT learning has a gradual understanding strategy so that it can maximize students' thinking skills (Durotulaila et al., 2014)

To see the high level of ability of students, especially in the ability to think critically, it can be seen from the following indicators, namely focusing questions, considering the credibility of a source, making and determining the results of consideration, induce and consider the results of induction, define terms and consider a definition as well as, determine an action.

The first indicator of critical thinking skills is focusing questions. Measurements on this indicator are based on learners' ability to focus on problems and identify criteria for considering possible answers. This indicator has increased, the increase that occurs is supported by the stimulus given at the *relating* stage of the REACT strategy. Students are trained to express opinions and communicate in explaining information from the problem provided. Students are given stimulus to be able to answer every question from lecturer. At this stage, students' knowledge is built through experiences they have experienced in the real world. With this desire, students are accustomed to identifying criteria to consider possible answers to the problems given.

The increase in skills at this stage is due to the *relating* process, the same thing as the results of research conducted by Rahmatoh in Ihsani, et al, that at the stage *relating* in REACT strategies can improve basic explanations skill (Ihsani et al., 2020). At this stage, students are also trained to develop the ability to focus questions, analyze and ask questions and answer every mathematical problem. (Yotiani et al., 2016)

The 2nd indicator is to consider the credibility of a source. The ability on this indicator is aroused at *the experiencing* stage of the REACT strategy. Students are trained to compose work steps by sorting random work steps. This makes learners have the ability to consider the credibility of a source and provide reasons for what has been chosen.

Observation assessment is seen from the ability of learners to conduct experiments in accordance with the steps of work so that learners are trained to consider the credibility

of the source by analyzing the correctness of the work steps used during the experiment. Through experiments, learners are given knowledge directly by means of exploration rather than just imagining. In planning the experiment, learners are required to determine the right procedure by considering the known aspects (Sahri Ramdan, 2015).

The *experiencing* stage can build the basic skills of learners based on the ideas contained in the *relating* stage, because at this stage learners explore through experiments so as to find themselves newly learned concepts (Arifin et al., 2014).

The third indicator is to make and determine considerations. The ability to make and determine the results of consideration leads students to express opinions based on existing facts (Rusmansyah, 2017). In making and considering decisions must be made wisely, because we must be able to distinguish between facts or not the right ones and consider the suitability of sources (Ennis, 2015)

The ability to make a consideration can be improved through practicum activities (Yotiani et al., 2016). Learners are directed to make a consideration through discussion and analysis so that the ability to make and determine the results of considerations can be improved (Yotiani et al., 2016). In REACT learning, students are directed to learning that causes curiosity to search so that they can find their own concepts and convey the information to others (Riva Ismawati & Saptorini, 2015). In finding and determining the results of consideration, students are asked to convey ideas derived from existing facts related to the problems presented (Rusmansyah, 2017).

The fourth indicator is inducing and considering the results of induction. In this indicator, learners are required to be able to make logical reasons that can later be drawn an answer from the reason (Nisa et al., 2017). The stage in REACT learning that can stimulate this indicator is the *experiencing* stage. This stage trains students to draw conclusions based on the results of experiments.

At the first meeting, students were still not precise in drawing conclusions because the conclusions made did not answer the purpose of the experiment. However, at subsequent meetings students have become accustomed to drawing conclusions based on the facts of the results of the experiment and in accordance with the purpose of the experiment conducted.

Learners are expected to be able to make conclusions well when discussing in the groups at the *experiencing* stage, their skills in making conclusion can be improved by the activity of concluding the findings during practicum (Arifin et al., 2014) Learners are trained to make conclusions based on practicum results so that learners can formulate, analyze and make conclusions (Yotiani et al., 2016). The results of this study are different from the results of the study (Syintia et al., 2018) which stated that the indicator inferred can be increased through *the cooperating* stage. At the *cooperating* stage, students are trained to discuss to conclude the results. experiments that have been done so that the indicator concludes to increase.

The fifth indicator is defining a term and considering a definition. Ennis (Ennis, 2015) explains the term and considers a definition that is an attempt to interpret a word.

The results of other studies related to the fifth indicator also state that *the cooperating* stage can help improve the skills of learners to provide further explanations (Arifin et al., 2014), because at this stage learners have opportunities to convey ideas and get feedback from other group members, so that students can evaluate their own understanding.

The sixth indicator is determining an action, seen in activities using concepts in accordance with existing criteria (Rusmansyah, 2017). At the *application* stage, students use concepts that have been learned and trained to provide solutions to given mathematical problems. At the *Applying* stage, students apply the concepts they have learned to solve realist and relevant problems (Karima et al., 2016).

The last stage of REACT strategy is *transferring*, at this stage students use their knowledge to do the exercise in a new context. Students can exchange ideas with group friends regarding what they find. *Transferring* means learning, using and expanding on what is already known. In the learning process, deep understanding is obtained from the ability to think and transfer knowledge (Karima et al., 2016).

The indicator aims to determine an action that arises when learners discuss in solving problems and answering questions in the worksheet (Ihsani et al., 2020). At the *stage of applying* and *transferring* students can make strategies in applying the concepts being studied (Arifin et al., 2014). The *applicationing* stage is carried out when solving the given problem, while the *transferring* stage is done by providing questions to evaluate the understanding of student concepts (Arifin et al., 2014)

The results and discussions clearly show that REACT strategies have a positive effect on students' mathematical abilities, especially on the ability to think critically. Implementation of REACT strategy by using teaching materials in the form of *hand outs* and valid lecture modules. This obviously has a positive impact on student activities, because students construct their thoughts by studying hand outs and modules (Darling Hammond, Flook, Cook-Harvey, Barron, & Osher, 2019).

CONCLUSION

REACT strategy is the implementation of a contextual learning approach. REACT strategies can be applied in developing high-level thinking skills that involve students actively through stages. The implementation of REACT strategy went smoothly and received an enthusiastic response from students. This can be seen from the activeness of students in every learning activity in the classroom. The activeness of students in the classroom can be seen from the high motivation of learning, the activeness of students in discussing in groups, asking lecturers. Students are more excited when studying, especially when lecturers ask students to present their work in groups.

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