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EFFECTIVENESS OF GUIDED DISCOVERY-BASED MODULE: A CASE STUDY IN PADANG CITY, INDONESIA

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Abstract

One of the research objectives was formulated to improve the quality of education, namely by understanding the problems of students and teachers. There were three main groups of quality characteristics of education highlighted in scientific and academic literature in Russia, namely the quality of educational objectives, the quality of the educational process, and the quality of educational outcomes. The problem of education in Indonesia is the quality of the education process. The development of teaching materials is an alternative to improve the quality of the education process. Research so far has only focused on the implementation of learning models by teachers in the classroom, but the model is not integrated into the teaching materials used. This paper examines how the effectiveness of a product that has been developed for two years on 27 Indonesian students. The product produced is a guided discovery-based module in the Complex Analysis subject. This product was developed after the preliminary analysis (defining) process. Students are given 16 modules during lectures; then students are given a final test containing all the competencies that must be achieved. Test results are scored, and statistical analyses are conducted to compare them with student score before using the module. The test used is t-test. The design used is one of the experimental research designs, One Shot Case Study. The results of the study showed that students who were taught with modules developed effectively to improve student learning outcomes. Further research can be done by implementing different learning models in teaching materials.

Keywords: Module, Guided Discovery, Effectiveness, Learning Outcome

Abstrak

Salah satu tujuan penelitian dirumuskan untuk meningkatkan kualitas pendidikan,yaitu dengan memahami masalah siswa dan guru.Ada tiga kelompok utama karakteristik kualitas pendidikan yang disorot dalam literatur ilmiah dan akademik di Rusia, yaitu kualitas potensi tujuan pendidikan, kualitas proses pendidikan, dan kualitas hasil pendidikan.Masalah Pendidikan di Indonesia adalah kualitas proses pendidikan. Pengembangan bahan ajar adalah alternatif untuk meningkatkan kualitas proses pendidikan. Penelitian selama ini hanya berfokus pada implementasi model pembelajaran oleh guru di kelas, namun model tersebut tidak terintegrasi pada bahan ajar yang digunakan.Tulisan ini meneliti bagaimana efektivitas suatu produk yang telah dikembangkan selama dua tahun terhadap 27 pelajar Indonesia. Produk yang dikembangkan adalah modul berbasis penemuan terbimbing pada matakuliah Analisis Kompleks. Produk ini dikembangkan setelah proses analisis awal (pendefinisian). Siswa diberikan modul selama perkuliahan sebanyak 16 pertemuan, kemudian siswa diberikan tes akhir yang berisi semua kompetensi yang harus dicapai.Hasil tes diberi skor dan dilakukan uji statistik untuk membandingkannya dengan skor hasil siswa sebelum menggunakan modul. Tes yang digunakan adalah *t* test. Desain yang digunakan adalah salah satu desain penelitian eksperimen, yaitu One Shot Case Study. Hasil penelitian menunjukkan bahwa siswa yang diajar dengan modul yang dikembangkan efektif untuk meningkatkan hasil belajar siswa. Penelitian lanjutan dapat dilakukan dengan mengimplementasikan model pembelajaran yang berbeda pada bahan ajar.

Kata kunci: Modul, Penemuan Terbimbing, Efektivitas, Hasil Belajar

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One of the problems in education is the incompatibility between the implementation and the education system, as well as the insufficient readiness of lecturers to teach (Fominykh, *et al*. 2016; Hanapi &

Nordin, 2014). Several researcher already research to improve the quality and readiness of teachers in education (Prahmana & Suwasti, 2014; Shahrill, *et al*. 2018; Muhtadi, *et al*. 2018; Ahamad, *et al*. 2018). These studies were carried out to improve the quality of learning process that provide appropriate solutions to help students' and teachers' weakness in learning mathematics.

There are various research to diagnose student weaknesses, such as studies about the difficulties and characteristics of students in solving a problem (Shahrill, *et al*. 2018; Harisman, *et al*. 2017; Sukirwan, *et al*. 2018). The students' difficulties can be seen from various aspects ranging from gesture outward up to their high level of thinking. One of the studies that look at the difficulties from the student's gesture is the research conducted by Harisman, *et al*. (2017) who saw how consistency gesture two junior high students in solving geometry problems. The conclusion of this study is there is a significant difference from the gesture shown by both boys and girls. The results were used as a diagnostic tool at the time of giving the material, whether girls or boys familiar with the material given or the material needs to be repeated.

Research conducted by Muir, *et al*. (2008), which examines the consistency of the behavior of 20 elementary school students in solving mathematical problems is research to diagnose a high level of thinking students. The Results of Muir's study is obtained information about the problem-solving behavior of students in grade 6. A detailed description of the type of strategies they used and how this strategy implemented has been discussed in the paper. The impact of Muir's research by reviewing research from Lowrie (1999) is recommended to use the problem posing in the learning process; he discovered that the problem-posing could help children to think about the problem-solving process with a sophisticated manner. It can be concluded that one way to improve the quality of learning is to choose a strategy that fits with the student's difficulties. This issue is also supported by Kaur & Blane (1994), using the same problem with Muir, *et al*. (2008); they diagnosed a variety of different strategies used by students at various grade levels in Singapore. The research result detects student weaknesses and provide appropriate solutions to overcome these problems.

Based on these studies, many ways made by teachers (including lecturers) in diagnosing the weaknesses of students. This study was also conducted to diagnose student weaknesses and then find a solution. The previous studies provide a solution with the teaching strategies or models (Sovia, 2015a; Sovia, 2015b; Sovia, *et al*. 2016). Furthermore, this study examines how a developed book can contribute to improve the student achievement. In the first year has seen the score of learning outcomes from Complex Analysis courses, students who receive grades of less than 65 (categories C, D, and E) of 44.91%. The fact that it is still far from the expectations due to students not understanding the material presented in teaching materials. During this time, the learning process of Complex Analysis use the lecture method and teaching material, namely textbook. Based on the observations of researchers, the use of conventional method cause learning becomes monotonous. Teaching material used in the learning process has not been able to construct and guide students to develop their knowledge. It is because learning model is not integrated into teaching material. Students do not understand the material

presented in teaching material (Sovia, 2015b). Therefore, the guided discovery module is suitable for teaching material.

This study is important because one way to improve the quality of learning is by doing research development. There has been a report of a survey of 1,722 teachers in 31 schools in the United States on effective ways to help teachers learn to change and develop the confidence, knowledge, potential, and change the way they teach that the desired instructional goals can be achieved (Kisa & Correnti, 2015). Their research form is survey research to improve the professionalism of teachers in teaching. In addition to teaching, according to Fishman, *et al*. (2013) curriculum is a core component of teaching, and learning context means that the curriculum can be developed to improve the quality of learning. The curriculum is closely associated with learning devices ranging from the syllabus, planning for learning, and teaching materials. Teaching materials are not by the characteristics of students will affect student learning outcomes. In addition to the development of teaching material, development of assessment tools can also be performed. A total of 24 teachers develops strategies for formative assessment; this was due to the pressure on schools to improve the results achieved by students in various tests (Wiliam, *et al*. 2004).

Hill, *et al*. (2004) conducted a diagnosis of the way teachers teach with designing measures to teach basic math. It is one form of researches to develop ways to teach basic math. Furthermore, one study in the field of mathematics studies on the development of teaching materials is research by Gomez, *et al*. (2015). Three college faculty of engineering science is used as a subject to design, develop, and improve contextual mathematics lessons where we concluded that language and literacy pedagogy gives a prominent influence in teaching materials. In this paper will be seen how the influence of the use of teaching materials developed by teachers (lecturers) to students mathematics learning outcomes. In the other hand, this paper also contains the final stage of the research that has been done continuously and periodically since 2015. This paper discusses whether there is an influence or effect of the use of modules to the 27 students who took a course Complex Analysis. For one semester, students learn using the guided discovery-based module, which has been valid and practical. At the end of the semester, students are given problems, then score outcomes after using the modules compared with a score of student results before using the module. This study aims to answer the question of whether there is an effect of the use of the module to the achievement of learning outcomes.

METHOD

Description of study

This study was a continuation and the last part of the research that has been conducted for two years. The guided discovery-based module, in the course of Complex Analysis, developed with 4D (Define, Design, Develop, and Disseminate) development methods. The first phase analyzing the needs of the students obtained the results that they need instructional materials capable of guiding to find the concepts. After going through a defining phase, that is the analysis of the syllabus, analysis of textbook,

interviews, analysis of student needs, and analysis of the literature, can be concluded that students require module-based guided discovery learning in Complex Analysis, at STKIP PGRI Sumatera Barat. The second phase of research and development (4D model) is the design stage (Sovia, 2015a). The module is designed of several learning activities where each activity contains learning materials, examples, exercises, feedback, follow-up, and an answer key. The next phase is the validation. The results of the validity of the product obtained that guided discovery-based module developed is very valid. Therefore, the module is eligible to be tested (Kariman, *et al*. 2015).

This research continued in 2016 to know the practicality of the modules. The module is tested on students at a large scale and small scale. On a small scale, six students were asked to fill questionnaires to understand the practicalities of modules that have been designed and tailored to the aspect of practicality; it can be concluded that the guided discovery-based module is very practical (Kariman, *et al*. 2016). In large-scale trial also showed that the modules are practically in every aspect (Sovia, *et al*. 2016).

Lastly, this study reveals how the effectiveness of the modules that have been developed. The effectiveness of the module to be reviewed on the aspects of learning outcomes 27 students who participate in Complex Analysis courses. This study aims to prove that there is influence the use of teaching materials developed to student results. One way of presenting the impact of development programs or products are designed closely related to the effectiveness of the program (Kennedy, 2016).

Participant

This research has been conducted for two years toward 27 students who took courses Complex Analysis in STKIP PGRI Sumatera Barat, Indonesia. One of the relevance of the subject matter that can be chosen for the study is conditioned by the difference between (a) the educational orientation pedagogical modern at future teachers and training based on the subject matter and content, and (b) the need to develop pedagogically. Based on these opinions, if the orientation of the teacher (or lecturer) is different from the orientation of the students, then improvement needs to be done. They have a characteristic, such as low learning achievement indicated by the data of lecturers, students who receive grades of less than 65 (categories C, D, and E) of 44, or 91%. It is, of course, different from the orientation of the lecturers, who expect students have good point.

Task

The task given to measure student learning outcomes at the end of the course for a semester after the use of the module is as follows.

1. Let $u(x,y) = y^3 - 3x^2y$, specify a function $v(x,y)$ so$f(z) = u + iv$ analytic. Then stated $f(z)$ in the term of z.
2. Specify
   a) $\frac{d}{dz}\left(2z\cos^{-1}(\ln z)\right)$
   b) $\lim\limits_{z\to m\pi i}(z - m\pi i)\left(\frac{e^z}{\sin z}\right)$

c) $\int_0^{\pi i} sin^5 z\, dz$

3. Note $z(t) = 3\cos t + i \sin 2t \text{with} 0 \leq t \leq 2\pi$. Investigate whether $z(t)$ is Jordan curve.
4. Count $\oint_c (\bar{z}^2 + 1)dz$ around the closed curve bounded by $y = x \text{and} x = 2$.

Four issues have been selected because it contains the entire basic competence in the subject of Complex Analysis. Each lecturer of the course has discussed this task. Task or problem has also been validated by the team of quality groups from mathematics education courses STKIP PGRI Sumatera Barat. The validation matter relating to the language problem, content, compliance with the material, level of difficulty, distinguishing features, and things that need to be considered in the selection of matter. The problem also considers the phases of mental development of students. It is providing the social situation of the development of age-appropriate. If all task is fulfilled, the students would show more activity and high creativity.

Procedure

A total of 27 students in teaching with Complex Analysis module for one semester were given the test with questions that are on the task at the end of the lecture. Having obtained a student answer sheet, the value is compared with the student before using the module. This research can be classified to experimental research. The design used is one shot case study that can be seen in Table 1.

Table 1. Research design

Class	Treatment	Post-test
Experiment	X	O

Description:

X: Treatment of a sample class, which is teaching and learning activities using complex analysis module based on guided discovery

O: Students test at the end of treatment

Learning outcomes were analyzed, and it aims to test the hypothesis. The hypothesis is:

H_0: There is no effect of Complex Analysis module based on guided discovery, to the learning outcomes

H_1: There is an effect of Complex Analysis module based on guided discovery, to the learning outcomes

This design was chosen because it was considered appropriate to resolve the problems faced by the students of 2013. The research looked at whether there is influence the use of the module to the achievement of student learning outcomes. Systematic teaching corrected later seen its effects on students. Lu, *et al*. (2014) did the same with the aim of the research was to evaluate the effectiveness of a synergistic approach to educational research. This research was conducted for graduate students in Hispanic-Serving Institution (HSI). The interdisciplinary group of faculty members to develop a series of workshops. Researchers conducted a pre-posttest and survey methods to evaluate all of the workshops. The result shows that student learning outcomes are increased. A synergistic approach, effective on a group of students.

Data Analysis

Data were analyzed by correcting the entire answer sheet, 27 students. Once the data was obtained in the form of a score of student results, scores were compared with scores of students before being given treatment (before using the module). The data is processed by using the t test to answer the research hypothesis. Trials or experimental research is really to see the cause-effect relationships of a phenomenon (Kadir, 2019).

RESULT AND DISCUSSION

Effective or not a product, method, or learning model can be seen by the increase or changes in motivation, learning outcomes, behavior, and so forth in a better direction. In this paper will be seen, the effectiveness of the product in the form of guided discovery-based modules, the lectures Complex Analysis in STKIP PGRI Sumatera Barat, Indonesia. Effectiveness highlighted here is on aspects of learning outcomes of students who attend the lecture. The effectiveness of student learning in mathematics, being TIMMS or PISA assessment is determined by several factors (Sugilar, 2016; Stacey, 2011). The Indonesian education system is often said that the students' achievement in mathematics is a major factor for teachers (Shadiq, 2013; Fitri & Prahmana, 2019). One indicator of success in learning is good learning achievement by students after going through the learning process.

Class begins by giving modules that have been developed over two years through the research design development of teaching materials with the type of 4D. Students are asked to read the material on the module. If there are difficulties in understanding the material, the student can ask the lecturer. Since reading and understanding the material, students are asked to do exercises in the module. The example of the student answers after learning by using the module can be seen in Figure 1.

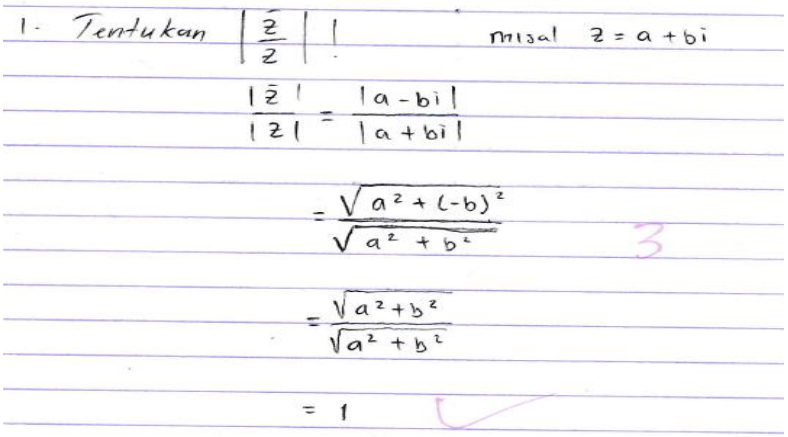

Figure 1. Student's answer in solving exercise 2 no. 1 in the module

Figure 1 shows that students can resolve the problem of the absolute values perfectly. It means that the module can make the students managed to learn independently, with the guidance of the steps on the description of the material without the guidance of a lecturer. After the students do the exercise, the lecturer gives reinforcement to the students about the parts that are considered important. Furthermore, the training modules also presented a practical exercise to do at home. Homework is given

for the student to repeat the subject matter at home. The characteristics of human memory has a relationship with the construction of personality (Dudina, *et al*. 2016). As a result, sometimes some students have a short memory, so it must often repeat the lessons at home. One form of answers from students in completing the tasks assigned for homework can be seen in Figure 2.

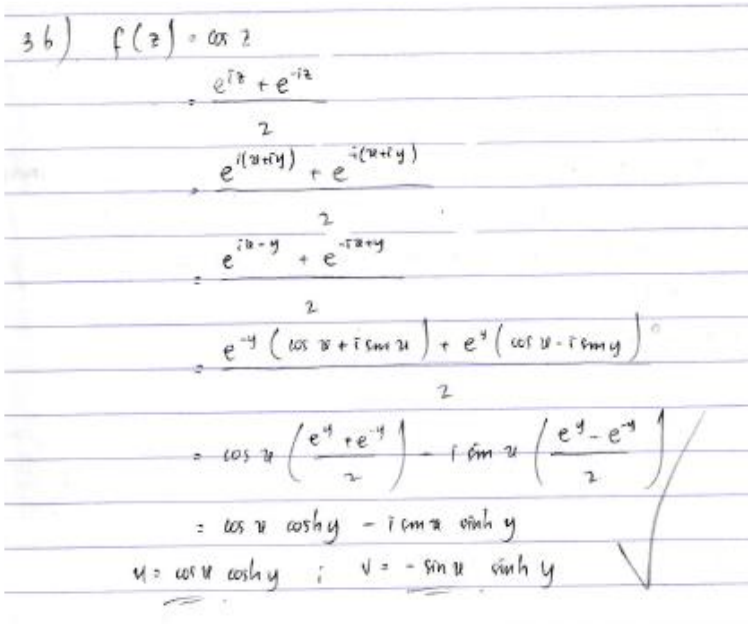

Figure 2. Students form of response to the Task (exercise 1) number 3b

Figure 2 shows the student's answer who also had no problems in answering the question of trigonometric functions. It is due to the module has been guided to construct a detailed knowledge through the guidance of the material that is needed to resolve the problems.

To determine whether the hypothesis is accepted or rejected, then the score of the learning outcomes before and after using the modules was analyzed using t test two-way. The student learning outcomes data before and after using the modules that are calculated through average, standard deviation, the highest value and the lowest value of 27 students were given treatment and were not given the treatment can be seen in Table 2.

Table 2. Calculation of average ($\bar{X}$), standard deviation (S), the highest value (X_{maks}), the lowest value (X_{min}) final test sample class

Sample Class	$\bar{X}$	S	X_{maks}	X_{min}
Before treatment	32,11	17,41	63	8
After treatment	41,70	13,52	69	15

Table 2 revels an average score of student results after given treatment is higher than the average score of student's learning outcomes before treatment. It indicates that the value is better after treatment than before treatment. Furthermore, performed statistical tests to see if there is the influence of the use of the modules to students. Hypothesis test results on the real level $\alpha = 0{,}05$ obtained $t_{count} = -2{,}46$

and $t_{table} = 2{,}05$, because $t_{count} < -t_{table}$ then reject $H_0$and accept H_1. Thus, it can be concluded that the use of Complex Analysis module in lectures effect on learning outcomes. How students can complete all the tests were given. The answer to the task No. 1 at the final test of ability levels of students (high, medium, and low) can be seen in Figure 3.

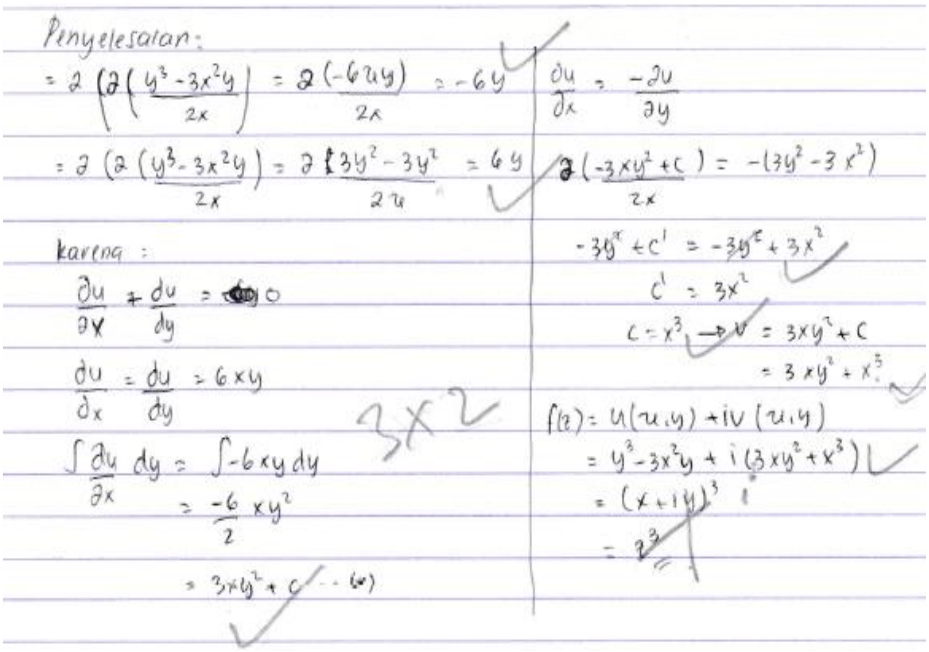

Figure 3. Forms of student's answer (with low ability) for Task 1 in final test

Based on the student's answer in Figure 3, the low-ability student has been able to solve problems on harmonic functions and Cauchy-Riemann equations, just at the end there are deficiencies in the states $f(z)$ in the term of z.

Figure 4. Forms of Student's Answer with Medium-Ability for task 1 in the final test

Figure 4 shows that students who have the medium-ability able to answer the question and almost perfect. But, just as low-ability students, there is still a bit of a mistake at the end of the answer, which is expressed $f(z)$ in the term of z. Furthermore, for high-ability students, the form of representation of one of their answers can be seen in Figure 5.

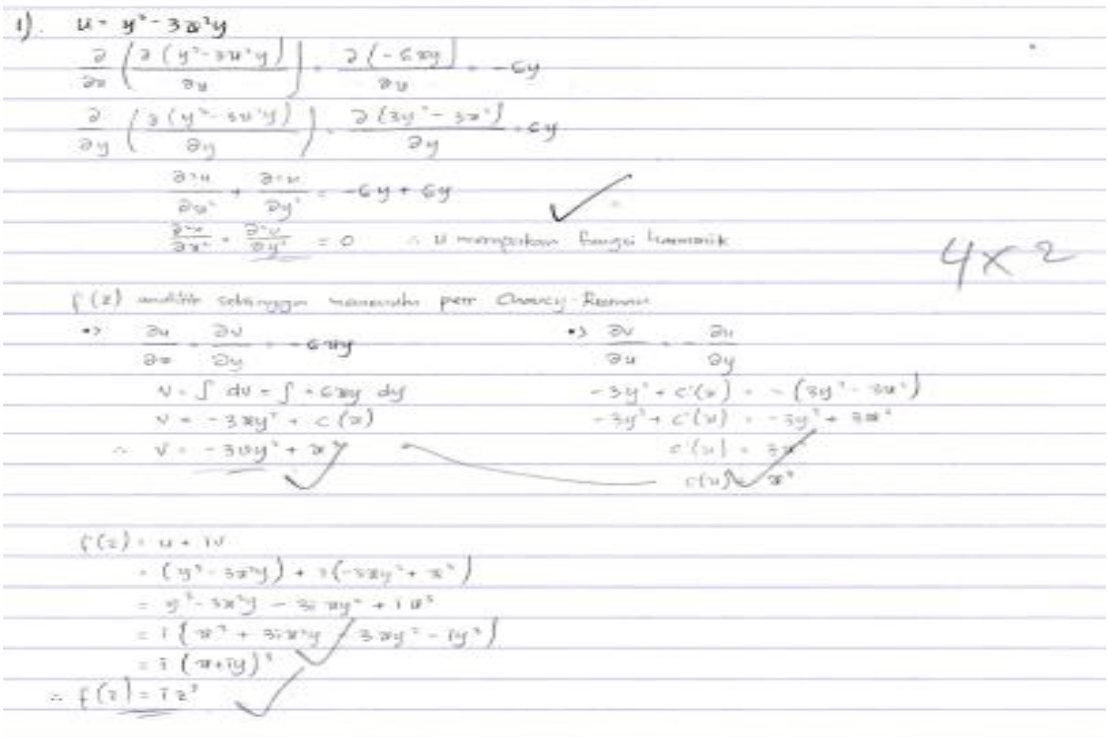

Figure 5. Forms of Student's Answer with High-Ability for task 1 in the final test

Figure 5 appears that high-ability students can solve problems correctly. It shows that the students already understand the concept of harmonic functions, Cauchy-Riemann equations, and understand how to express $f(z)$ in the term of z. If the answer of the three students who have different abilities compared, then the student with low and medium ability will usually have a naive way or routine in solving a given problem. It is problem-solving for beginners, usually by manipulating the existing numbers on the problem (Muir, *et al*. 2008; Ahamad, *et al*. 2018; Shahrill, *et al*. 2018). It is not visible in answer to both the student level; they tend to demonstrate the ability to think that not only manipulate numbers or symbols on the matter but is already showing the way or the chosen strategy towards more sophisticated. It shows the effectiveness of using the guided discovery-based modules that have been developed. The results of this study are similar to the research conducted by Yurniwati & Hanum (2017)**,** which conclude that guided discovery learning improves students' mathematics learning outcomes.

CONCLUSION

The study was conducted over two years, starting from the significance of module definition until the module development stage. In 2015, the module was developed based on guided discovery to lectures of Complex Analysis in STKIP PGRI Sumatera Barat. This article is the final part of the study,

which aims to see whether there is an effect of the use of modules on the learning outcomes of students. A total of 27 students is given a final test in the form of four questions that have been validated by education experts. Then, the data is processed and performed statistical tests (comparing the results with a score of student results before using the module). Therefore, it can be concluded that the use of Complex Analysis module in lectures effect on learning outcomes. For future research, we can use guided discovery-based module to increase the behavior of students in problem-solving and understanding the concept. The subject for the next research prefers to use a big sample. Directions of research that is being promoted by every country in the world are to improve the system and the quality of learning. The learning system can be improved by analyzing the weaknesses of educators and students then find a solution.

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