Teaching function using questioning and clarifying features

Função do ensino: uso de recursos de perguntas e esclarecimentos

Función didáctica mediante preguntas y aclaraciones

DOI:10.34117/bjdv10n3-044

Originals received: 02/16/2024
Acceptance for publication: 03/01/2024

Nila Kartika Sari
Doctoral Student in Mathematics Education, Master in Mathematics Education
Institution: Pascasarjana, Universitas Negeri Surabaya, Faculty of Education, Tribhuwana Tunggadewi University
Address: Malang – 65144, Indonesia
E-mail: nilaks71@gmail.com

Kardiana Metha Rozhana
Master of Elementary Education
Institution: Faculty of Education, Tribhuwana Tunggadewi University
Address: Malang – 65144, Indonesia
E-mail: kmrozhana@gmail.com

Firsta Bagus Sugiharto
Ph.D in Out-of-school Educations
Institution: Faculty of Education, Tribhuwana Tunggadewi University
Address: Malang – 65144, Indonesia
E-mail: firstabsugiharto@unitri.ac.id

ABSTRACT
This study aims to determine how effective learning in students using questioning and clarifying sharpening through reciprocal teaching on function material. The initial stage of the research, students are formed into small groups that will ask and clarify the problems given. Then, the results will be displayed in class and responded to each other between groups. The final results of the research obtained learning procedures with questioning and clarifying features, namely how students ask and how students clarify questions in their small groups and large groups (class) on polynomial functions. A good impact for students is an increase in student learning outcomes, namely 86.7% of students are able to get a score of more than or equal to 75.

Keywords: functions, reciprocal teaching, questioning, clarifying.

RESUMO
Este estudo tem como objetivo determinar a eficácia do aprendizado dos alunos usando questionamento e esclarecimento por meio do ensino recíproco do material de funções. No estágio inicial da pesquisa, os alunos são formados em pequenos grupos que perguntarão e esclarecerão os problemas apresentados. Em seguida, os resultados serão exibidos em sala de aula e respondidos entre os grupos. Os resultados finais da pesquisa obtiveram procedimentos de aprendizagem com recursos de questionamento e...
esclarecimento, ou seja, como os alunos fazem e como esclarecem as perguntas em seus pequenos grupos e grandes grupos (classe) sobre funções polinomiais. Um bom impacto para os alunos é um aumento nos resultados de aprendizagem dos alunos, ou seja, 86,7% dos alunos conseguem obter uma pontuação maior ou igual a 75.

**Palavras-chave:** funções, ensino recíproco, questionamento, esclarecimento.

**RESUMEN**
Este estudio tiene como objetivo determinar cómo el aprendizaje efectivo en los estudiantes utilizando el cuestionamiento y la clarificación de agudización a través de la enseñanza recíproca sobre el material de la función. La etapa inicial de la investigación, los estudiantes se forman en pequeños grupos que preguntan y aclaran los problemas dados. A continuación, los resultados se expondrán en clase y se responderán entre grupos. Los resultados finales de la investigación obtuvieron procedimientos de aprendizaje con características interrogativas y aclaratorias, a saber, cómo preguntan y cómo aclaran los alumnos las cuestiones en sus pequeños grupos y en los grandes grupos (clase) sobre funciones polinómicas. Una buena repercusión para los estudiantes es el aumento de los resultados de aprendizaje, a saber, el 86,7% de los estudiantes son capaces de obtener una puntuación superior o igual a 75.

**Palabras clave:** funciones, enseñanza recíproca, cuestionamiento, clarificación.

**1 INTRODUCTION**

The national education system must be able to ensure equitable distribution of educational opportunities, improve the quality and relevance and efficiency of education management to meet the challenges in accordance with the demands of local, national and global life changes. According to Government Regulation (PP) No. 19 of 2005 concerning National Education Standards (Hidayat & Tamimuddin, 2015) that the learning process of educational units is organized interactively, inspiring, fun, challenging, and motivating students to actively participate, as well as providing sufficient space for creativity (Artigue, 1999; Bergqvist & Lithner, 2012; Schoen et al., 2018; “Трансформация Образования в Условиях Цифровизации,” 2019), and independence according to talent and interest. This is what one of these tasks is to provide teaching, while the implementation of the teaching carried out must be directed at improving the quality of learning (Kurt, 2017; Lyz’ et al., 2020; Sari, 2016; Sari et al., 2023).

Tribhuwana Tunggadewi University is one of the private universities that has an elementary teacher education study program, and one of the courses that must be taken by undergraduate students is Mathematics. The material on functions is included in the course. Based on the results of research on learning that has been carried out, students
tend to have difficulty in sketching function graphs, one of them is on polynomial function graph (Sari, 2016). Basically, the concept of polynomial function graphs in this basic mathematics course does not involve the concept of derivatives even though they have received similar material at the high school level with the concept of derivatives. Understanding the concept to sketch the graph of a polynomial function (Vinet & Zhedanov, 2011) can be built from an understanding of the concept of zeroes of polynomial functions, leading-term tests, multiplicity of zeroes, and characteristics of polynomial function graphs regarding the number of turning points and zeroes based on the highest rank of the tribe. In this kind of problem, students tend to sketch by subsuming any value of \( x \) in the polynomial function. If the problem is developed by finding the equation of the position of a curve, students tend to have difficulty because they will only find the specific points of the substituted \( x \) values and it will take longer to determine them. In sketching the polynomial function, it is necessary to understand the understandings as mentioned, so it is necessary to have a learning that can make it easier for students to understand the concept of the material, namely learning that will provide reciprocity both in terms of questioning and clarifying the problems (Brown, 2010; Özerem, 2012) that are done and one of the strategies that can be applied is the reciprocal teaching strategy (Barrow, 2015; Novitasari et al., 2020; Olia et al., 2010).

Reciprocal Teaching is a learning strategy that has the characteristics of summarizing teaching materials, formulating questions and predictions, and clarifying questions and answers as well as materials to be presented (Mcallum, 2014a; Sundahry et al., 2018). According to Sundahry et al., (2018), reciprocal teaching can be used in learning because it is a strategy that is carried out in co-operation (discussion) to understand reading material so as to improve understanding of the reading material. In reciprocal teaching, there is questioning as one of the characteristics that is very useful for digging up information, checking students' understanding and can improve students' critical thinking skills. Another feature of reciprocal teaching is clarifying, which can be done by students in improving their creative and critical thinking skills to identify all forms of important information in solving the problem at hand. Thus, if we sharpen the two main characteristics of reciprocal teaching strategy are questioning (composing questions and answers) and clarifying (composing clarifying answers to the questions asked) in a lesson, we get learning with sharpening the characteristics of questioning & clarifying. Learning with the sharpening of questioning & clarifying characteristics allows students to understand the material by asking questions about these concepts and
clarifying concepts (Cooper & Greive, 2009; Novitasari et al., 2020; Sari, 2016) and questions raised between students, so that students have the experience to construct the knowledge they have acquired.

Reciprocal teaching can be described as a teaching strategy that is a dialogue between the teacher and the educator with the aim of constructing the meaning of a text. The design of this strategy aims to build comprehension in reading texts. According to Brown (in Mcallum, 2014a) the reciprocal teaching strategy is designed to provide a simple introduction as a group discussion technique aimed at understanding and remembering material. According to Brown (in Mcallum, 2014a), the reciprocal teaching strategy is designed to provide a simple introduction as a group discussion technique aimed at understanding and remembering material. This reciprocal teaching strategy is a learning step with a concrete strategy in which the teacher and students lead the discussion in turn, then in the discussion questions are asked about the main problem or other types of problems and end by summarizing the core of the problem and its resolution.

Still according to Brown (in Mcallum, 2014a; Novitasari et al., 2020) the purpose of this strategy is to build common meaning with steps that priority student and lecturer involvement. In practice, this strategy can be modified for learning mathematics and problems of understanding terms and definitions in mathematics. According to (Cuquet & García San Pedro, 2019; Foster & Tall, 1996; Lòpez et al., 2018; Trouche et al., 2020) in understanding mathematical terms, learning actions can be used, namely:

a. Identify the purpose of learning with reciprocal teaching strategy and express why each strategy is important.
b. Find steps in each characteristic that can be applied.
c. The teacher models the strategy used in learning.

In the reciprocal teaching strategy, in the initial phase the lecturer starts by introducing each feature of the reciprocal teaching strategy to the students. Lecturers also tell them the purpose of this teaching strategy and explain each feature that will be used. In the first feature, the lecturer, as the educator in this study, conducted a series of dialogues, between the lecturer and the students, with the dialogue centered on a section of text. In the first feature, the lecturer, as the educator in this study, conducts a series of dialogues, between the lecturer and the students, with the dialogue centered on the passage of the text. The second feature of this strategy is questioning. The implementation of this second feature is by discussing questions about the main content
of the text. The role of the lecturer is as a facilitator in students' differences of opinion or misunderstandings about the content of the text. At this stage the lecturer provides confirmation about the content of the text compiled by students, this aims to identify the core of the results of reading and student discussion.

The third strategy used is clarification. In this strategy, students clarify words or concepts from the material they have discussed and do not understand. In this third strategy, lecturers can also help students to find the meaning of words, or tell students to use definitions in identifying a concept. The last strategy is predicting. In the predicting strategy, lecturers ask students to make predictions about possible other material related to the text. Things that can be the basis of students in predicting are knowledge about the topic they read, clues given in the text they read, and their ideas that are not the same as the author's ideas.

Questioning as one of the characteristics of reciprocal teaching is very useful for digging up information, checking students' understanding and can improve students' critical thinking, while the other characteristic, namely clarifying can be done by students in creative and critical thinking to identify important information in solving the problem at hand (Trianto, 2007: 110). If a lesson is implemented with a reciprocal teaching strategy by sharpening the two characteristics of the strategy, namely questioning and clarifying, then this can mean that the characteristics of other reciprocal teaching strategies are still implemented but no in-depth observation of these characteristics is made. The sharpening of the characteristics of the reciprocal teaching strategy is carried out on questioning and clarifying. The sharpening of questioning is carried out because by students formulating questions and preparing clarification of the material, these students can think critically so that the learning outcomes obtained will increase. In learning that sharpens the characteristics of questioning & clarifying in reciprocal teaching strategies to determine student understanding of polynomial functions by preparing questions and clarifying questions and materials.

According to Lewis et al., (2009), Siiman et al., (2016), and Simonton, (2016) the knowledge that a person has always starts from asking questions. Questioning can be seen as a concept of individual curiosity, while answering questions reflects a person's ability to think. The activity of composing or asking a question is one of the students' critical thinking processes to find or explore information both administratively and academically, check students' understanding, evoke responses in students, and focus students' attention on something the teacher wants (Seeger et al., 1998; Мысн, 2019). In learning with the
sharpening of questioning & clarifying characteristics, the role of lecturers is as facilitators and initial models in learning (Sari, 2016). After students can carry out their learning, the role of lecturers is reduced. Further learning activities are mostly carried out by students by interacting with lecturers, students with students and with teaching materials.

The lesson begins with the teacher giving an understanding of the learning process by sharpening the characteristics of questioning & clarifying. This learning begins by forming groups consisting of 3-4 students. The lecturer as well as the researcher directed each group to read and conclude the teaching materials for polynomial functions. After reading and summarizing the teaching materials, the lecturer gives an understanding to the students that from the materials that have been read, students should ask questions related to polynomial functions. Raising questions can be done in groups. After asking questions, each group can also clarify the questions and answers raised by each group and present in class. The main purpose of this research is to produce a learning procedure for polynomial functions by sharpening the characteristics of questioning & clarifying and its impact on students. This research is expected to provide benefits for teachers/lecturers in adding insight into learning strategies for polynomial functions and provide an overview for developing research with the same strategy for different materials or developing the same material with different strategies.

2 METHODS

This research is a qualitative research. This research will explore the procedure of learning polynomial functions with the sharpening of questioning & clarifying characteristics, by looking at the results of student work on solving the problems given and the results of the second midterm exam to reveal understanding when the subject reconstructs the concept of polynomial function graphs. The subjects of this study were 3rd semester students of the elementary teacher education study program of Tribhuwana Tunggadewi University who were taking mathematics. Students were randomly grouped in small groups of 3-4 people and then observed by observers.

2.1 RESEARCH INSTRUMENTS

The main instrument in this study was the researcher himself who was assisted by two observers. The problem posed to the group was a problem about sketching
polynomial functions. At the beginning of the learning activities, the subjects were given material about polynomial functions and then given problems:

Sketch the graph of \( f(x) = x^4 - 4x^3 + 3x^2 \) \hspace{1cm} (1)

In addition, the answers to the second midterm questions that were also analyzed were:

1. Sketch the graph of \( g(x) = -x^3 + 2x^2 + 4x - 8 \), explain your procedure in detail.
2. \( f(x) \) is a polynomial function of degree 5 which the coefficients are rational. The graph of \( f(x) \) is given below. The coordinate point of \( A \) is \( \left(-\frac{3}{2}, -\frac{53}{32}\right) \).

![Graph of a Polynomial Function](source)

Find the polynomial function \( f(x) \) and list all of the zeros

Source: original by the author

2.2 DATA ANALYSIS TECHNIQUE

The data in this study include data from observations of lecturer and student activities derived from observers (Creswell, 2014; Tracy, n.d.), and data on student test results with the provision of more than 85% of students completing the second midterm exam on the questions posed as above. The data was then analyzed with the steps of analyzing data according to Mills and Huberman, namely data reduction, data presentation, conclusion drawing. Meanwhile, data validity is the most important thing in research, because it will guarantee the trustworthiness of the findings in solving the problem under study. To ensure the validity of the data in this study, triangulation was used. The data in this study, namely data from observation of student and lecturer activities and student test results, are then reduced, presented and conclusions are drawn based on the success criteria for each of these data. Based on the results of this
conclusion, the data were compared, namely comparing observation data from observers and student test data from students.

3 RESULTS AND DISCUSSION

This study was conducted in two meetings. In the first meeting, the results of student observations showed quite good criteria, as well as the results of lecturer observations. In the second meeting, the results of student and lecturer observations showed good criteria. The observation of student activities was carried out by two observers so that more representative results could be obtained. The results of observations by the two observers showed that students had difficulty adjusting at the beginning of learning due to different opinions in the group. Meanwhile, from the final test, it is known that the percentage of students who scored more than 65 (by conversion) was 17 students, \( \text{percentage} = \frac{19}{22} \times 100\% \approx 86.3\% \). This shows that this learning fulfills the criteria for learning completeness, which is at least 85% of the number of students who take the test. The learning outcomes obtained from learning polynomial functions with questioning & clarifying sharpening meet the criteria set, namely at least 85% of 22 students get a score of more than equal to 65 for the specified test questions. This result can be obtained because students already have knowledge from the learning process in the classroom that uses questioning & clarifying which can improve students' critical thinking skills. This is in accordance with what is expressed by Sari et al.,(2021); Siswono, (2011); and Tohir et al., (2018), namely questioning & clarifying can develop critical thinking skills so as to improve learning outcomes.

Based on the results of observations on learning activities and final tests have met the criteria set, then this learning activity has been considered to have achieved the success criteria. Thus it can be concluded that learning with the sharpening of questioning & clarifying characteristics has met the success criteria set in this study. The research findings on learning with the sharpening of questioning & clarifying characteristics, among others, are student activities in compiling questions that have been running quite effectively, students' attention is not too focused on the lecturer, they have interacted in groups and clarified the answers given by their friends in one group. In this case, learning polynomial functions with the sharpening of questioning & clarifying characteristics in formulating questions and clarifications is carried out in groups, consisting of 3-4 students. This is as stated by (Barrow, 2015; Cooper & Greive, 2009; Mcallum, 2014b)re
that one way that teachers can optimize the reciprocal teaching learning model, especially in large classes, is by grouping students in small groups. Meanwhile, according to Tall et al., (n.d.) the advantages of learning in groups are (1) processing the subject matter more deeply and applying the learning results that have been obtained by working or learning individually on new problems or problems, (2) fulfilling students' needs to feel happy in learning and motivated in learning, (3) gaining the ability to cooperate (social skills).

Lecturers in learning polynomial functions with questioning & clarifying characteristics only act as facilitators and clarify if there is a misunderstanding between students during discussions or presentations in class. This is in line with what is expressed by Brown (in Howard, 2004), namely that the lecturer initially becomes the leader of the discussion, after the student discussion goes well, the lecturer's role is only as a facilitator. Lecturers at the end of learning direct students to make conclusions about the material that has been understood. This is done to give reinforcement to the material that has been learnt. In the learning of polynomial functions, there were 3 students who were silent, they tended to be passive in formulating questions in groups. This happened because they were not used to working together in groups to formulate questions and answer these questions. In addition, they were afraid of not being able to answer questions in their group. After the lecturer found out the cause of the passive students, the lecturer tried to approach to give direction that with this learning students can clarify each other's answers in the group so that they can help each other. The steps taken by the lecturer are in accordance with (Saxon et al., 2003), namely if students have begun to carry out the dialogue process, the lecturer is only a facilitator who directs students to carry out their roles in learning.

4 CONCLUSION

The conclusion of this research is that the procedure for learning polynomial functions with the sharpening of questioning & clarifying characteristics for Tribhuwana Tunggadewi University students, namely (1) Students in groups do questioning, namely students compile questions and answers based on teaching materials about polynomial functions, (2) Students in groups do clarifying, namely clarifying questions or answers to questions both in groups and in class presentations. Meanwhile, another impact of the application of polynomial function learning with the sharpening of questioning & clarifying characteristics for Tribhuwana Tunggadewi University students can improve
learning outcomes of polynomial functions, namely 86.3% of students who get a score of more than equal to 75 in the midterm exam 2.

In addition, based on the research results and research findings, it is recommended to teachers to use learning strategies with sharpening questioning & clarifying characteristics in classroom learning, by paying attention to several things, namely: teachers should be more active in designing teaching materials used in learning, besides that teachers should be able to conduct further research on learning with the sharpening of questioning & clarifying characteristics as a component of reciprocal teaching learning strategies, so that improving the quality of mathematics learning can be carried out continuously and can also conduct further research on learning with the sharpening of other reciprocal teaching characteristics.
REFERENCES


Tall, D., Winkelmann, B., & Bielefeld, U. (n.d.). *Hidden Algorithms and the Drawing of*
Discontinuous Functions. 1–11.


Tracy, S. J. (n.d.). *Qualitative research METHODS.*


