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Ontogenic Learning Obstacles in The Learning of Functional Graph Topic Form Two

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Abstract

The textbooks used are now the primary reference for teachers and students in following the learning system that the Ministry of Education Malaysia (MOE) has set up. This study explored students' ontogenic learning obstacles in learning Functional Graph Topic Form Two which is in the textbook. The researcher used a qualitative design by conducting semi-structured interviews with six students form two students who had undergone learning the Functional Graph Topic. The interviews were based on the student's experiences and answers to the written test sessions. Six respondents were selected from 22 students based on the criteria of the written test who studied the Functional Graph Topic with the same teacher. After the selection, interviews were conducted with the six respondents. Some aspects of ontogenic learning obstacles are psychological ontogenic learning obstacles, instrumental ontogenic learning obstacles, and conceptual ontogenic learning obstacles. In this research, the aspect of psychological ontogenic learning obstacles, there were 33.33% student face the obstacle in the preparation for learning the Functional Graph Topic, while for interest in the Functional Graph Topic was 83.33%, and 66.66% for motivation to learn the Functional Graph Topic. Students also face instrumental ontogenic learning obstacles which 50% students face obstacle in student's existing knowledge, while the elements seen in the conceptual ontogenic learning obstacles involve 66.66% of the student's learning experience. This data found that students experienced varying ontogenic learning obstacles, but some faced all elements of ontogenic learning obstacles, while others only experienced certain elements. In conclusion, every student faces at least one aspect of the ontogenic learning obstacles. Based on the conclusion of the data, this research can assist teachers in creating an alternative to reduce the chances of students experiencing ontogenic learning obstacles when learning the Functional Graph Topic Form Two like teachers can use different teaching methods by providing different learning materials for students with different skill levels, such as more challenging worksheets for more advanced students.

Keywords: ontogenic learning obstacles, psychological ontogenic learning obstacles, instrumental ontogenic learning obstacles, conceptual ontogenic learning obstacles, Functional Graph topics

INTRODUCTION

Mathematics has been essential since ancient times because it is widely used daily. It can be seen that mathematics-related knowledge has been applied since they were in school as early as childhood. Mathematics in school is one of the core subjects that students need to learn. In the 1970s and 1980s, Guy Brousseau explained the theory of didactic situations based on didactic engineering methodologies [1]. According to [2]didactic situation theory in mathematics is a scientific concept that allows a researcher or teacher to understand or predict a phenomenon in a teaching situation about mathematical knowledge. In the 1990s, Brousseau emphasized the importance of environmental responses in didactic situation theory. The environment in question consists of those intervening in education, such as teachers, institutions, and cultural diversity. The didactic situation theory provides an understanding of how knowledge can develop in the classroom and who contributes to this development. In the school's knowledge development process, learning obstacles can occur to students in the process of receiving students' knowledge.

Learning obstacles often occur in the teaching and learning process experienced by many students in both primary and secondary schools. This learning obstacle occurs when students are faced with a problem that arises in the learning process carried out by students. According to [3], an obstacle is a difficulty that is a barrier as a bulwark for students. [4] stated that learning obstacles often occur when students struggle to solve problems in different contexts. Many other factors cause learning obstacles, consisting of relationships between the teachers, students, and knowledge materials that are not well produced. This statement is supported by [5], who stated that teachers, students, and materials are the foundation for mathematics learning. Students acquire a quality of education influenced by the teacher's material delivery. It can be seen that when the material presented is too simple, it can affect the development of students' intellectual skills. Meanwhile, if the delivery of knowledge materials is too difficult, it can cause obstacles to students' learning process.

This explanation shows that the learning obstacles have a relationship between teachers, students, and knowledge materials, especially during the learning process involving the topic of Functional Graphs carried out with students in primary and secondary schools. The learning obstacles during the learning process for the topic of Functional Graphs often occur when there are errors caused by teachers, students, or even the knowledge material itself. Therefore, teachers, students, and materials play an important role in the success of the learning process in schools. The impact of learning obstacles that occur can significantly impact students' overall mastery of the topic of Functional Graphs as this topic is very important for second grade students to learn because this topic helps students understand the relationship between the independent variable and the dependent variable. This is the basis of many other mathematical concepts such as linear, quadratic, and exponential equations. The learning obstacles experienced by students must be overcome so that students can master mathematics completely. Therefore, this research is needed to identify the learning obstacles that most affect students in learning the topic of Function Graphs. Students' mastery of a subject is when students can relate mathematical concepts, which is the first step to making students more proficient in applying various skills that use concepts.

Ontogenic Learning Obstacles

Ontogenic learning obstacles are one of the learning obstacles experienced by students when learning the topic of Functional Graphs. [6] stated that the limitations students face when growing or identifying as their mental preparation for the learning process are known as ontogenic learning obstacles. This is influenced by the psychological factors of the students themselves, which causes their progress to be limited depending on the student's existing knowledge, self-motivation, experience, abilities possessed by the students and understanding that dramatically impact learning success. This ontogenic learning obstacle occurs when there is a gap in existing knowledge with the emergence of new knowledge [6]

According to Kusumaningsih et al., (2020), the lack of acceptance of the student's mentality when facing the learning process causes ontogenic learning obstacles. In the study by [8], they researched the textbook's content. There are task at the beginning of the introduction of the topic that have a high level of difficulty. This causes ontogenic learning obstacles for students because they can affect their mental readiness to learn the topic. [9] believe that understanding that does not match students' readiness will cause this ontogenic learning obstacle. This ontogenic learning obstacle can occur due to the student's unwillingness in terms of mental preparation to receive new knowledge. This happens due to the lack of previous solid knowledge or the influence of experience to be applied when the process of accepting new knowledge is carried out.

This learning obstacle affects students' thinking about accepting new knowledge to learn because there is no lack of skills that can be applied in the latest teaching. This obstacle will cause anxiety in students. Learning obstacles experienced by students due to mental and internal unpreparedness will cause students to feel worried because they cannot master or receive new knowledge. According to [10], the subject of mathematics that students learn with mathematical calculations can cause mathematical anxiety, which is also a critical situation experienced by students. This condition can affect the psychology of students in the reception of knowledge, the ability to optimize memory, the motivation of students and psychosomatic responses, which can also affect students' achievement in mathematics. This ontogenic learning obstacle must be considered essential because the emergence of anxiety in students will affect their psychology, which is their mentality to accept any new knowledge that is related.

According to [11], ontogenic learning obstacles occur when a student's ability to think is limited to the questions or exercises given, so the thinking level does not reach the set level of achievement. Ontogenic learning obstacles can be detected through the level of skill achievement acquired by students through questions or exercises provided by teachers. Therefore, this study was conducted to identify the ontogenic learning obstacles experienced by students in learning the topic of Functional Graphs because this topic is an essential topic that students need to master before learning related advanced topics. Ontogenic learning obstacles need to be identified by teachers so that students are ready to receive new knowledge, fully master the concepts learned, and answer various levels of questions given either through classroom exercises or tests given during examinations.

Lutfi et al., (2021) stated that there are three ontogenic learning obstacles: psychological ontogenic learning obstacles, instrumental ontogenic learning obstacles, and conceptual ontogenic learning obstacles. According to him, psychological ontogenic learning obstacles involve the psychology of the student, such as the motivation and interest that the student has. This can be identified through the motivation and interest of the student by looking at the student's seriousness at the beginning of the class before the teacher starts the teaching session. This can be seen externally, as shown by the students when the teacher begins an introduction session on a topic. Instrumental ontogenic learning obstacles involve technical processes in learning, which can be seen when students answer questions given by the teacher in class. Conceptual ontogenic learning obstacles involve introducing new concepts that are not in line with the student's experience of past learning, and this can be seen through the mastery of concepts taught and introduced by teachers.

Psychological Ontogenic Learning Obstacles

Psychological ontogenic learning obstacles are one of the obstacles to ontogenic learning obstacle. [12] stated that psychological ontogenic learning obstacles involve psychology, which is a student's mental process and thinking, such as his motivation and interest in a topic. This statement is supported by [13], that this psychological ontogenic learning obstacle occurs due to students who are not ready to learn, which stems from psychological aspects such as motivation, self-interest, student behaviour and their interest in the concepts learned.

Based on a study conductedby Yeh et al., (2019)[14], they tested a product to see the increase in students' interest in mathematics. The results showed a difference in the interest of low-achieving students before and after the study. Post-study analysis showed that low-achieving students acquired interests like those of other samples with different achievements. According to teachers, students who give up on mathematics can regain confidence when they get the correct answers to essential tasks. This shows that psychological thinking can influence students' interest in mathematics. Thus, interest can affect the existence of psychological ontogenic learning obstacles. According to the researcher, this psychological ontogenic learning obstacle can be seen when students react, such as drowsiness during the teaching and learning process, which shows their low interest in mathematics subjects. From this statement, it can be seen that this psychological ontogenic learning obstacle can be assessed based on the reactions or responses shown by students during the teaching and learning process carried out in the classroom. Teachers' observation and evaluation of student responses can help teachers deal with the problem from continuing.

Instrumental Ontogenics Learning Obstacles

Instrumental ontogenic learning obstacle is an obstacle contained in ontogenic learning obstacle. [12] stated that instrumental ontogenic learning obstacles are obstacles related to a technical process in learning. This statement is supported by a study conducted by [13], Hajar et al., (2023), stating that instrumental ontogenic learning obstacles occur when students are not skilled in applying existing knowledge to higher-level questions even though the questions use the same concept. According to [13], this instrumental ontogenic learning obstacle occurs because students are not ready to face the technical learning process, such as making calculations until they get the desired answer.

A study by [15] found that 71% of students could not answer questions involving triangles, students knew the broad formula for triangles but did not know how to obtain high scores based on the broad formula. This shows that students experience instrumental ontogenic learning obstacles when they cannot apply their existing knowledge in the form of questions. Problems like this often occur when teachers have finished teaching the basic understanding of a concept and started teaching in the problem-solving section guided by textbooks. This can be seen when students cannot apply the concepts they have learned to calculate story-based questions. For example, students cannot answer questions that have a higher level than the questions used as examples in class. In the study conducted by [16], students are required to draw a graph and determine the equation for the graph. It was found that students could only draw graphs but could not determine the similarity to the graphs drawn. This indicates that students experience instrumental ontogenic impairment when they cannot apply their existing knowledge in the form of questions.

Conceptual Ontogenic Learning Obstacles

Conceptual ontogenic learning obstacles can be identified based on aspects of ontogenic learning obstacles. [12] stated that conceptual ontogenic learning obstacles occur when the concepts that students learn during the learning process are not at the same level as the learning experience of students. This statement is explained based on a study conducted by [13], which showed that students do not have strong basic knowledge and do not have experience in solving related questions, causing them to experience conceptual ontogenic learning obstacles. In their study, students had difficulty answering questions related to algebra because they were never faced with these questions due to constraints in the face-to-face teaching and learning process.

This shows that students' learning experience is essential to avoid conceptual ontogenic learning obstacles. Lack of learning experience will make it difficult for students to take early steps in making calculations or technical processes. In the study by [17], two students were seen discussing and answering questions related to the definition of Function. They reflected on what they had learned with their teachers in class, stating that Function is the equation that describes the shape of a parabola. Based on the discussion, through past experiences, students can recognize a concept. Their study found that students used digital methods to use calculators to obtain maximum and minimum values for a function as a reference in graph construction. This also shows that past experiences can help students in building conceptual knowledge.

Likewise, the concepts that students need to learn are the same. Lack or inadequate mastery of concepts will lead to conceptual ontogenic learning obstacles in students' learning process. Strong knowledge and skill of concepts are required to solve any related math questions. For example, students need to be proficient in the relationship between Function and Function through arrow diagrams, graphs, and orderly pairs to solve questions related to function graphs.

STUDY PROBLEMS

Textbooks are an indispensable medium, so students and teachers will face difficulties without them. [18]stated that textbooks are a source for the teaching and learning process in a teacher's teaching practice. According to [18], textbooks are an essential medium for teachers' needs rather than for students' needs because teachers need textbooks as a guide in teaching to impart knowledge compared to students who only need them when instructed by teachers. This statement is supported by [19]Azzahra et al., (2022), who state that teachers rely too much on using textbooks as teaching guides, so more than 50% of the teaching content relies only on textbooks. A study states that most teachers complain about the content in textbooks due to the use of difficult-to-understand terms and sentences that are used too long, making it difficult for teachers and students to use the textbooks.

The teacher's teaching every day makes the teacher aware of the shortcomings or errors in the textbook so that it affects the students' understanding. According to the level of knowledge of materials that do not meet students' cognitive needs, students cannot participate in learning activities with excellence. Students' lack of understanding of the material contained in the textbook will affect their overall mastery of a topic. According to [4], learning obstacles can be identified based on students' mastery of learning materials. However, according to [10], the learning obstacles experienced by students are a habit in achieving mastery of mathematics.

Many studies have found that students have difficulty understanding Function even though it is essential knowledge. Referring to the survey conducted by [20], the students found that they could write functional equations well but could not state the characteristics of the graph that needed to be formed based on the functional equations. This is because it is difficult for students to give ideas through writing. According to a study conducted by [21]Cawley et al. (2019, some students made mistakes when drawing functional graphs; the plotted graphs were wrong. It is caused by students entering the wrong equation through a scientific calculator. It can be seen in Figure 1 below that on the left is the wrong graph drawn by the student, and on the right is the correct answer.

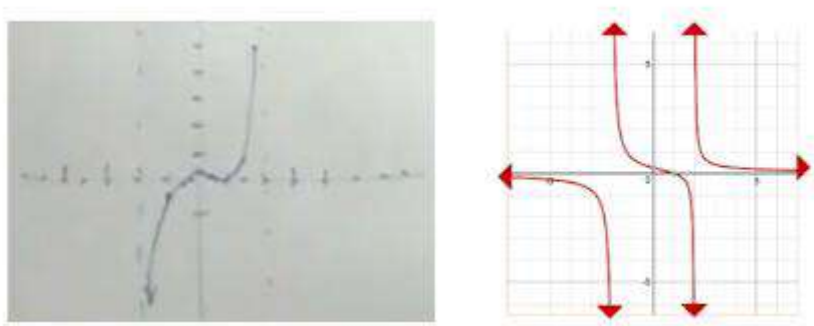


Figure 1 Inaccuracies in sketching functional graphs were cited from studies [21]

In the study by [22], students had difficulties processing information through algebraic expressions when the wrong domain was assigned to the Function presented. Students are also found to have trouble interpreting a function's graph representation. Thus, it can be seen that ontogenic learning obstacles can occur due to the difficulties experienced by students in learning topics related to Function. Researchers in previous studies have identified various learning obstacles faced by students. In the survey conducted by [13] Hajar et al (2023), they researched the textbook's content. There are assignments at the beginning of the introduction of the topic that have a high level of difficulty. This causes ontogenic learning obstacles for students because they can affect their mental readiness to learn the topic. This makes the explanation displayed difficult for students to understand comprehensively. The problem of students in Malaysia in learning Functional Graphs through textbooks can also be seen in the study of [23], which states that students face difficulties in understanding the topic of Functional Graphs when faced with conventional learning methods such as relying solely on teachers and textbooks.

In addition, there are several problems faced by students in learning the topic of Functional Graphs; namely, students are unable to apply the concepts contained in functional graphs to be used in daily life, are unable to make connections between variables in functional graphs and cannot draw graph shapes well.

STUDY OBJECTIVES

1. To explore the ontogenic learning obstacles students face in depth based on the content of the Form Two Mathematics textbook on Functional Graphs.

STUDY METHODOLOGY

Design

This study aimed to explore the ontogenic learning obstacles experienced by students based on the content in the textbook for the topic of Functional Graphs. The study is conducted qualitatively using a phenomenological approach to gain a deep and detailed understanding of the questions contained in this study based on the experience of a person who is faced with the issue of ontogenic learning obstacles. The target respondents in this research are 6 selected respondents. According to [24], the number of respondents in a qualitative study is difficult to determine until data saturation is reached, but 6-12 respondents are sufficient for a qualitative research project. Qualitative research is used to find out why and how the phenomenon occurs. According to [25], phenomenology is an illumination of life experiences. This statement is supported by [26], who state that phenomenological design can lead researchers to content that meets understanding through experience. This study used semi-structured interview which state by [23], semi-structured questions allow researchers to express key questions and spontaneously insert questions according to the situation at the time, while also being able to leave out any aspect of the planned question. Therefore, qualitative research is characterized as subjective research and not objective. Thus, the data collected is in interviews rather than numbers. This shows that the data collected in qualitative research cannot be analyzed measurably using any statistical method. Therefore, the coding process is carried out according to the aspects and elements prioritized throughout the study.

The study design is based on *Didactic Design Research* (DDR). The learning obstacles to be identified refer to the *Didactic Transposition Process* [27]Chevallard and Bosch, 2020), as stated in Figure 2 below, which is part of the Didactic Study Design.

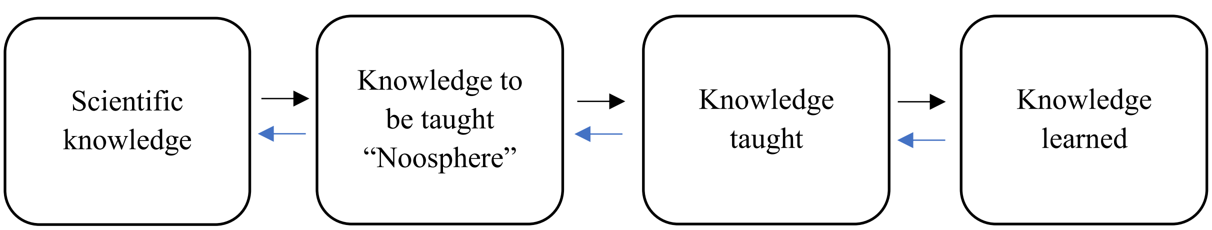


Figure 2 The Didactic Transposition Process

Based on Figure 2., it is a Didactic Transposition Process consisting of scientific knowledge pioneered by scientists or researchers. This scientific knowledge is tested by a group of humans (*Noosphere*) consisting of mathematicians, mathematics teachers, or experts in Mathematics Education to be introduced to the institutions of society formed as one of the education curricula. Teachers use the knowledge from the curriculum to teach and pass it on to students as a learning to learn. There are obstacles to ontogenic learning that can be identified through any of the processes contained in the Didactic Transposition Process.

Data Collection and Analysis Procedures

For written tests, student answers are labeled using Newman's Error Analysis. According to Swari et al., (2020), Newman's Error Analysis consists of 5 aspects namely (1) reading, (2) understanding, (3) transformation, (4) process skills, (5) coding.

Table 1 Problem-Solving Ability Indicator using Newman's Error Method

Newman Aspects	Phase	Indicator
Reading	1	Students cannot read keywords or symbols
Understanding	2	The students reads all the words in the question but does not understand the overall meaning and thus cannot continue any further
Transformation	3	The students cannot identify the operation, or the series of operations.
Process Skills	4	Students can identify operations or series of operations but do not know the steps to carry out these operations
Encoding	5	The student makes a solution to the problem but is unable to express the solution in the correct written form

Based on the Table 1, a descriptive analysis was conducted for the selection of respondents for the interview session based on the lowest level of student achievement based on written test. Subsequent interview data collected from this study were analyzed through the six-phase thematic analysis model documented by [28]. Based on the written test result, the researcher selected respondents to conduct interviews based on the representation of each category to obtain students' reviews of the answers they gave in the written test. Subsequent interview data collected from this study were analyzed through a six-phase thematic analysis model documented by [28].

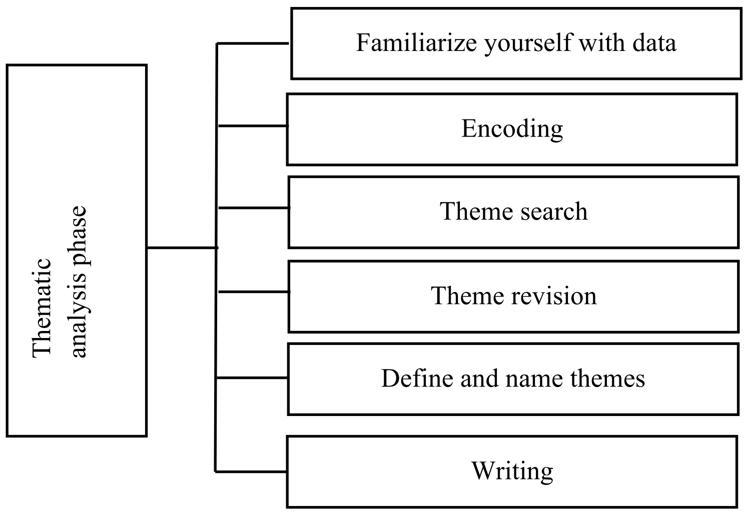


Figure 3 Phase of the thematic analysis model ([28,29]).

Thematic analysis is suitable for qualitative data because the phases shown do not need to be used according to their steps, but this study can move along with the phases without having to perform the previous phase ([28,29]. The theme that exists in this study is deductive thematic analysis. Inductive thematic analysis is based on an existing conceptual framework that guides in the process of coding and theme development. The six stages involved in thematic data analysis are:

Stage 1 : Familiarize yourself with the data
Information from the audio recordings of the interviews of the six study respondents was manually transcribed into written form. Interview transcripts are read a minimum of one time.

Stage 2 : Coding
Through written transcripts, data is encoded across the entire dataset. The transcript is scrutinized line by line to perform the encoding. The data is also organized with each code and the main coding theme section. Coding helps a lot in theme search. The main coding themes are based on ontogenic learning obstacles, didactic learning obstacles and epistemological learning obstacles. A new theme will be added if the data is obtained in an interview session.

Rank 3 : Theme search

The code is combined and organized according to the relevant sub-themes identified. It is formed in a mind map. In this section the code relationships and subthemes can be found. Based on the subthemes formed, there are subthemes that are retained, merged, filtered, isolated or discarded. The subthemes in this study are psychological ontogenic learning obstacles, instrumental ontogenic learning obstacles and conceptual ontogenic learning obstacles; understanding of concepts, difficulties in applying concepts and difficulties in applying procedures; Limited knowledge resources, additional knowledge and different questions from the examples shown by the teacher as well as a new theme involving the language of instruction.

Stage 4 : Theme revision

The subthemes are refined and revised. The subthemes are refined and the patterns are considered to see their suitability to the data obtained. It is to ensure that the subthemes formed are appropriate and meet the main content of the study. It is also a check if there is any missing data in the coding that has been executed. The theme revisions were reviewed by experts to confirm that the theme used was suitable for the study.

Rank 5 : Define and name the theme

The refined subtheme forms a main theme that represents the codes that have been formed. A headline is formed through it.

Rank 6 : Writing

The writing of the report is carried out based on the theme title that is formed. The theme title is argued in relation to the question in the study. The conclusion of the theme was carried out across respondents regarding the learning barriers identified to the study respondents based on data sources obtained from textbook analysis and written tests.

Thematic analysis is appropriate for qualitative data because the phases displayed are unnecessarily used at their pace. However, this study can move in phases without performing the previous phase ([28,29]Braun dan Clarke, 2006; Volungevičienė et al., 2020). The theme that exists in this study is deductive thematic analysis. Inductive thematic analysis is based on an existing conceptual framework that guides the coding and theme development process. It aims to validate existing theories.

STUDY FINDINGS

Psychological Ontogenic Learning Obstacles

a) Preparation for learning the topic of function graphs

The analysis of the interviews conducted on all respondents was about their preparation in learning the topic of Function Graph before the teacher started teaching it. Based on the interviews conducted to explore the respondents' preparation, R1 stated that the preparation was done by looking at the subtopics contained in the topic of the Function Graph: "*I opened my book... Take a look at the title... Then look at the chapters he has*". According to R2, there was no preparation because the respondents did not know about the topic and would only take note of the topic at school. "*Like before, I didn't do anything because I didn't see the topic anymore. So close to the school* ".

Based on the analysis of the student's preparation, it can be seen that some students do not have the preparation to learn the topic of Functional Graphs. This supports the statement of [9] that learning that does not match students' readiness will cause this ontogenic learning obstacle. This can be seen in the ontogenic learning obstacle when it is caused by the student's unwillingness in terms of mental preparation to receive new knowledge.

b) Students' Interest in Function Graph Topics

The subsequent analysis was conducted on the student's interest in Functional Graphs. Based on the interviews conducted to explore students' interest in Functional Graphs, R1 stated that if they do not understand the teacher's teaching on Functional Graph, it causes the respondents to feel bored. If they know it, the respondents will follow the instructions asked by the teacher when the teacher's teaching is being carried out: "*If I don't understand it, I will feel bored; if I understand it, I did it*." According to R2, respondents face difficulties understanding and pursuing teachers' teachings in schools when following teachers' teachings in schools. Due to these problems, respondents attended tuition classes outside of school hours to better understand the topic of Functional Graphs. The tuition she attended was constructive for respondents in understanding the topic with the tutoring and training provided by the tuition teacher. *"It's hard to catch up, but aaa... At first, it was like doing all the teachers' work, and then I would ask the tuition teacher. Then, he would explain everything, teach, and take the exam. I would understand completely if I was referring to the school. I didn't understand it very* much". R5 stated that boredom arises when learning the topic of Function Graphs because of the lack of interest in the subject: "*Ha, bored... erm, I don't know why*".

The researcher also asked questions about the desire of respondents to volunteer to answer questions asked by teachers. According to R1, if he understands a question, the respondent will answer it, but usually, the respondent does not volunteer when the teacher asks a question, *"If I don't understand that, I will be bored, if I understand that, I will do it".* R5, on the other hand, does not offer to answer the teacher's question on the topic of the functional graph, "*nope (does not offer to answer the teacher's question)".*

Based on the analysis, it can be seen that there are students who have less interest in learning the topic of Functional Graph, which can affect their emotions and enthusiasm for learning the topic. This is more convincing than the fact that this psychological ontogenic learning obstacle can be seen when students give adverse reactions during the teaching and learning process, which shows their low interest in mathematics subjects [14].

c) Students' Motivation for Learning the Topic of Graph Function

The following analysis was conducted on the student's motivation for learning the topic of functional graphs. Based on the interviews conducted to explore students' motivation for learning the topic of Functional Graph, the researcher wanted to examine the motivation of students by asking questions about the steps taken by respondents if they still do not understand the learning of the topic of Functional Graph even though they have reviewed the teaching of the subject. R3 stated that if they still do not understand the topic of Functional Graphs, the respondents only ask their friends because they feel embarrassed to ask the teacher, "*I am embarrassed to ask the teacher, I ask my friend*." In addition, the analysis results found that most of the written questions given to R3 were not answered with enthusiasm, like question 3, which was responded to without justification for the answers given "*I think I hit a lot*".

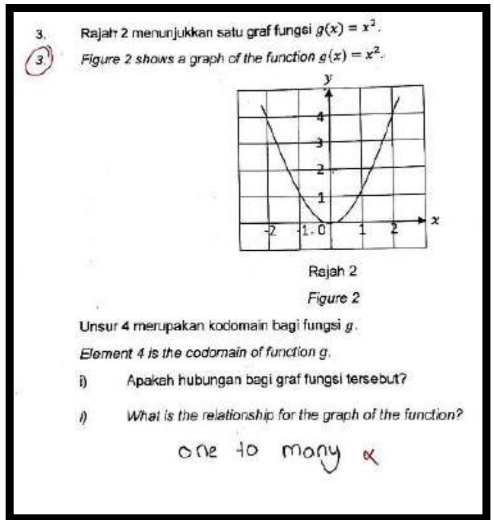


Figure 4 Answer Question 3 by R3.

Next, for R4, when he still does not understand the topic of Functional Graphs, R4 asks the school teacher or his tuition teacher, "*I ask the teacher, or I ask the teacher's tuition*." However, just like R3, there are written test questions that cannot be justified by the answers given and do not answer the questions vigorously, such as question 2(b), "*I was lazy at the time*."

Figure 5 Answer to Question 2(b) by R4

Based on the students' motivation, it can be seen that they have less motivation to answer questions. This can be seen when students do not question Function Graphs seriously. This supports the idea that the mathematics subject that students learn concerning mathematical calculations can cause mathematical anxiety, which is also a critical condition experienced by students. This condition can affect the psychology of students in the reception of knowledge, the ability to optimize memory, the motivation of students, and psychosomatic responses, which can also affect students' achievement in mathematics [10].

Instrumental Ontogenics Learning Obstacles

Applying Existing Knowledge into the Form of Functional Graph Topic-Related Questions

The analysis of the interviews conducted was to see the application of existing knowledge in the form of questions related to the topic of Functional Graphs answered by the respondents in the written test questions given before the interview session was conducted with the respondents. Existing knowledge in this section means knowledge of the Functional Graph topic only applied in the form of the topic question. Based on the analysis, question 3 was chosen to assess the respondents' skills in using their existing knowledge in questions related to functional graphs. It can be seen that based on question 3, all the respondents could not answer correctly, so the researcher asked questions about their knowledge of the function graph on the questions associated with domains and codomains.

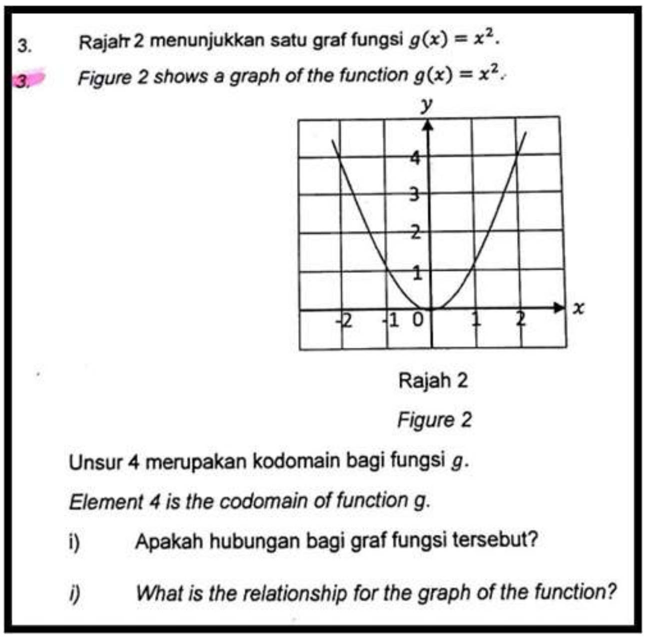


Figure 6 Question 3.

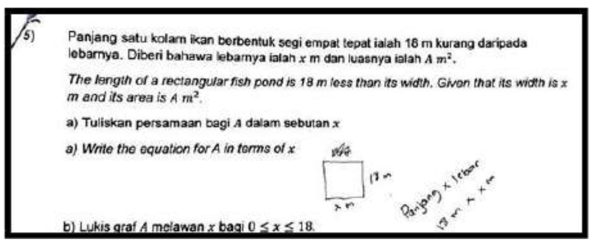
Based on question 3, R1 states that the value on the y-axis is a domain, while the value on the x- axis is a codomain "*one two... Domain (shows axis-y)... Negative one, negative two (referring to codomains)*". R2 also states that the codomain is the x-axis while the domain is the y-axis "*this (denoting axis- x as codomain) ... This domain (denotes y-axis)".* R3 also states that axis-y is a domain and axis-x is a codomain of "*axis-y domain... axis-x codomain*".

Based on the student's answers in Question 3, it can be seen that the students are using the wrong concepts in expressing domains and codomains based on the axis of the graph. This shows that students' existing knowledge is not strong when a bad idea is used in answering questions. This reinforces that instrumental ontogenic learning obstacles occur when students are not adept at applying existing knowledge to higher-level questions, even though the questions use the same concepts. According to [13], this instrumental ontogenic learning obstacle occurs because students are not ready to face the technical learning process, such as making calculations, until they get the desired answer.

Conceptual Ontogenic Learning Obstacles

Student Learning Experience

The subsequent analysis was based on the respondents' answers to Questions 5(a) and 5(c), given to the respondents to see their learning experiences. Based on question 5(a), it was found that all the respondents gave answers that did not meet the question's requirements, and the majority only left blanks. As such, researchers encourage them to try to answer the question. Through question 5(a), the researcher asks R1 to draw a rectangle, but the rectangle drawn by R1 is a square. The researcher requested R1 to write down the information provided in the question "*here (while writing 18 m on the top of the rectangle, then delete and write the value of 18 m on the right side of the rectangle, write x m on the bottom of the rectangle - as removing information from the question)".*



5) Panjang satu kolam ikan berbentuk segi empat tepat ialah 18 m kurang daripada lebarnya. Diberi bahawa lebarnya ialah x m dan luasnya ialah A m^2.

The length of a rectangular fish pond is 18 m less than its width. Given that its width is x m and its area is A m^2.

a) Tuliskan persamaan bagi A dalam sebutan x

a) Write the equation for A in terms of x

b) Lukis graf A melawan x bagi $0 \leq x \leq 18$.

Figure 7 Answer to Question 5(a) by R1.

The researcher asked R1 to state what was understood from the given question. R1 states that it is necessary to find the width first and then find the value, but based on the question, the value is the width of the fishpond is x "*find the width first, right?... After that, just look for this x (refer to the question about the length of 18 meters less than the width "*

Next, the researcher asked R1 to express her understanding when the question stated a missing word. R1 states that less means small. The researcher requested R1 to express the formula for the area of the rectangle and write it in the form of an equation based on the given question. However, R1 does not apply his knowledge of the reality of 'less than' to the equation he declares "*small (regarding the word less) ... The breadth of the width (area formula) ... the area in this equation (respondents write "18 m X x m")".*

The subsequent analysis was carried out on question 5(c) to see the learning experience of the respondents in drawing functional graphs. Based on the answer given by R3, it can be seen that the respondents expressed the values on the table of values correctly; however, for the plot part of the graph, it can be seen that R3 is wrong in describing the values on the axis-y and axis-x just like those expressed by R2, "*this is two, after thirty-two, the point is near here (showing the value of 2 on the axis- y and the value of 32 on the axis)$-$ x in plotting the point* ".

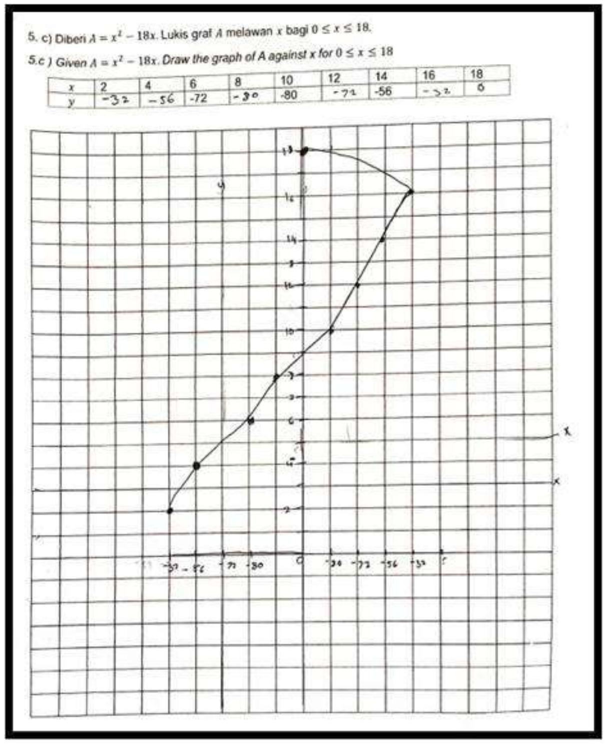


Figure 8 Answer to Question 5(c) by R3

Based on the answers given by the students, there is a wrong use of concepts in forming graphs, especially the basic concepts involving the axis of the graph. Errors in applying concepts also lead to mistakes in plotting graphs to obtain accurate final answers. Furthermore, some students are unable to draw rectangles correctly, which indicates that the learning experience is poor in mastering the knowledge of basic concepts. This reinforces the [13] statement that students do not have strong fundamental knowledge and do not have experience in solving related questions, causing students to experience conceptual ontogenic learning obstacles.

DISCUSSION OF STUDY FINDINGS

Students were found to have ontogenic learning obstacles, which can be seen in the psychological ontogenic learning obstacles section when they are not prepared to learn the topic of Functional Graphs, which also reflects their interest and motivation in understanding the topic of Functional Graphs as stated by [13]. Similarly, it was seen that students were less interested in learning the topic of Functional Graphs when they felt bored and expressed less interest in Mathematics subjects. Interest can be seen based on the student's response to the learning process, whether seen as bored, sleepy, or on, as stated by [14]. Apart from that, it can be seen that preparation, interest, and motivation can also influence students' existing knowledge. Based on the conclusion from the data, it can be seen that students who prepare tend to apply their existing knowledge when completing the assignment after learning the topic of Function Graph. This is because students understand the words or terms used better when ready. Therefore, students are more adept at applying existing knowledge when conducting research [16]

In a study by [14], they tested a product to see an increase in students' interest in mathematics. The results showed a difference in the interest of low-achieving students before and after the study. Post-study analysis showed that low-achieving students acquired interests similar to those of other samples with different achievements. Meanwhile, in this study, the conclusion from the study data found that most students experienced feelings of boredom, despair, and lack of interest in learning related to the topic of Functional Graph when they felt that this topic was too complex for them to learn. Therefore, an alternative can be implemented to increase their interest and motivation in learning about Functional Graphs.

A study by [15], found that 71% of students could not answer questions involving triangles. Students knew the broad formula for triangles but did not know how to get a high score based on the broad formula. This shows that students experience instrumental ontogenic learning obstacles when they cannot apply their existing knowledge in the form of questions. In the study by [16], students are required to draw a graph and determine the equation for the graph. It was found that students could only draw graphs but could not determine the similarity to the graphs drawn. Similarly, this study found that the students could not solve problems related to the relationship and shape of the graph on the correct test in Question 3. Some students fail to solve the question, and even students cannot correctly express domains and codomains based on axes$-x$ and axes$-y$ based on the given graph.

As for the learning experience, some students cannot apply what they learned in the past when carrying out tasks related to the Function Graph. A learning experience is significant, and constantly reviewing it will help students become more proficient in performing tasks in various topics, not only on Functional Graphs. In the Dilling and Witzke (2020) study conducted, it was seen that two students discussed answering questions related to the definition of Function. They reflected on what they had learned with their teachers in class, stating that Function is the equation that describes the shape of a parabola. Based on the discussion, it can be seen that through past experiences, students can recognize a concept. Another study by [17]Dilling and Witzke (2020) found that students used digital methods to use calculators to obtain maximum and minimum values for a function as a reference in graph construction. This also shows that past experiences can help students in building conceptual knowledge. In this study, as in the textbooks, most students could not make any calculations involving learning experience when they made calculations using their methods without justification.

In conclusion, it can be seen that preparation, interest, motivation, existing knowledge, and learning experience can cause students to experience ontogenic learning obstacles. Overall, psychological ontogenic, instrumental, and conceptual ontogenic learning obstacles are also interrelated, which causes a student to experience ontogenic learning obstacles. Based on the conclusion from the data, students experience at least one element in each aspect that leads them to experience ontogenic learning obstacles.

STUDY IMPLICATIONS

Exploring ontogenic learning obstacles for students can help teachers create an alternative to reduce the chances of students experiencing these obstacles in learning the topic of Form Two Functional Graphs. Students will also benefit when they can explore the shortcomings or weaknesses faced in improving the knowledge gained in understanding the topic of Functional Graph or other issues in the future. Therefore, the conclusion from the data of the analysis of ontogenic learning obstacles can be used as a starting point to reform or improve teachers' teaching to students in the future.

CONCLUSION

Based on the conclusion of the study data, it can be seen that some students experience the most significant ontogenic learning obstacles when they experience all elements of ontogenic learning obstacles. The study's findings showed that there were students who faced more than one element of ontogenic learning obstacle and students who experienced only one ontogenic learning obstacle. However, it can be seen that every student faces learning obstacles at least one element of ontogenic learning obstacle, which leads them to face learning obstacles in learning the topic of Form Two Function Graphs.

Some suggestions that teachers can make is to use technology tools such as graphic software and learning applications to help students better understand the concept of function graphs such as using software such as GeoGebra to visualize function graphs and allow students to interact with the graph. In addition, teachers can plan learning activities that challenge students to solve real-world problems involving function graphs such as assigning project assignments where students must use function graphs to analyze data and make predictions.

The recommendations for future research are to explore learning obstacles from the teacher's perspective and the teaching obstacles teachers face based on the Functional Graphs topic. in addition, future studies need to be conducted to identify the learning barriers faced by students in understanding function graphs and develop effective interventions to overcome them such as studying students' difficulties in understanding the concept of asymptote and how to teach this concept more effectively. Next, further research can be carried out on the evaluation of the effectiveness of the use of technology such as graphics software in the teaching of function graphs such as examining how the use of software such as GeoGebra can improve students' understanding of function graphs.

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