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THE INFLUENCE OF GENDER IN PHYSICS ON MASTERY OF THE CONCEPT OF GRAPH REPRESENTATION THROUGH TEST OF UNDERSTANDING GRAPHS IN KINEMATICS (TUG-K) ANALYSIS

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ABSTRACT

This study aims to determine the effect of gender on the mastery of the concept of graphical representation through the analysis of the Test of Understanding Graphs in Kinematics (TUG-K). This research method is a comparative study that aims to compare two or more variables, to get answers or facts whether there is a comparison of the object being studied. This research is qualitative research. The number of samples in this study was 23 people consisting of 8 male students and 15 female students. The research instrument used was 5 descriptive questions referred to from TUG-K Beichner and analyzed by the CRI method. Based on the results of the study, it was found that from the number of students who knew the concept, it was known that 1 out of 8 (1:8) male students knew the concept, and 3 out of 15 (1:5) female students. From this data, female students master concepts more than male students.

Keywords: TUG-K; Concept Understanding; Representation

Introduction

The characteristics of abstract physics learning material demand the ability to master and manage changes between different representations simultaneously (Rahayu et al., 2021). The abstractness of these theories and concepts will be real and meaningful if they are presented in various forms of representation, such as graphical representations, motion diagrams, mathematics, and tables. For example, in presenting the position of objects that are always in motion, it will be difficult to understand if it is only presented in verbal representations, it will be more meaningful if it is displayed in various representations such as representations of motion diagrams, graphs, and tables.

One of the physics materials which contains the concept of representation of motion diagrams, graphs, and tables is the kinematics of straight motion. Kinematics is a part of classical mechanics where motion can be expressed in space and time regardless of the cause of the motion (Iskandar & Syahir, 2018) In kinematics, by knowing the equation of the position of the object, other information about the object can be determined such as the speed and acceleration of the object. Information about the acceleration of objects is

very important to learn the concept of mechanics, especially Newton's Law, acceleration is a very important and fundamental concept in mechanics (Muzakki et al., 2022), in order to understand mechanics well, it is necessary to have a solid understanding of kinematics concepts (Saputri et al., 2019)

The results of research conducted by (Bunawan et al., 2015) that chart reading and graph interpretation skills in students are still inadequate, besides that proficiency in analyzing graphs depends on the type of graph and the level or type of question developed. (Rahma & Kurniawan, 2021) found that students have difficulty in reading, interpreting, and understanding information depicted in graphs. (Anis et al., 2019) their research revealed that the meaning of graphs in physics concepts is more difficult than in mathematical concepts. (Beichner, 1994) in his research discusses the kinematics of straight motion graphs of position, speed, and acceleration which makes the Test Of Understanding Graphs In Kinematics (TUG-K) in his introduction Beichner writes that graphs are the heart of physics and are very efficient for solving scientific problems, the use of graphs is very broad as a teaching tool but in fact, many students still have difficulty reading graphs and students have difficulty interpreting the meaning of existing graphs.

The results obtained by Beichner the average score of students is 40% quite low. The most visible difficulty of students is determining the gradient or slope of the graph, another problem that needs to be urgently considered is the assumption that a graph is an image where the graph does not change even though the coordinates change and move (Guryadi & Sutrisna, 2020).

In relation to TUG-K, Antwi, et al also conducted research on understanding the concept of reading graphs. In its introduction (Antwi, 2018) found that students misinterpret, especially in describing the shape of the graph, it is difficult to change the graph from one shape to another, gives different interpretations for the slope and area under the graph, and finds it difficult to calculate the slope and area precisely. The results of research conducted by Bunawan, Uzun, Robert J. Beichner, and Victor Antwi et al, show that in the field there are still many students who have difficulty in interpreting graphs, some of the difficulties are determining changes in the speed of objects that experience In constant acceleration, difficulty distinguishing graph gradients and changing the perception that graphs are not images.

Ainsworth (Suminar et al., 2013) states that students' ability to interpret representations is influenced by a combination of representations, individual differences, and processes in understanding a representation. Individual differences are influenced by familiarity with representation, familiarity with the concept represented age of students, way of thinking, intelligence, and gender or gender.

Based on the description above, researchers are interested in researching the understanding of the concept of graphic representation through TUG-K based on gender with the title "The Influence of Gender Issue on Mastery of the Concept of Graphic Representation through the Analysis of Test of Understanding Graphs in Kinematics (TUG-K)". As a form of novelty, this research lies in the Test of Understanding Graphs in Kinematics (TUG-K) in the form of a description problem.

Research Method

Research Methods and Samples

This research method is a comparative study. The definition of comparative study is scientific research or studies based on comparison. Aswarni's opinion quoted by Suharsimi (Arikunto, 2013) states that "Comparative research will find similarities and differences about objects, people, work procedures, ideas, criticism of people, groups, of an idea or a work procedure". Another opinion, Mohammad Nasir (1988: 68) said that "Comparative study or research is a type of descriptive research that wants to find answers fundamentally about cause and effect, by analyzing the factors causing the occurrence or emergence of a particular phenomenon". So a comparative study is a research that aims to compare two or more variables, to get an answer or fact about whether there is a comparison or not of the object under study.

This research is qualitative research. Qualitative research is an approach that is also called an investigative approach because researchers usually collect data by meeting face-to-face and interacting with people at the research site (Rukin, 2019). Qualitative research can also be intended as a type of research whose findings are not obtained through statistical procedures or other forms of calculation. However, the data collected from qualitative research allows it to be analyzed through a calculation.

The sample in this study was 23 people in Physics. The sampling technique in this study was carried out by purposive sampling. That means the sample is selected based on the objectives set in the study.

Research Instruments

Research instruments are data collection tools from the research conducted. The case study on understanding kinematics graphs involves an instrument, namely a diagnostic test that hebiles from the Test of Understanding Graph Kinematic (TUGK). This test is in the form of a description with a total of 5 questions. The measured concept consists of the concepts of magnitude kinematics of position, velocity, and acceleration. This material has been adjusted to the curriculum applicable in schools.

Data Analysis Techniques

The technical data analysis carried out in this study uses the Certainty of Response Index (CRI) in analyzing diagnostic test results to determine the ability to understand graphs

determined through the criteria of knowing concepts, not knowing concepts, and misconceptions. Then it will be compared between men and women.

The diagnostic test questions are in the form of TUG-K questions totaling 5 questions describing kinematics graphs. The following is the result of the analysis of the discussion of the question

Table 1. Analysis discusses understanding kinematics graphs.

No	Analysis	No corresponding questions
1	The ability to describe the motion of objects presented in graphic form	1, 2
2	The ability to determine the motion of acceleration or constant speed.	3, 4, 5

Based on the analysis that has been determined in table 1, students' graph comprehension skills are analyzed using CRI.

CRI is used to discover a person's misconceptions by measuring the confidence level in answering questions. Misconceptions are differences in concepts that someone has that are different from the concepts of scientists (Heuvelen, 1991). The CRI scale is set to six fixed scales (0-5) as proposed by Saleem Hassan (1999), including:

Table 2. CRI criteria by Saleem Hassan

Scale	Criterion	Information
0	Totally Guesed Answer	Answering questions is 100% done by guessing.
1	Almost guess	Answer questions with a percentage of guessing 75%-99%
2	Not sure	Answer questions with a percentage of guessing 50%-74%
3	Sure	Answer questions with a percentage of guessing 25%-49%
4	Almost Certain	Answer questions with a percentage of guessing 1%-24%
5	Certain	Answering the question has no element of guessing at all.

A scale of 0 has the criteria of Totally Guesed Answer or guessing which means students in answering the given questions do not know the concept at all. While the highest scale of this CRI is 5 with the criteria of being sure to be right which means in answering students' problems and knowing the concept correctly without any mistakes. These CRI criteria are listed in each question.

Each student had four possible combinations of right or wrong answers with a high CRI (>2.5) or low CRI (<2.5). The four combinations can be seen in the table below (Saleem Hasan, et al: 1999).

Table 3. CRI Combination Table

Answer Criteria	Low CRI (<2.5)	High CRI (>2.5)
Correct answer	The answer is correct but a low CRI means not knowing the concept (Lucky guess).	Correct answers and high CRI mean mastering concepts well.
Wrong Answer	Wrong answers and low CRI mean not knowing the concept.	Wrong answer but high CRI means a misconception.

Table 3 shows that the criteria to be set by CRI for a person are knowing the concept, not knowing the concept and misconceptions. These three criteria will be useful in providing a profile of students' difficulty in understanding charts. Not knowing concepts and misconceptions means that students can be said to have difficulty in understanding these concepts (Gumilar, 2015).

However, because TUGK is used in the form of description questions, it is only distinguished between Pass and Not Pass with a passing standard of 70.

The last stage is to determine how the influence of gender on the level of understanding of the kinematics graph concept is obtained from how many male and female students are for the criteria of knowing the concept.

Result And Discussion

TUGK questions were distributed to 23 Physics students consisting of 8 male students and 15 female students. The data obtained are then analyzed using the T-test to test the hypothesis and the CRI method to find out students' misconceptions, do not know the concept, and know the concept.

Table 4. Table of Research Results

No	NAME	NPM	Gender	TUGK	CRI	Attainment	Information
1	Sehla Harnof	A1E020002	Man	70	3,6	L	Mastering the Concept
2	Ayuni Nisa Syafira	A1E020004	Woman	45	2,8	TL	Misconceptions
3	Andra Haryanto	A1E020006	Man	60	3,8	TL	Misconceptions
4	Emilia Denti	A1E020008	Woman	40	2,3	TL	Do not Know the Concept
5	Hidayah Nurhasana	A1E020010	Woman	80	3,4	L	Mastering the Concept

No	NAME	NPM	Gender	TUGK	CRI	Attainment	Information
6	Anida Seviana Saputri	A1E020012	Woman	30	2,2	TL	Do not Know the Concept
7	Ima Setiani	A1E020014	Woman	35	1,4	TL	Do not Know the Concept
8	Gusti Ameda Pazah	A1E020016	Man	30	1,2	TL	Do not Know the Concept
9	Siti Rohayati	A1E020018	Woman	45	3,2	TL	Misconceptions
10	Meutia Farani Aziz	A1E020022	Woman	70	2,2	L	Do not Know the Concept
11	Sabri Henfi Afla	A1E020024	Man	30	1,6	TL	Do not Know the Concept
12	Francisco Yola	A1E020026	Man	20	1,4	TL	Do not Know the Concept
13	Dini Syafitri	A1E020028	Woman	55	2,3	TL	Do not Know the Concept
14	Mifta Meylinda	A1E020030	Woman	47	2,2	TL	Do not Know the Concept
15	Nita Utami Nesty	A1E020032	Woman	67	2,4	TL	Do not Know the Concept
16	Dwi Novriensi	A1E020034	Woman	73	4,2	L	Mastering the Concept
17	Rolen Safutra Fanned	A1E020036	Man	25	1,8	TL	Do not Know the Concept
18	Sonia Surabina BR Depari	A1E020038	Woman	68	3,2	TL	Misconceptions
19	Meutia Rahma Agustin Novel	A1E020040	Woman	68	2,3	TL	Do not Know the Concept
20	Maida Oktalia	A1E020044	Woman	37	2,6	TL	Do not Know the Concept
21	Nur Achmad Tuljannah	A1E020048	Man	36	1,2	TL	Do not Know the Concept

No	NAME	NPM	Gender	TUGK	CRI	Attainment	Information
22	Anhar Yoga Pratama	A1E020050	Man	30	2,2	TL	Do not Know the Concept
23	Fityahti Hilya Utami	A1E020052	Woman	78	3,8	L	Mastering the Concept
Misconceptions							17,39%
Do not Know the Concept							65,22%
Mastering the Concept							17,39%

Interpretation of T Test Results

H0: There is no significant average difference between men and women

Ha: There is a significant average difference between men and women

T-Test

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Hasil TUGK	Laki-laki	8	37.63	17.711	6.262
	Perempuan	15	55.87	16.928	4.371

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Hasil TUGK	Equal variances assumed	.157	.696	-2.423	21	.024	-18.242	7.527	-33.895	-2.588
	Equal variances not assumed			-2.389	13.840	.032	-18.242	7.636	-34.638	-1.845

Value of Sig. (2-tailed) = 0.024. While the alpha of the study = 5% or 0.05. That is, (0.024 < 0.05) it can be concluded that this study Ha accepted.

Next, determine what the t-table value is for this study based on the df value in the Independent Samples Test table and alpha divided by 2. Look at the image above:

Value df (degree of freedom) = 21. While the alpha of the study was 5%/2 = 2.5% or 0.025Next, see the t-table value of df=21 and Tail Probability of 0.025. The t-table value in this study was 2.080. While the value of t-count = -2.423So in this study, t-table > t-count (2.423 > 2.262). This means that H0 is rejected and Ha is accepted, that is, there is a significant average difference in TUGK results between male and female students.

CRI Analysis Results

Based on the CRI analysis, 4 students had misconceptions, or around 17.40%, 15 students did not know the concept 65.20%, and 4 students knew the concept around 17.40%.

If you look at the number of students who know the concept, it is known that 1 in 8 (1:8) male students know the concept, and 3 in 15 (1:5) female students. From this data, female students master the concept more than male students (Annisa et al., 2021)

Conclusion

Based on the results of the research obtained, it can be concluded that: There is a significant average difference in TUGK results between male students and female students, female students master the concept more than male students, based on the results of TUGK, it can also be seen that there are still many students who have not mastered how to read kinematics material graphs.

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