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Application of Physics Infographic Learning Media to Student Graphic Interpretation Ability at Straight Motion Topic

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Abstract
This research is a descriptive and quantitative study to know students' graphic interpretation ability after applying infographic learning media to learning physics in straight-motion material at MA DDI Kanang. The type of research is pre-experimental with a one-shot case study research design. The independent variable of the research was infographic media, and the dependent variable was students' ability to interpret graphs. The population in this study consisted of 45 class X MIPA students at MA DDI Kanang. Research data were obtained by giving objective tests or multiple choice questions based on four indicators of graph interpretation capability: determining the value of a certain quantity from the graph, translating graphic language into verbal language, identifying graphics based on descriptions, and identifying graphs with different variables. Based on the results of descriptive data analysis using the SPSS application, it was found that the average score of students' graphic interpretation skills at MA DDI was 9.04 and was in the moderate category. The impact is that students can only interpret simple graphs, and have difficulty comparing graphs with various variables.
Keywords: Chart Interpretation; Infographics; Learning

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INTRODUCTION
Education in the world runs dynamically along with technological developments. Likewise, educators and observers of education in Indonesia continue to strive to create learning conditions or situations that are relevant to the needs of students and the social community. Through the 2013 curriculum, students are given more space to be actively involved in learning and the opportunity to apply their knowledge (Fernando & Marikar, 2017; Moyle et al., 2016; Stanberry, 2018). Education in the 21st century is expected to have an impact on the creation of shared prosperity under the ideals of the Indonesian people as contained in the opening of the 1945 Constitution 21st-century (Malik, 2018; Santoso, and Murod, 2021). Learning requires learner-centered learning. So, in practice, educators who are ready to update their skills and knowledge according to the conditions or situations of students are also needed. There are three main concepts in the 2013 curriculum and the socialization of the independent curriculum by the Ministry

of Education and Culture, namely 21st-century skills, a scientific approach, and authentic assessment. Problem-based learning (PBL) and project-based learning (PjBL) are two learning models that must be used in schools. Models, materials, objectives, methods, media, and evaluation are learning components directly related to a learning process's success (Al-Fraihat et al., 2020; Rusman, 2016). Meanwhile, learning activities are a set of activities carried out by students to get the expected goals of learning (Hasan, et.al, 2021).

According to Khaeruddin (2017), one of the advantages of the problem-based learning model is that students can more freely develop their knowledge and understanding. Besides that, learning prepared with a learning implementation plan is often less effective due to inhibiting factors. Barriers to learning can be related to mental readiness (ontogenic), learning materials (didactic), and limited initial knowledge (epistemology) (Lestari et al., 2017). Of the three, the limited initial knowledge aspect significantly impacts learning, especially in science.

Graphs in physics are synonymous with kinematics material which includes straight motion. Graphs are usually associated with mathematical things. Understanding graphics requires spatial, mathematical, and logical abilities (Jansen et al., 2018; Subali et.al., 2015). The difficulty of students in understanding straight motion material is the level of abstractness of the material, which is quite high (Mesic, et.al., 2015; Siahaan et al., 2017).

Interpretation is part of the cognitive level of understanding. Previous research from Amin et al. (2020) illustrates the low ability to interpret kinematic graphs for high school students in South Sulawesi. Interpretation ability is part of understanding the concept. Amin, et al.'s research results further explained that 74.08% of students could interpret kinematics graphs in the "very low" category. In line with this research, the results of the research by Wahyuni and Pramadanti (2021) and Setyono et al. (2016) showed that students' ability to interpret student graphs was also still low. In addition, in the study by Uzun et al. (2012), students have difficulty interpreting and understanding the information presented on graphs

Researchers also found similar problems when observing physics learning with problem-based learning models at MA DDI Kanang. Information was obtained that the lack of optimal application of the problem-based learning model in schools was related to the low basic knowledge of students, including the ability to interpret graphs. When students were given examples of questions containing straight motion graphs, the majority of students could not read the graphs, both the magnitudes on the graph and the meaning of the relationship between the variables on the graph. Thus, the problem of the low ability to interpret graphs is a phenomenon that occurs frequently and needs to be resolved.

Mustain (2015) explained that graphics are widely used in physics to present observational or experimental data, phenomena, and the relationship between variables in physical quantities. Through graphs, predictions can be made based on the patterns obtained (Karamustafaylu, 2011). Understanding graph interpretation is one of the abilities must-have basis scientists (Beichner, 11994), and requires basic knowledge and skills (Nuno Crato, 2020).

Amin et al. (2020) describe that there are four graphic interpretation indicators, namely (1) Determining the value of a certain quantity from the chart, (2) Translating graphic language into verbal language, (3) Identifying the chart based on the description, and (4)

Identifying graphs with different variables.

This opinion results from the development of Zavala (2017) on the Beichner Graphic-Kinematics Interpretation Test indicator or TUG-K 2.6. Zavala then added a new indicator component that identifies charts with different variables. The low ability of graph interpretation is a problem that needs to be solved. Evaluation of graph interpretation abilities can use multiple choice tests (Lichtenbeiger et al., 2017)

Based on the observation in August 2022, the environmental characteristic of MA DD Kanang as an Islamic school is that it has no support for applying media that utilizes technology such as a computer. So, static learning media is a solution that can be used. Media is defined as a connector or intermediary of knowledge from the teacher to students to achieve effective learning (Hasan, et.al, 2021). One example of media that can be applied in a static form and is currently widely used is infographic media. Generation Z likes visual graphics (Shofatun, Agustini, and Rahayu., 2021). It is not uncommon to find the information presented in this form on social media, even in offices.

Infographics are a visual-based learning media to present data, ideas, or facts through writing, symbols, graphics, tables or pictures, information in the form of tables, charts/graphics, and or pictures (Purba et al., 2021) to make information that was initially complex easy for readers to understand (Smicklas 2012). Infographics make messages or information more structured so that they are easy to understand (Randy Krum, 2014), increasing readers' understanding of certain topics or issues (Ferreira, 2014).

This is because interpretation is very important to help students optimize their learning, especially in presenting and reading experimental physics data. So, this study aims to determine the impact of students after the application of infographic media on straight motion physics topic.

METHOD

This type of research is pre-experimental in the form of a One-Shot Case Study design with only one control group, and to know the student's understanding of physics graphics after being given treatment. Application of infographic learning media with problem-based learning model. The research location is at MA DDI Kanang and will be in the odd semester of 2022/2023. The population used was class X MIPA students at MA DDI Kanang consisting of 45 students. There are independent variables and dependent variables. The independent variable in this study is the application of infographic media. Meanwhile, the dependent variable is the student's ability to interpret graphs on a straight-motion topic. The ability to interpret students' straight motion graphics in this study was measured using a test instrument in the form of an objective test (multiple choice).

Data collection was carried out after the application of infographic learning media in classroom learning. Furthermore, a test that has passed the validation test is given to students. Correct answers score 1 (one), while wrong answers score 0 (zero). The data analysis technique is quantitative analysis with descriptive statistics using SPSS and Microsoft Excel applications to calculate the average score, the average percentage of achievement for each indicator, and the categorization of student scores. Presentation of data in tabular form uses categorization guidelines from Amin et al. (2020); the goal is for data can be easily read and processed into diagrammatic form.

Table 1 Categorization of student graph interpretation scores

Interval	Category
17-20	Very High

Interval	Category
13-16	High
9-12	Moderate
5-8	Low
0-4	Very Low

Meanwhile, the categorization of scores for each indicator in the population was prepared using the categorization guidelines for the normal curve from Azwar (2009) concerning the ideal mean value and ideal standard deviation.

Table 2 Categorization of student achievement levels on each graphic interpretation indicator

Interval	Category
$x > (1{,}5\sigma + M)$	Very High
$(M+0{,}5\sigma) < x \leq (M+1{,}5\sigma)$	High
$(M-0{,}5\sigma) < x \leq (M+0{,}5\sigma)$	Moderate
$(M-1{,}5\sigma) < x \leq (M\ 0{,}5\sigma)$	Low
$x \geq (M-1{,}5\sigma)$	Very Low

Information :
x = indicator acquisition score
M = ideal average of each indicator
σ = ideal standard deviation

RESULT AND DISCUSSION

The problems formulated in the research were solved with two stages of activity, namely applying problem-based learning assisted by infographic media and administering a post-test to measure students' graphic interpretation skills.

This study applies PBL, which is supported by learning media in the form of infographics for straight-motion material. Researchers act as educators. Furthermore, the learning process involves problem-solving, discussion, and practicum. Researchers guide and assist students in understanding straight-motion topics, including what is contained in infographics.

The preparation of infographics begins with selecting material and determining storytelling (storyline or discussion), fonts, graphics, and images. The characteristics of the student learning environment are Islamic boarding schools located in tourist villages, so infographics are made by adding verses to several parts and using images that students can easily recognize. The goal is to make infographics more communicative. Infographic design using Corel Draw X7 and Photoshop applications.

Table 3 Statistical results of students' graphic interpretation ability test

Statistic	Statistic Score
Sample size (n)	45
The maximum ideal score obtained	20
The minimum ideal score obtained	0
The highest score obtained	18
The lowest score obtained	3
Average Score	9.04
Standard Deviation	3.45
Variance	11.907

The research occurred from the 1st to the 3rd meeting, and the learning evaluation was carried out at the 4th meeting. Learning begins with students starting to understand the basic concepts of straight motion and how to read graphs based on the infographics that have been distributed. Learning focused on Uniform Straight Motion and Uniformly Changing Straight Motion at the second meeting. The 3rd week or the last meeting is filled with vertical motion material, and infographics related to the material are also distributed to students.

In the 1st to 3rd meetings, the impact of infographic media can be seen in the knowledge aspects of students who were previously unable to read and recognize the variables in graphs. Scientifically these impacts can be known through evaluation.

The score of students' graphic interpretation ability test results can be categorized based on the categorization of graph interpretation abilities made in the form of a frequency distribution table as follows. The distribution for each student's score is displayed in Table 4.

Table 4 Frequency distribution categorization of ability to interpret graphs

Interval	Category	f
17-20	Very High	2
13-16	High	3
9-12	Moderate	22
5-8	Low	13
0-4	Very Low	5

Based on Table 4, it can be seen that 22 students are in the moderate category. There are two students in the very high category. Meanwhile, comparison graphs for each categorization are presented in Figure 1.

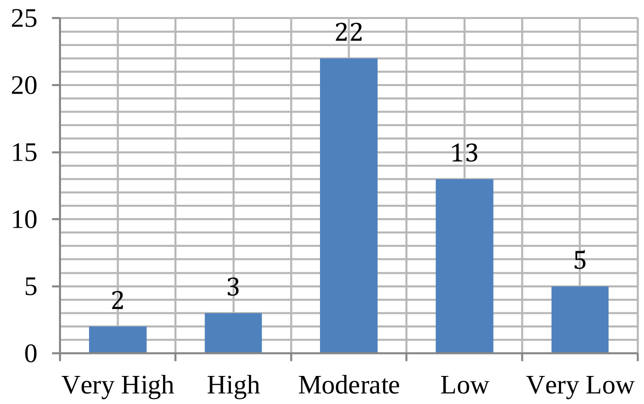

Figure 1 Categorization of Learners' Ability to Interpret Graphs

Furthermore, to describe students' interpretation abilities in answering tests, they are grouped based on four graphic interpretation indicators: determining a certain value from the graph, translating graphic language into verbal language, identifying graphs based on descriptions, and identifying graphs with different variables. The results can be seen in Table 5.

Table 5 Categorization of student graphic interpretation ability on each indicator

Indicator	Category
Determines the value of a certain quantity from the graph	Moderate
Translate graphic language into verbal language	Moderate
Identify graphs by description	Moderate
Identify graphs with different variables	Low

After conducting the test, it was found that the average student's graphic interpretation ability was in the "moderate", which is a modus from data. In addition, the analysis results on each indicator show that the indicator determines the value of a certain quantity from the chart; translates graphic language into verbal language; and identifies graphs based on descriptions, which are in the moderate category. Meanwhile, the indicator identifies charts with different variables in the low category.

The research was only conducted in the experimental class, there was no control class. The cause is the limited number of research subjects (number of classes). Learning with infographic media as the main treatment in the population. Based on data analysis, the average ability to interpret student graphs is in the moderate category. Based on the outline of the research ability of students after learning in categories can be defined as moderate; low, very low; high and very high.

Students in the moderate category generally learn straight-motion topics without another reference than infographics. So, their basic knowledge is insufficient to answer questions requiring a deeper understanding of the topic. Students in the moderate category can answer each indicator, but not optimally. Students with high ability in interpreting graphs understand every variable from rewriting infographics to their books. It can be seen from their correct answers that more than half of the maximum scores on the indicator identify charts with descriptions and identify charts with different variables. Then, students with low ability categories do not read infographics with focus and only read physics material in class which is held once a week. So, they couldn't answer the question because they forgot the function of each variable and couldn't make correlations between variables. This makes it difficult to define variables in a straight motion, including the concepts of velocity and acceleration in graphs.

Based on Table 5, the indicator determines the value of a certain quantity from the graph, translates graphic language into verbal language, identifies graphs by description, and identifies graphs with different variables that are in the moderate category because student knowledge about the variable is not optimal. It looks clearly at the Indicator that identifies graphs with different variables that only 4 (students) can answer correctly and made students' interpretation ability for that indicator in the low category. Overall in research, most students do not read infographics carefully and use infographics as their only source of learning.

Suparya et al. (2022) found that students who used learning resources only in textbooks or did not use learning resources tended to have low scientific abilities. Graphic literacy is the strongest predictor of graphic comprehension and is correlated with the arithmetic ability (Durrand et al., 2020). In addition, another study by Short and Armstrong (1993) found that students taught with a literacy approach were more open to using charts, diagrams, and graphs for their investigations in class. Literacy can be increased by exchanging information from various sources (Dragos & Mih, 2015). Lack of learning resources and motivation to read in class results in students not having enough information to make correct interpretations of graphs that are complex or consist of many variables and require a lot of basic information.

Applying infographics can improve students' interpretation skills to a moderate level. Considering that learning in the pandemic era caused many students not familiar with the function and application of graphs in physics and only familiar with bar and circle charts. Next, students began to be able to read straight motion graphics after applying problem-based learning assisted by this infographic media. although, the application of this infographic is not optimal and still needs to be developed to improve students' graph interpretation ability in the future.

CONCLUSION

Students’ ability to interpret graphics after applying infographic physics for straight-motion material is in the "moderate" category. Students X MIPA DDI Kanang can make interpretations limited to simple graphic, and they found it difficult to interpret graphics with various variables. The cause of students' graphic interpretation abilities being less than optimal is low literacy, including literacy of the infographics, as well as the provision of learning resources other than infographics (e.g. textbooks). This research also recommends that future research find more about the correlation between infographic literacy and students’ interpretation and the impact of infographics on graphic literacy in physics learning.

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