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Developing Website-based Interactive Learning Media Integrated with Kirchhoff's Law Experimental Tools

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ABSTRACT

Understanding the correct concept is a fundamental goal of learning physics. One material that is still vulnerable to conceptual understanding is Kirchhoff's law. For that, we need media that can bridge the understanding of the concept of this material. Media development by integrating real experimental tools with digital technology is the right solution to answer this problem. Integrated interactive Google site with tool practice form senior high school tool simplification designed for upgrade understanding concept science high school students on the material Kirchhoff's law electricity dynamic. Development used R&D with 4D stages (Define, Design, Development, Disseminate). Media implementation used limited tests with some students and implementation through one class in a high school in Bandung. Data analysis used the Rasch model. Based on the results of Rasch Model analysis, students tested have a medium category, and the given predictions in the Google Sites were high and low. Based on the analysis results of student responses to tools, students who used the tool directly agreed and strongly agreed that it and Google Sites could improve their conceptual comprehension skills.

Keywords: Development, Learning media, Conceptual understanding, Google site, Kirchhoff's law

INTRODUCTION

One of the characteristics of the 21st century is the advancement of information technology in various fields of life, such as economics, socio-culture, politics, and education. Learning media is one of the applications of technological advances in education (Nafi'a et al., 2020; Rahim et al., 2019). Learning media is an effective and efficient tool for achieving learning goals (Puspitarini & Hanif, 2019) and is needed to serve students with differences in cognitive development (Widodo, 2018). One of the learning media that can be used is the website.

The website is a platform for disseminating information via the Internet, which can be accessed through software (Mangelep, 2018; Rahayu et al., 2019; Asrizal et al., 2022). The website can be accessed via a domain with several information collections. The information presented on the website generally contains words, pictures, videos, animations, or known multimedia (Febriyanto et al., 2019; Yulia et al., 2022). The visuals can be a combination of one another, both static (cannot change) and dynamic (can change), according to certain conditions and capacities (Irawan & Saputro, 2021). Websites can be developed, one of which is by using Google Sites. Yuniar et al. (2021) developed Google Sites as teaching material using a custom domain to make it easier for students to find and memorize domains that will become a reference for learning informatics subjects.

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In contrast to informatics subjects which require finding and memorizing, physics subjects require more students to understand and analyze concepts correctly (Dwi et al., 2013; Diani, 2015). Among the physics material that requires conceptual understanding and analysis is Kirchhoff's laws on DC dynamic electricity (Rosdiana et al., 2019). In addition, the sub-topic of Kirchhoff's law is the most difficult discussion on dynamic electricity, with a percentage of 71.42%.

Difficulties in this material are caused by internal and external factors, such as the lack of interest and motivation in students' learning and the lack of variations in media and learning methods (Nofitasari & Sihombing, 2017). Besides understanding the correct concept, Kirchhoff's Law sub-topic requires process skills with direct experimentation (Supriyatman & Sukarno, 2014; Kang et al., 2019). The researcher developed an interactive Google Site integrated with Kirchhoff's Law circuit to achieve this goal. The developed Google Site contains in-depth material, worksheets related to the developed Kirchhoff's Law circuit, and evaluations that students can access anytime.

Interactive learning media allows users to control learning material simply, for example, simple start and stop for animations and manipulating items on the screen (Song et al., 2014). The 'interactive' in question is the user's learning environment. Users can access any material needed. This interactivity certainly has positive and negative impacts. The positive impact is that students can choose which parts they are interested in to grow learning motivation. While the negative impact is that learning objectives are not achieved if users do not access all content.

The Kirchhoff's law experimental tool developed simplifies the SMA KIT equipped with a digital measuring instrument. The addition of this digital measuring instrument is used to see directly the magnitude of the variables measured in dynamic electric material at the magnitude of the current strength and potential difference. Kirchhoff's law explicitly explains current division and voltage division. With the simplification of the SMA KIT equipped with a digital multimeter, it is hoped that students will understand the concept of dividing current and voltage correctly.

The difference in understanding each student's concept depends on his cognitive load. The survey results show that different cognitive loads provide varying results depending on the instructional design of the learning task (Skulmowski & Rey, 2020). Students feel cognitive load during learning due to the excess working memory capacity of students (Nurwanda et al., 2020). Students with high cognitive load will find it difficult to understand learning correctly. Therefore, a fun instructional design is needed for students in learning. This research aims to develop an interactive learning media assisted by Google Sites integrated with the SMA KIT experiment tool with Kirchhoff's law.

METHODS

The development model used is the 4D model by Thagarajan and Doroty S. Sammel (1974). The 4D model has four stages: define, design, develop, and disseminate. This research is limited to the development stage. Description about steps as below.

The defining stages of this research are 1) determining the problem, 2) identifying the expected competencies based on core and basic competencies of physics, 3) determining the material to be conveyed through the media, and 4) formulating indicators of learning objectives. At the design stage, the process includes: 1) compiling questions to measure students' material understanding, 2) determining the media format, and 3) making the initial design. The development stage includes: 1) preparing for making circuits and developing complete Google Sites with material layout, prediction of student answers, and a post-test to measure students' conceptual understanding; 2) media validation; and 3) trials and implementation tests. The test subjects in this study were six grade-12 students. The subjects for implementing the development results were 32 grade-12 students at one of Bandung's public high schools. The stages from defining to implementation were carried out from October to December 2022.

Data collection in this study used student worksheets. The instruments used were documentation and questionnaires of student responses to the developed media (Wahyudin, 2015). Questionnaires are a data collection technique for giving written questions or statements, both open and closed, to respondents to answer (Sugiyono, 2015). The questionnaire is used for validation tests and student assessments of the ease and benefit of using circuits and Google Sites.

The data in this study were analyzed by descriptive qualitative and descriptive quantitative. Qualitative data is in the form of the results of the Rasch model analysis of students' answers before and after learning. Quantitative data analysis techniques change the average percentage to determine media eligibility and student assessment criteria. Sugiyono (2015) converts the eligibility of the media into the category of uneligible (0% - 25%), fairly eligible (> 25% - 50%), eligible (> 50% - 75%), and very eligible (> 75% - 100%).

Furthermore, researchers used the Rasch model with several assessment criteria to analyze the implementation test results. These criteria are Cronbach's alpha score criteria and person and item reliability criteria. The Cronbach's alpha criteria used were very poor (< 0.5), poor (0.5 – 0.6), moderate (0.61 – 0.7), good (0.71 – 0.8), and very good (> 0.8) categories. Meanwhile, the criteria for person and item reliability values used were weak (< 0.67), moderate (0.67 – 0.8), good (0.8 – 0.9), excellent (0.91 – 0.94), and special (> 0.94) categories. After the categories of person and item reliability values are obtained, it is necessary to separate the strata. Separation of strata aims to see the grouping between respondents and the question items given more thoroughly. Separation of strata is obtained four times the item separation from the results of the Rasch model analysis, plus one, then divided by three.

RESULTS AND DISCUSSION

Results

Interactive Google Sites integrated with the high school KIT simplification experimental tool. This development that focuses on Kirchhoff's law material on dynamic electricity. Development with a 4D model limited to the development stage. Description about results as below.

Defining Stage Results

The defining stage is the first step in research. This stage is needed as the first step to conducting development research. At this stage, a preliminary study was carried out to see the problems in the field. The results of the preliminary study data analysis are presented in Table 1.

Table 1. Preliminary Study Results

No.	Preliminary Study Result	Information
1.	Obstacle	Dynamic electricity learning difficulty
2.	The most difficult sub-material	Kirchhoff's law material
3.	Challenge	Low motivation and lack of interactive media variations
4.	Interview	Students' physics learning difficulty, lack of

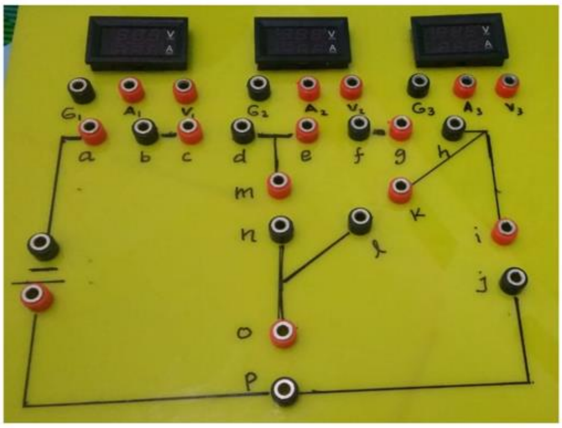
	practicum, especially during the Covid-19 pandemic, and lack of a variety of learning media

Source: (Hanif, 2020; Sudarsana et al., 2019; Hapsadri et al., 2019).

Table 1 describes the results of a literature study and interviews to find recurring problems. Based on the results of the literature review in sections number 1 to 3, dynamic electricity material is difficult for students to understand, especially in Kirchhoff's Law material. In addition, low motivation and a lack of variety of learning media are challenges teachers face to make learning in the classroom more interesting and meaningful.

Design Stage Result

The design phase contains a fully developed Google Sites design complete with Kirchhoff's Law circuit design. Kirchhoff's law circuit simplifies the SMA KIT, which aims to focus students on doing experiments directly. This circuit is designed using a digital multimeter to make it easier for students to directly detect the magnitude of the current and voltage of each resistance in the circuit. Kirchhoff's Law circuit integrated with Google Sites is shown in Figure 1.



Experiment Board

1. There are 3 of the multimeters (Amperemeter and Voltmeter) with:
   - G1, G2, G3 is ground for measuring instrument 1-3
   - A1, A2, A3 is amperemeter input for measuring instrument 1-3
   - V1, V2, V3 is input voltmeter for measuring instrument 1-3
   - All of the multimeter can't show negative value
2. There is 1 voltage source connected to the power supply
3. there are 16 connector points from a to p and the connection of each connector is as shown in the picture beside

Figure 1. Kirchhoff's Law Circuit Integrated with Google Sites

Figure 1 shows the developed experimental tools and the experiment guide. Experimental tools were given symbols to make it easier for students to do experiments. Points a to p in the experimental device is used to place resistance components and cables/connections. Points G_1, G_2, and G_3 are the ground (negative pole), while points A_1, A_2, and A_3 are the positive poles of the ammeter. Points V_1, V_2, V_3 are the positive pole of the voltmeter. Students can see the current and voltage strength measurements results from three resistances simultaneously. Furthermore, students can compare the results of current and voltage strength measurements from series and parallel arrangements according to the concepts described. Some steps make it easier for students to assemble components as expected.

Development Stage Results

The designed experimental tools and Google Sites were developed at the development stage. At this stage, trials and limited implementation tests were carried out to see the effectiveness of the developed interactive media. The results of trials and limited tests are explained as follows.

Trial Results

Website-based interactive learning media integrated with Kirchhoff's Law experimental tools were tested by researchers. Multimeter calibration is an improvement before being tested on six students. Researchers took experimental data based on student worksheets in Google Sites. From the trial results, the developed tools met the criteria for implementation. The results of the trial on six students are described in Table 2.

Table 2. Trial Results

Voltage	Trial Students' Results			Reference Data		
6 V	I_1= 0.13 A	V_1=0.43 V	5 Ω	I_1= 0.13 A	V_1=0.80 V	5 Ω
	I_2= 0.12 A	V_2=4.93 V	30 Ω	I_2= 0.12 A	V_2=4.68 V	40 Ω
9 V	I_1= 0.20 A	V_1=1.36 V	5 Ω	I_1= 0.18 A	V_1=1.82 V	5 Ω
	I_2= 0.21 A	V_2=7.29 V	30 Ω	I_2= 0.19 A	V_2=6.94 V	40 Ω

Table 2 shows that the researcher's experimental data is almost identical to the six students' trial results. The differences can be caused by the influence of digital multimeter calibration and the influence of resistance/resistors during the test, and the connecting cable factor. Based on the data analysis results, the percentage of current strength error was 0%, while the percentage of voltage error was below 50%.

Implementation Stage Results

Analysis of Students' Initial Skills Through Answers to the Predictions of the Displayed Phenomena

The phenomenon displayed on Google Sites is the Wheatstone bridge phenomenon. This phenomenon uses five lights connected to form a Wheatstone bridge. Instrument level analysis using the Rasch model can be accessed in the statistical summary in Figure 2.

```
INPUT: 7 Person  6 Item  REPORTED: 7 Person  6 Item  9 CATS     WINSTEPS 5.4.2.0
--------------------------------------------------------------------------------

     SUMMARY OF 7 MEASURED Person
-------------------------------------------------------------------------------
|          TOTAL                         MODEL         INFIT         OUTFIT    |
|          SCORE     COUNT     MEASURE    S.E.      MNSQ   ZSTD   MNSQ   ZSTD |
|-----------------------------------------------------------------------------|
| MEAN       9.1       6.0       -.24     .83      1.04    .13    .80    .04 |
|  SEM        .8        .0        .53     .01       .22    .28    .18    .23 |
| P.SD       2.0        .0       1.29     .03       .55    .68    .45    .57 |
| S.SD       2.1        .0       1.40     .04       .59    .73    .49    .61 |
| MAX.      13.0       6.0       2.16     .87      2.23   1.52   1.83   1.07 |
| MIN.       6.0       6.0      -2.46     .76       .57   -.48    .39   -.67 |
|-----------------------------------------------------------------------------|
| REAL RMSE    .92 TRUE SD     .90  SEPARATION   .98  Person RELIABILITY  .49 |
|MODEL RMSE    .83 TRUE SD     .99  SEPARATION  1.19  Person RELIABILITY  .59 |
| S.E. OF Person MEAN = .53                                                   |
-------------------------------------------------------------------------------
Person RAW SCORE-TO-MEASURE CORRELATION = 1.00
CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .52  SEM = 1.35
STANDARDIZED (50 ITEM) RELIABILITY = .92

     SUMMARY OF 6 MEASURED Item
-------------------------------------------------------------------------------
|          TOTAL                         MODEL         INFIT         OUTFIT    |
|          SCORE     COUNT     MEASURE    S.E.      MNSQ   ZSTD   MNSQ   ZSTD |
|-----------------------------------------------------------------------------|
| MEAN      10.7       7.0        .00     .86       .88   -.11    .80    .00 |
|  SEM       1.9        .0        .88     .11       .25    .41    .27    .37 |
| P.SD       4.2        .0       1.96     .25       .56    .92    .60    .82 |
| S.SD       4.6        .0       2.15     .27       .61   1.01    .65    .90 |
| MAX.      17.0       7.0       2.15    1.21      1.82   1.45   1.80   1.44 |
| MIN.       6.0       7.0      -2.53     .61       .41   -.84    .21   -.78 |
|-----------------------------------------------------------------------------|
| REAL RMSE    .95 TRUE SD    1.72  SEPARATION  1.81  Item   RELIABILITY  .77 |
|MODEL RMSE    .89 TRUE SD    1.74  SEPARATION  1.96  Item   RELIABILITY  .79 |
| S.E. OF Item MEAN = .88                                                     |
-------------------------------------------------------------------------------
Item RAW SCORE-TO-MEASURE CORRELATION = -.43
Global statistics: please see Table 44.
UMEAN=.0000 USCALE=1.0000
```

Figure 2. Statistical Summary Answers to the Wheatstone Bridge Phenomenon

Figure 2 provides general information about the quality of student response patterns, the quality of the instruments used, and the interactions between persons and items. From Figure 3, information is obtained to analyze its quality. The Person Measure was -0.24 logit, showing the average score of all students in working on the given items. The person logit value is less than 0.0, or the average logit item value indicates a tendency for the group's skills to be lower than the difficulty level of the questions given.

Cronbach's alpha value measures reliability, student interactions, and the question answers. From Figure 2, a Cronbach alpha value of 0.52 is obtained, meaning the reliability between student interaction and the answers is poor. These results could be influenced by the individual inconsistency in answering the questions, the poor quality of the questions, and the number of students filling out the instrument.

Furthermore, the value of person reliability and item reliability is analyzed. From the analysis results, the value of person reliability was 0.49, and item reliability was 0.77. Therefore, it can be concluded that the consistency of students in answering the questions is weak, and the quality of the items in terms of the reliability aspect quality instrument is average.

Other data that can be analyzed are the INFIT MNSQ and OUTFIT MNSQ. The ideal value is 1.00 (the closer to 1.00, the better). INFIT ZSTD and OUTFIT ZSTD have an ideal value of 0.00 (the closer to 0.00, the better). MNSQ shows the value of randomness or the amount of distortion in the measurement system, while ZSTD shows whether the data fits the model or its significance if the data fits the model. For people and items from the results of the Rasch analysis, these two values are good because they are close to the ideal value.

The grouping of person and item items is known from the separation value. The greater the value, the better the quality of the instrument because it can identify groups of respondents and items. In order to see the grouping more thoroughly, the strata separation equation is used. With an item separation value of 1.81, the stratum separation value is 2.74. Grouping can be divided into less than three groups of items, interpreted as easy-medium questions, moderate-difficult, or easy-difficult. There is no moderate category.

Wright Map Analysis

One of the features of Rasch modeling with the ministep program is to produce a map that describes the distribution of students' abilities and the distribution of the difficulty levels of the questions on the same scale. The Wright map on the left depicts students' ability to predict the answers to the problems given, and the right side depicts the difficulty level of each question. The problem given is the phenomenon of the Wheatstone bridge in Google Sites as a prediction of students' initial abilities. The Wright map is shown in Figure 3.

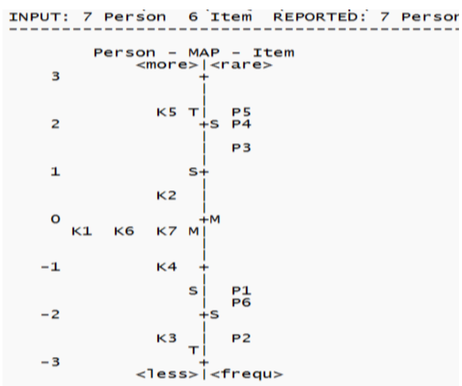


Figure 3. Wright Map Analysis

Based on Figure 3, the average logit item (M) value is above the average logit person (M). It means that the ability of the group of students tends to be lower than the difficulty level of the questions given. Most students only gathered at a moderate ability level. K1, K6, and K7 students have the same logit, meaning their ability levels are the same. Most students have moderate ability levels. Only students in K5 are high, and K3 are low.

The distribution of the logit values of the questions is quite good. It means that there is no logit value for each item that is the same, but the questions are gathered at a high difficulty level (P3, P4, P5, phenomena 2 and 3 in the Wheatstone bridge phenomenon) and low (P1, P2, P6; Phenomenon 1 and 4 in the Wheatstone bridge phenomenon). No questions measure the average level of student ability even though most students' ability level is moderate, so it is necessary to add predictive questions with moderate difficulty. Only students in K5 have high abilities, and K3 have low abilities.

From the logit scores of K5 students, they likely understand the material taught by the class teacher and can predict the given Wheatstone bridge problem. However, it is different with K3 students, whose logit score is lower than the difficulty level of the questions. This low score is probably because K3 students do not understand the material taught by the class teacher. In addition, based on statistical probability, K1, K2, K4, K6, and K7, based on statistical probability, are only able to answer low-level questions but cannot answer high-level questions.

Analysis of Students' Final Skills Through Their Quiz Answers

The test was conducted outside of learning; not all students responded to or answered quizzes. The quiz is in the form of 11 drag-and-drop questions to determine the value of the current strength, the voltage at the end of the resistance, and the total voltage. The number of students who took the test was 12 out of 30. Analysis of students' post-test answers related to Kirchhoff's Law using the Rasch analysis model is as follows:

Statistical Summary

The results of the statistical summary analysis provide overall information about the quality of student response patterns, the quality of the instrument, and the interaction between students and the instrument. This analysis includes an extreme analysis that differs from the previous prediction and non-extreme analyses. From Figure 4, information can be obtained to analyze its quality according to the previous criteria.

SUMMARY OF 10 MEASURED (NON-EXTREME) Person

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	7.7	11.0	-.37	1.26	.90	-.25	1.22	.13
SEM	.6	.0	.74	.04	.26	.36	.78	.31
P.SD	1.7	.0	2.23	.11	.77	1.07	2.33	.92
S.SD	1.8	.0	2.35	.12	.82	1.13	2.45	.97
MAX.	10.0	11.0	2.63	1.39	2.22	1.56	8.10	2.62
MIN.	6.0	11.0	-2.56	1.09	.30	-1.08	.15	-.53

REAL RMSE 1.47 TRUE SD 1.68 SEPARATION 1.14 Person RELIABILITY .57
MODEL RMSE 1.26 TRUE SD 1.84 SEPARATION 1.45 Person RELIABILITY .68
S.E. OF Person MEAN = .74

MAXIMUM EXTREME SCORE: 2 Person 16.7%

SUMMARY OF 6 MEASURED (NON-EXTREME) Item

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	6.5	12.0	.00	.98	.89	-.31	1.22	.09
SEM	1.0	.0	.89	.04	.24	.45	.80	.43
P.SD	2.2	.0	2.00	.10	.55	1.01	1.80	.97
S.SD	2.4	.0	2.19	.11	.60	1.10	1.97	1.06
MAX.	10.0	12.0	3.40	1.15	1.96	1.44	5.21	2.04
MIN.	3.0	12.0	-2.87	.86	.21	-1.51	.14	-1.18

REAL RMSE 1.06 TRUE SD 1.69 SEPARATION 1.59 Item RELIABILITY .72
MODEL RMSE .98 TRUE SD 1.74 SEPARATION 1.77 Item RELIABILITY .76
S.E. OF Item MEAN = .89

MAXIMUM EXTREME SCORE: 5 Item 45.5%

SUMMARY OF 12 MEASURED (EXTREME AND NON-EXTREME) Person

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	8.2	11.0	.44	1.38				
SEM	.6	.0	.82	.09				
P.SD	2.0	.0	2.72	.29				
S.SD	2.1	.0	2.84	.30				
MAX.	11.0	11.0	4.46	1.99				
MIN.	6.0	11.0	-2.56	1.09				

REAL RMSE 1.57 TRUE SD 2.22 SEPARATION 1.42 Person RELIABILITY .67
MODEL RMSE 1.41 TRUE SD 2.32 SEPARATION 1.65 Person RELIABILITY .73
S.E. OF Person MEAN = .82

Person RAW SCORE-TO-MEASURE CORRELATION = 1.00
CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .75 SEM = 1.01
STANDARDIZED (50 ITEM) RELIABILITY = .92

SUMMARY OF 11 MEASURED (EXTREME AND NON-EXTREME) Item

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	9.0	12.0	-2.35	1.37				
SEM	1.0	.0	.94	.14				
P.SD	3.2	.0	2.97	.44				
S.SD	3.3	.0	3.12	.46				
MAX.	12.0	12.0	3.40	1.85				
MIN.	3.0	12.0	-5.18	.86				

REAL RMSE 1.47 TRUE SD 2.58 SEPARATION 1.75 Item RELIABILITY .75
MODEL RMSE 1.44 TRUE SD 2.60 SEPARATION 1.80 Item RELIABILITY .76
S.E. OF Item MEAN = .94

Figure 4. Statistical Analysis of *Quiz* as Post-test Scores

In Figure 4, there are extreme scores for both person and item. Because the Rasch analysis model uses logarithmic probability values, people with perfect or wrong scores are all considered extreme scores, likewise, with items. In Figure 4, two students have extreme scores (perfect scores/all correct). At the extreme scores for the items, there are five questions that all students can answer correctly.

Next, are the analysis results using Person and Item Measures for extreme scores. Students will be extreme if they enter 0.44 logs, and questions will be extreme if they enter -2.35 logs. The difference in the logit value is quite significant, and the logit person (student) score is higher than the item or question. This value indicates a tendency for the group's ability to be much higher than the difficulty level of the questions given. Therefore, it can be concluded that students master the concepts in the questions.

Based on Figure 4, Cronbach's alpha value is 0.75, meaning the interaction reliability between person and item is good. The value of person reliability, if the extreme value is entered, is 0.67, and item reliability, if the extreme value is entered, is 0.75. Therefore, it can be concluded that the consistency of students in answering questions and the quality of the items in the instrument is sufficient. The results of the statistical summary analysis show that the reliability and validity of the instruments or questions used are good, and the students' abilities seen from the logit average are far above the difficulty level of the questions. So, it can be concluded that the students' abilities to answer Kirchhoff's Law post-test questions are high.

Analysis of Student Responses to the Developed Experimental Tools and Google Sites

Based on the analysis of students' response questionnaires to experimental tools, students agreed that the developed tools made them more able to understand the concept of dynamic electricity. There are eight statements given to students: 1) I am interested in learning physics using Kirchhoff's Law experimental tools on DC dynamic electricity, 2) I am interested in learning physics using Kirchhoff's law experimental tools on DC dynamic electricity because of the design, 3) The experimental tools make me understand Kirchhoff's law material better, 4) Experimental tools make it easier for me to imagine the implementation in everyday life, 5) My data collection ability increases with the experimental activities carried out, 6) The experimental tools are quite easy to operate, 7) Data collection using experimental tools is quite easy, and 8) The experimental tool is quite practical to use. The results of the analysis of student responses to experimental tools are explained in Figure 5.

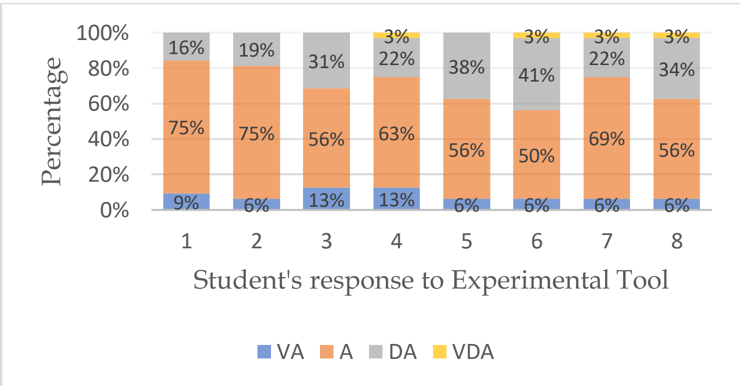


Figure 5. Student Responses to the Developed Experimental Tools

Based on Figure 5, only a small number of students strongly disagree. As many as 3% of students strongly disagree that experimental tools make it easier to imagine the implementation in everyday life, the operation of experimental tools is quite easy, data collection using experimental tools is quite easy, and the experimental tool is quite practical to use. This is due to limited tools, so some students cannot use experimental tools directly.

More than 50% of students agree that practical experimental tools are used, making it easier to understand Kirchhoff's laws. So, it can be concluded that experimental tools are effective in helping students to understand Kirchhoff's Law material.

Next is an analysis of student responses to the development of Google Sites. Among the statements given to students regarding the Google Sites that were developed were as follows: 1) I am interested in learning physics using the developed Google Sites, 2) I am interested in learning physics because of the design of the Google Sites, 3) The developed Google Sites make me understand Kirchhoff's law material better, 4) The developed Google Sites make it easier for me to imagine the implementation in everyday life, 5) The developed Google Sites is quite easy to operate, 6) The developed Google Sites is quite practical to use. The results of the analysis of student responses to the developed Google Sites are explained in Figure 6.

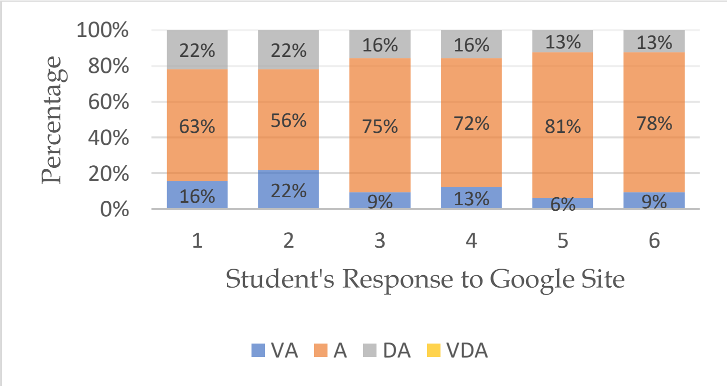


Figure 6. Student Responses to the Developed Google Sites

Based on Figure 6, no one strongly disagrees. Based on the statements, less than 25 % of students disagree that Google Sites makes them more interested in learning physics. This is because not all students tend to immediately like something, including the interactive media developed by Kirchhoff's Law material. However, more than 70 % of students are interested in learning physics and understanding more about Kirchhoff's Law material through the developed Google Sites. Therefore, interactive media development is eligible to be used as learning media.

Discussion

The results of developing Google Sites and experimental tools can motivate students to learn about dynamic electricity. These results prove that direct student interaction in the learning process can make them more enthusiastic about learning (Oktiani, 2017). Then foster student interest and motivation because of images that can provoke student creativity (Amir, 2017). In addition, interactive media developed by utilizing technology can foster students' digital literacy (Rahmah et al., 2021; Heryani et al., 2022) and increase students' conceptual understanding (Suwindra, 2012; Kurniawati, 2018).

The results of interactive media development are also relevant to the development of interactive multimedia in mathematics, including figures, equations, and videos (Istiqlal, 2017). The results of this multimedia development are also worthy of being used as learning media. The development of Google Sites was carried out on material on mathematical functions (Tambunan & Siagian, 2022), German (Ginting & Afifah, 2022), and material on work and energy in physics learning (Wulandari et al., 2022).

The results of previous studies still focused on developing Google Sites only. In addition, the development of experimental tools on physics material was also developed. There are on melde material (Widayanti & Yuberti, 2018), magnetic fields (Anugrah, 2015), free fall motion (Maiyena et al., 2018), and magnetic electricity (Waris et al. ., 2017). The results of the experimental development are worthy of being used as physics learning media.

Combining Google Sites and real experiment tools will have a more positive impact than just one. The positive impact of developing interactive media allows students to become more literate, especially in digital and data literacy. Literacy ability is one indicator of the success of the independent learning curriculum. Integrating experimental procedures from digital technology into real experimental tools, predicting phenomena, and answering questions enable students to have higher-order thinking skills. In addition, students can freely access material, videos, and questions related to Kirchhoff's Law material. Students' conceptual understanding increases because students are equipped with visualizations of the water flow. The course of current is one of the important concepts that students must understand while studying dynamic electricity, especially in Kirchhoff's laws.

The results of the development of this interactive media have limitations. First, the experimental tools developed are still few, so not all grade-12 students can use these experimental tools simultaneously. Second, the development results are still being implemented in one school in Bandung. Third, this material only focuses on Kirchhoff's law material, so this interactive media cannot represent DC dynamic electricity material as a whole.

CONCLUSION

By integrating Google Sites and experimental tools on the dynamic electricity concept of Kirchhoff's law material, interactive learning media can increase students' conceptual understanding and learning motivation. Data analysis using the Rasch model showed that the ability of the group of students was lower than the difficulty level of the questions given. Students respond within the range of agreeing that Google Sites and the experimental tools developed can help them understand the concept of dynamic electricity in Kirchhoff's Law material. The tool's limitations are the main factors that make students respond to disagree and strongly disagree. Students who used the tool directly agreed and strongly agreed that it and Google Sites could improve their conceptual comprehension skills. Overall, the results of developing this interactive media deserve to be used as media for learning physics, especially in the dynamic electricity of Kirchhoff's Laws material.

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