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RESEARCH ARTICLE

THE EFFECTS OF COMIC-ASSISTED ELECTRICAL LABORATORY ON ACHIEVEMENT AND INTEREST TOWARDS LEARNING PHYSICS

Aslindawati Abdullah[1], Dr. Nurul Syafiqah Yap Abdullah[2] and Dr. Ikhwan Hadi Yaacob[3]

1. Research Scholar, Faculty of Science and Mathematics, Sultan Idris Education University (UPSI), Perak, 35900 Malaysia.
2. Senior Lecturer, Faculty of Science and Mathematics, Sultan Idris Education University (UPSI), Perak, 35900 Malaysia.
3. Senior Lecturer, Faculty of Science and Mathematics, Sultan Idris Education University (UPSI), Perak, 35900 Malaysia.

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Abstract

A powerful media for instruction and learning to understand physics principles is essential for clarifying abstract ideas. A poor teaching strategy will discourage students from mastering their experimenting skills and worsen their comprehension of the material in practical terms. This study aimed to investigate the impact of an intervention employing a comic-assisted Electrical laboratory learning application on students' achievement and interest for physics in the matriculation program. In this study from 2022, 134 students with low Electrical test scores took part. This study was carried out utilizing a one group pre- and post-test study design and a quasi-experimental quantitative analysis. This study involves study subjects getting an intervention for eight weeks and their experience was measured quantitatively to ascertain the success of the intervention that has been carried out. The comic instrument, the Electrical Topic Achievement Test, and the Comic Based Physics Learning Interest questionnaire which were based on comic teaching materials were the instruments employed in this study. The study's conclusions demonstrate a notable improvement in student interest and accomplishment as well as in their recall of facts and capacity to respond to problems requiring sophisticated thought processes related to Electrical. The study's conclusions also demonstrate a rise in the high degree of student interest for learning physics, as well as a gain value or N-Gain of 0.83. As a result, this study demonstrates how applying Electrical laboratory learning with comics can serve as an active teaching and learning media, boosting student interest to meet learning goals more successfully

Introduction:-

An essential component of teaching and learning is instructional media. It serves as a medium for information between students and instructors, as well as between students and all other participants in the learning process. Instructional media or teaching media have become more important as teaching aids as a result of the advancement of technological

Corresponding Author:- Aslindawati Abdullah
Address:- Research Scholar, Faculty of Science and Mathematics, Sultan Idris Education University (UPSI), Perak, 35900 Malaysia.

applications in education (Haleem, et al., 2022). In addition to printed materials, instructional media also includes slides, films, audio visuals, models and other resources. Numerous earlier studies' findings demonstrate that instructional media influences students' involvement in the learning process, enhances their comprehension and increases their interest (Ordu, 2021). Hence, instructional media helps students understand Physics by helping them visualize the abstract ideas covered in the course. As a result, it may facilitate students' conceptual understanding and using learning comics is unquestionably one of the most important instructional media. Comics were works of art in which a narrative is formed by the arrangement of still pictures. Wijaya et al., (2021) states that educational comics is a type of visual medium used to communicate information that tells a story using a combination of text and images. To enhance learning results, the use of educational comics as a teaching medium has been widely used (Abroriet al., 2023; Matuk et al., 2021;). Hence, students will find learning objectives are meaningful and achievable if comics are employed in the right way. Comics are, nevertheless, less common in Malaysia, particularly during laboratory sessions. This may be due to the belief held by educators that comic books were only for entertainment and have no educational value for readers.

Study Background

According to the Physics Syllabus Description of the Matriculation Program (Matriculation Department, 2022,the goal of teaching physics in matriculation colleges is to develop self-reliant, inquiry-oriented students who can handle science in a systematic and comprehensive manner. Physics is a challenging science to comprehend since, according to the Physics study, it emphasizes ideas and concepts that are difficult to visualize. One of the topics covered in the Matriculation program's Physics class is Electrical. Electrostatics, capacitors, direct current circuits, applications of electrical devices such potentiometers and Wheatstone bridges, and alternating current circuits werepart of the topics covered. Study by Ponto (2020) demonstrate that students rarely grasp the idea of electrical circuits and have a lot of difficulties comprehending the ideas of electrical current and voltage. The topic of Electricalcontains abstract concepts that call for a suitable teaching strategy, such as student-centered, active group involvement, hands-on activities, and mental challenges that wereapplicable (Schiavon et al., 2022). Students' knowledge and skills will be developed by direct experience rather than by rote memorizing of physics theory when this teaching and learning strategy is used. There werenumerous aspects of comics that can support students' learning. Complex concepts werepresented in a way that is easier to comprehend, understand, and recall through the use of cartoon concepts and corresponding comic pictures (Asiah, 2020). Comics were seen as an effective medium for science communication because they combine visual representation with scientific explanation. Furthermore, the use of comic sketches has been shown to boost students' intrinsic interest and engagement in the classroom (Lin et al., 2015). More ever, comic have been utilized as a teaching media in education for many years because of their unique visual style, universal appeal, and humorous and captivating narrative. As a result, comics were employed in a study that examined the interest shifts and academic progress of physics students. According to Pardimin& Widodo's (2017) study, usingcomics as a teaching media can boost student enthusiasm, create a welcoming environment for them, and facilitate an enjoyable learning process. Furthermore, according to Lin et al. (2015), using comics in teaching and learning can boost interest and engagement.

This study aims to investigate the impact of using comics in the laboratory learning of the topic of Electrical among students enrolled in the matriculation program's Physics subject on two significant domains: academic achievement in Physics and the shift in students' interest towards Physics learning. While the use of traditional textbooks lowers the interest for reading pleasure, the study's findings will eventually be used as a justification and framework for the application of comics as an effective teaching medium in the teaching and learning of Physics and STEM subjects in the matriculation program of readers.

Problem Statement

According to the findings of earlier study, interest is a crucial component needed for learning. According to Makhtar et al. (2021), pupils who were highly driven have more positive attitudes and views towards learning physics. In addition, according to the results of Fadieny& Fauzi's (2019) study, using learning comics as an engaging teaching media can boost students' interest. The claim that pictorial instruction via comics is an excellent substitute teaching medium to boost student interest supports the study's findings (Nikmah et al. 2019). There are, however, not many study conducted in Malaysia on the use of comics in instruction, particularly at matriculation institutions. An investigation by Matuk et at., (2021) concentrated on the biology coursework performance of high school pupils. According to their study, using comics in the classroom raised student achievement. Their study, however, did not look at the impact of employing comics to boost students' interest. Teaching media in the form of textbooks and student worksheets were discovered based on needs analysis, which is the outcome of student interviews, observation of student learning activities, and interviews with matriculation college physics teachers. Furthermore, the issue of

diminishing interest or learning interest among students enrolled in Physics courses is further compounded by traditional, teacher- centered learning methods and other variables. This circumstance is consistent with Jusof's (2022) study's findings, which indicate that low academic achievement among pupils is mostly caused by teacher-centered teaching and learning. According to a study by Wahyudin et al. (2020), students will be motivated to learn if interest factors were incorporated into both teaching and learning. The findings of the pre-tests and interviews were used to determine the primary issue with this study. Pre-test results were analysed, and it was discovered that pupils had trouble fully grasping the idea of Electrical. The study participants' interest level falls into the medium range, according to the results of the Physics Learning Interest questionnaire. The interview's findings indicate that most students enjoy reading comic books and frequently utilize engaging, colourful, and visually stimulating instructional materials. Consequently, they concur that using comics to present instructional and learning materials will encourage students to learn.

According to the problem statement that has been presented, when students struggle to recall physics knowledge, their interest to study the topic in depth decreases and ultimately impacts their performance. By incorporating comic books into the laboratory's teaching and learning process on the subject of Electrical, this study is focused on finding a solution to the discussed issue. This study is focused on determining the suitability of comics to enhance achievement and interest among students in the Physics subject of the matriculation program, as interest is one of the factors that affect student achievement in Physics.The study is guided by the following three main research questions:
(1)Is laboratory learning with the help of comics can improve student achievement in the Physics subject of Electrical compared to conventional methods?
(2)Is comic-assisted laboratory learning can improve students' ability to remember the facts of the physics topic of Electrical compared to conventional methods?
(3)Is laboratory learning with the help of comics can increase the level of interest towards the Physics topic of Electrical compared to conventional methods?

Target Group
The subjects of this study were 134 Physics students in the second semester of matriculation college in 2022. Subjects were selected using purposive sampling techniques and then the number of study subjects was determined using convenience sampling techniques. This study was conducted based on quasi-experimental quantitative analysis and it involved study subjects receiving one-group pre and post-test intervention for six weeks and their experience was measured quantitatively to determine the effectiveness of the intervention that had been carried out. The design of this study does not require a control group (Creswell, 2009) and is able to study the effectiveness of the intervention by controlling interfering factors such as the intervention reaching maturity, which is carried out for eight weeks (Rasdi al., 2021). The study subjects learned about Electrical in two different ways: first, through traditional classroom instruction, and second, through laboratory instruction using digital comic book. This indicates that by learning through experience, the study participants themselves undergo changes in their level of conceptual mastery, their ability to recall of facts, and their success in the physics course on the topic of Electrical. Learning from their personal experiences enables students to become more motivated and self-assured when it comes to the physics topic of Electrical.

Planning and Execution of Actions
This study uses the Electrical Topic Achievement Test questions consisting of 33 objective questions and 4 structural questions. Student achievement on the pre- and post-tests is assessed using this test. The low-level and high-level cognitive domains of Bloom's Taxonomy were represented by these questions. Twelve of the questions were low cognitive, and there were twenty-five high cognitive. The achievement test has a total score of 100 points. Pre- and post-tests on the study subjects were administered for two hours prior to and following the comedy application intervention in the laboratory on the topic of Electrical. The change in the study subjects' interest level before and after the intervention was measured using the Physics Learning Interest Instrument, which is based on comedic teaching media. This five-point Likert scale questionnaire, which comprises ten question items and a high level of validity (Cronbach Alpha value of 0.89), was derived from Deashara's (2016) study. The two study instruments have undergone a validation process to guarantee that there is no ambiguity about their degree of truthfulness. The laboratory learning on the topic of Electrical in this study involves the use of comics as a teaching media. The use of comics helps to summarize complex practical procedures in a way that is simpler and easier to understand because the visual representation of comics can help readers understand theconcepts being discussed. According to McDermott et al. (2018), the characters in these comics can help readers grasp and retain concepts by guiding and engaging them with comics. Unlike the method of assigning pupils to use text reference materials, this learning comic also takes into

account the humorous components and narrative of the comic story(Ozdemir, 2017). This element aligns with the view of study of McDermott et al. (2018) that readers can form connections between abstract concepts that may be challenging to understand and relatable experiences when analogies are used in comics to explain such ideas. As a teaching media, **Figure 1**and **Figure 2** provides a digital drawing of every character and the background in the comic. Every character has a distinct purpose, and the dialogue and narration are skilfully placed to create an easily understood plot that makes use of informal, everyday language. The comic's content goes beyond simply narrating ideas, it also includes questions meant to assess the reader's comprehension and memory of the topics covered. Educational comic that offers engaging plot encourage and stimulate the reader's interest in learning more about the concepts of Electrical contained in the matriculation program's Physics syllabus. This crucial stage will guarantee that matriculating physics students are motivated to learn without becoming disinterested or losing concentration.

Fig 1:- Comics using digital drawings attract the attention of readers.

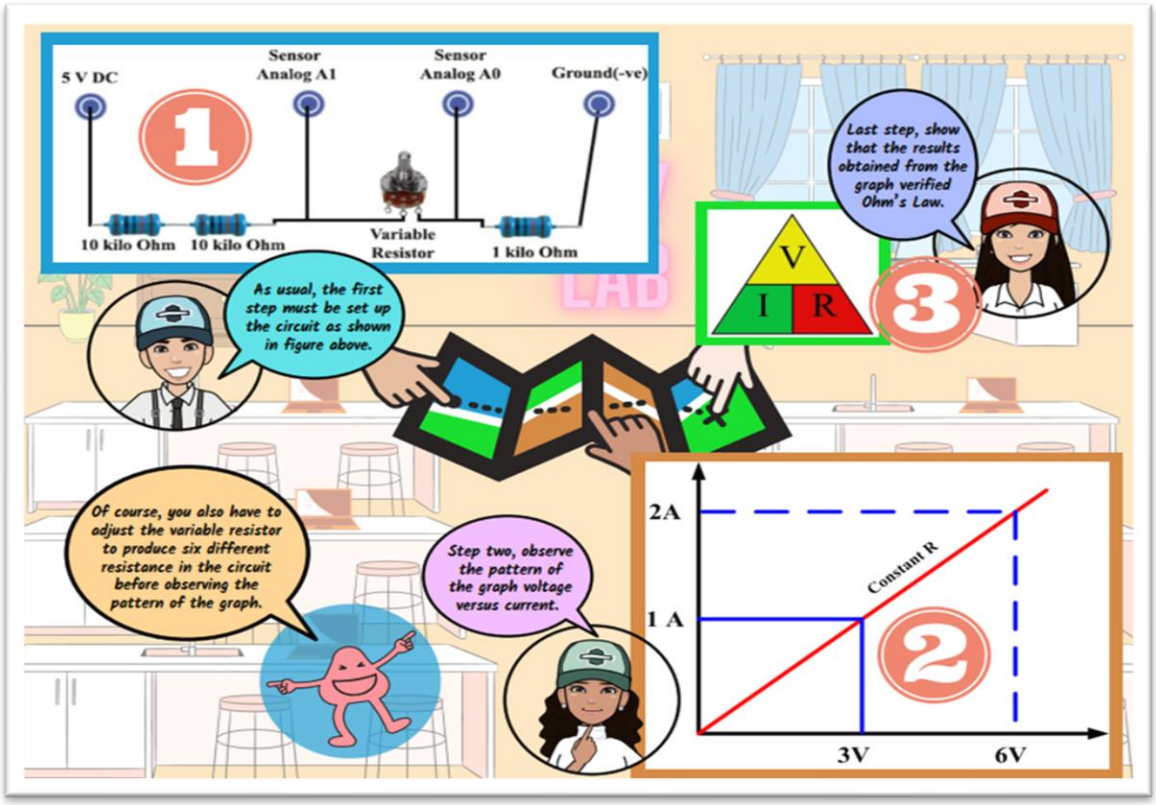

Fig 2:- Comic-assisted electrical laboratory using digital drawing.

Fig 3:- Students run application-based practice comic-assisted electrical laboratory.

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Results:-

There were two stages to the data gathering process: before and post, separated by eight weeks. Data before and after the study were gathered using the Electrical Topic Achievement Test. The change in the study subjects' interest level before and after the intervention was measured using the Physics Learning Interest Instrument, which is based on comedic teaching media.

Achievement Improvement

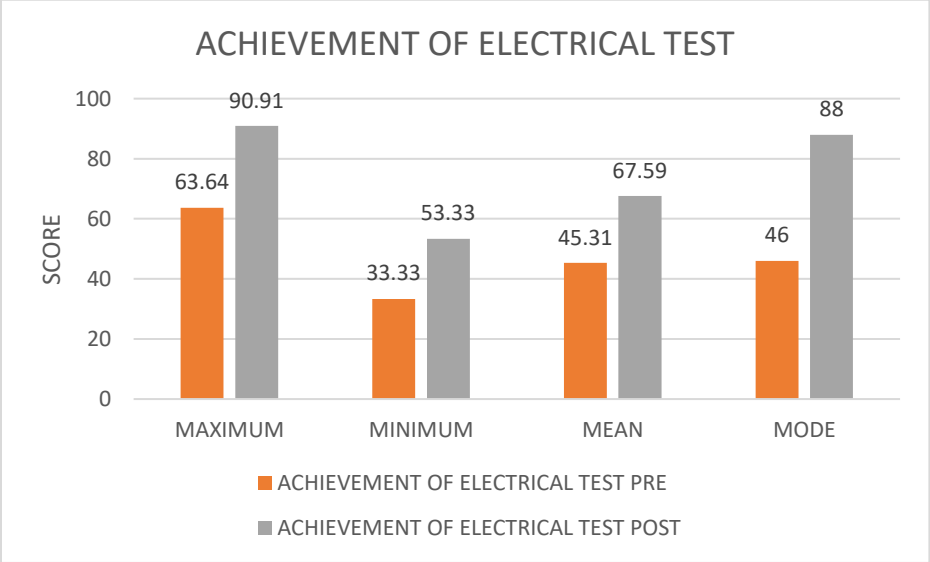

Fig 4:- Analysis of pre and post.

Pre- and post-tests were given to the study subjects following their use of comic-assisted laboratory learning to assess the change in their achievement on the topic of Electrical. The same number of questions and the same level of cognitive as the pre-test was used to generate the post-test. Examine the inference data derived from **Figure 4** pre- and post-test results. The study subjects' maximum pre-test score was 63.64 percent overall. After the intervention in this study's phase, the maximum score increased to 90.91 percent. The mean test score improved from 45.31 percent to 67.59 percent with an average score increase. The minimum score and the mode score of the pre- and post-test showed a very substantial rise in total scores. This quantitative analysis demonstrates that the intervention has resulted in a noteworthy improvement in terms of achievement, fact recall, and the capacity to respond to questions requiring advanced cognitive abilities related to Electrical.

Greater Level of Interest After The Intervention

A Physics Learning Interest questionnaire based on educational comic teaching medium was used to gauge the study subjects' degree of interest. The N-Gain equation or the increase in production based on the work of Fadaei, A. S. (2019) were used to calculate the rise in student interest. by applying the formula that follows.

$$g = \frac{S_f - S_i}{100 - S_i}$$

that is

g = N-Gain value
Sf = score posttest (format 100 marks)
Si= score posttest (format 100 marks)
Research of N-Gain value or increase in income described using **Table 1**.

Table 1:- Gain's Category (Hake, 1998).

Gain Score	Category
g> 0.7	High
0.3 ≤ g ≥ 0.7	Moderate
g <0.3	Low

Table 2:- Interest Level Scores Before Intervention.

No	Item	Likert Scale	Marks
1	I am doing Electrical exercises right away	3.12	60.40
2	There are things that stimulate my curiosity if I learn without using the media	3.54	70.80
3	I reviewed the material given by the teacher outside class time	2.89	57.80
4	Learning using teaching media is quite interesting	3.86	77.20
5	I have a goal to get a score above the average score for the topic Electrical	3.52	70.40
6	I think the teaching media influenced my interest to study physics	2.63	52.60
7	I am interested in getting additional information related to Physics	2.77	55.40
8	I am interested in studying physics and understanding concepts and applications in everyday life	3.85	77.00
9	I do not feel bored while studying the theory and practice of physics	3.23	64.60
10	I am excited and interested in studying physics at a higher level	2.65	53.00
Average Score		3.21	64.12

Table 3:- Interest level score results after intervention.

No	Item	Likert Scale	Marks
1	I am doing Electrical exercises right away	4.52	90.40
2	There are things that stimulate my curiosity if I learn without using the media	4.83	96.60
3	I reviewed the material given by the teacher outside class time	4.67	93.40
4	Learning using teaching media is quite interesting	4.75	95.00
5	I have a goal to get a score above the average score for the topic Electrical	4.91	98.20
6	I think the teaching media influenced my interest to study physics	4.82	96.40
7	I am interested in getting additional information related to Physics	4.58	91.60
8	I am interested in studying physics and understanding concepts and applications in everyday life	4.15	83.00
9	I do not feel bored while studying the theory and practice of physics	4.96	99.20
10	I am excited and interested in studying physics at a higher level	4.68	93.60
Average Score		4.71	94.16

The question items assessing the study subjects' interest is shown in **Table 2.** The first item “I am doing Electrical exercises right away", demonstrates the study subject's level of interest to investigate the Electrical topic's concept following the teaching and learning session. Prior to the intervention, this item had a score of 3.12; after the intervention, the score improved to 4.52. To determine the percentage of score rise, study was done on the Likert score outcome when it was calculated to a hundred percent value. The value of the score increased by 30 points, or from 60.40 to 90.40, for item one. The ninth item "I do not feel bored while studying the theory and practice of Physics ", which resulted in a Likert scale score of 3.23 prior to the intervention and 4.96 subsequent to it. The final item, "I am excited and interested in studying physics at a higher level," indicates the overall level of enthusiasm to study the subject in further detail. It showed a rise in scores from 2.65 to 4.68, or a 40.6-point increase in terms of scores before and after the intervention. When the N-Gain equation (Hake, 1998) was used to calculate the increase value or N-Gain, the result was an increase in the high level of interest among the study subjects, or N-Gain = 0.83. Every item evaluated has demonstrated a notable improvement, and these score values demonstrate that the intervention implemented has raised the study subjects' interest levels. When compared to the study subjects' interest level prior to the intervention, the scores shown in **Table 3** demonstrate that the study subjects' interest level increased. The degree of interest was also measured before and after the intervention, rising from 64.12 to 94.16 points.

Reflections and Conclusions: -

The study's findings demonstrate that, among students enrolled in the Two Semester System of the Physics stream matriculation program who have low scores in the topic of Electrical in Physics, the integration of comics in laboratory learning can boost achievement and interest for the subject. The results of this study demonstrate that using comics to support laboratory learning on the topic of Electrical helps students do more effectively, retain more physics information, and become more motivated. Because they were actively involved in the teaching and learning process, students will be able to build knowledge based on experience throughout the learning process. Their interest to learn Physics therefore increases and their belief that Physics is a challenging subject to learn will improve. This study shows that educational comic can encourage students to think creatively and without boundaries. Next, higher learning interest of Physics will help them with social skills and exam performance. Study outcomes demonstrate that all the study's objectives were successfully met and that low-achieving students can enhance their performance through laboratory learning not only in the classroom but also in their social environments. According to the findings of the interview conducted to find out how the students felt about the intervention, the effect of colourful and attractive comic pictures, straightforward language and use of attractive characters and plots can make complicated laboratory instruction easier for students to understand.

N-Gain analyses demonstrate how introducing comics to students can greatly boost their interest. Thus, the study's findings were consistent with earlier study showing that comics make physics concepts simpler to comprehend and retain (Suri,2021; Pathoni, Alrizal, & Febriyanti,2020). The results of this study were consistent with those of earlier study, which found that is comics can serve as an alternative medium for teaching physics and that using comics in the classroom can boost students' enthusiasm and involvement (Lin et al. 2015). Additionally, comics can help pupils develop their high-level thinking and visual representation skills (Haroky, 2019). The author makes recommendations for more study that investigates how comic applications affect shifts in learning engagement and visual representation abilities. By utilizing other study themes and issues from physics and other STEM fields, the scope of this investigation can be further broadened.

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