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Table of Contents

1 **Design of Video Transmission with Wi-Fi on Runway Inspection using Jetson Nano and Data Synchronization**
Raisyafitri Ayman, Suparlan, Johan Wahyudi

12 **Design of Microstrip Meander Line Antenna for Frequency Resonance 332 MHz on Portable ILS/VOR Receiver for Navigation Aids**
Juan Ronaldo Sianipar, Muh. Wildan, Teguh Firmansyah

19 **The Influence of the Cooperative Integrated Reading and Composition (CIRC) Learning Model Assisted by Audio-Visual Media on Science Learning Outcomes of Class VII Solar System Material SMPN 8 South Bengkulu**
Raudhatul Jannah, Adisel, Wiji Aziiz Hari Mukti

27 **The Influence of Peers on Student Learning Outcomes of Aqidah Akhlak Learning in Madrasah Ibtidaiyah Muhammadiyah Palak Siring South Bengkulu**
Wega Agreliza, Alimni, Zubaidah

33 **Online Frequency Distribution Application using a Javascript-Based Blogger Platform**
Rohmad Wahid Rhomdani. Chusnul Khotimah Galatea

40 **Implementation of Augmented Reality (AR) in the Development of Space Building Modeling Learning Media for Elementary School Students 040481 Juma Raja Village**
Asrar Aspia Manurung, Indah Purnama Sari, Sri Hariani Manurung

47 **Analysis of Mathematical Communication of Students through AIR Model at SMAN 1 Driyorejo Gresik**
Refanni Nadya Safitri, Annisa Dwi Sulistyaningtyas

53 **Android-based Interactive Multimedia Development Using ISpring Suite 11 in Informatics Engineering Class X Senior High School**
Rahmadini Triana Martin, Syafril, Meldi Ade Kurnia Yusri, Fetri Yeni J.

58 **Application of Integrals in Calculating Ball Volume Using GeoGebra**
Irvan

Indonesian Journal of Education & Mathematical Science
Vol. 5, No. 1, Januari 2024, pp. 1~11
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Design of Video Transmission with Wi-Fi on Runway Inspection using Jetson Nano and Data Synchronization

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ABSTRACT

This study aims to facilitate runway maintenance activities by designing a transmission video on an unmanned aerial vehicle (UAV). This design is designed to transmit video in real time via WiFi and provide location information via the integrated GPS data. The evaluation phase was carried out to evaluate the success of the design according to predetermined criteria. In the trial design, the video transmission distance and data transmission speed were tested, as well as the synchronization between GPS and video data. The test results show that the design of this video transmission has not fulfilled all the criteria set. The design can transmit video and synchronize, but there are problems with Jetson Nano so that it cannot carry out remote trials. It is hoped that this design can assist in runway inspection activities using UAVs, as well as provide accurate information via video and GPS data.

Keywords: transmission video design, unmanned aerial vehicle (UAV), GPS data and video

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1. INTRODUCTION

The airport is one of the vital facilities that can connect between regions more quickly. With the high traffic that exists at an airport, this facility is required to be in good condition and free from things that can disrupt flight traffic. According to Law No. 1 of 2009 concerning Aviation, Part Two, Aviation Safety Supervision, Article 312 paragraph (2) Aviation safety supervision as referred to in paragraph (1) is an ongoing surveillance activity to see compliance with aviation safety regulations carried out by work units or public service providers which include audits, inspection, observation, and monitoring. Paragraph (3) Supervision as referred to in paragraph (2) is carried out by work units or public service delivery agencies.

Routine inspection and maintenance of the runway is necessary to ensure that it remains in good condition according to the applicable regulations and technical requirements. At airports with high flight frequency, runway checks are carried out every hour or according to established operating standards. The inspection uses a car containing the driver and personnel who inspect visually with direct vision so that it takes time for officers to inspect the runway.

Unmanned Aerial Vehicle (UAV) or commonly known as drones commonly used as an alternative. Drones can also be custom built or can be adapted to the needs of its users. Drones can be deployed to conduct aerial surveys of the runway, offering a bird's-eye view and high-resolution imagery for a comprehensive assessment of its condition. It is hoped that in the future drones can become a solution for the maintenance and inspection of equipment and facilities at airports throughout Indonesia.

Custom-built drones or those adapted to specific needs can be equipped with various sensors and cameras, allowing them to capture detailed images and data during inspection flights. These drones can navigate the entire length of the runway efficiently, covering vast areas in a relatively short time. This not only reduces the workload on ground personnel but also enhances the accuracy and effectiveness of the inspection process.

Incorporating drones into the maintenance and inspection procedures of airports is expected to revolutionize the aviation industry in Indonesia and beyond. With the potential for increased automation and data analytics, drones can facilitate predictive maintenance, identifying potential issues before they escalate, and ensuring proactive measures are taken.

As technology continues to evolve, drones are likely to play an ever-expanding role in aviation safety and infrastructure maintenance. The integration of these unmanned systems in airports aligns

with the goal of fostering a safer and more efficient air transport network throughout Indonesia. As regulations evolve to accommodate drone usage in aviation, airports can leverage these technological advancements to elevate safety standards and optimize maintenance practices, ultimately enhancing the overall flying experience for passengers and flight crews alike.

A. Camera

The Runcam Thumb Pro is a cutting-edge camera that boasts an impressive array of features, making it a top choice for capturing stunning aerial footage. Its standout feature is the 155° wide lens, which provides an expansive field of view, allowing users to capture breathtaking panoramic shots and immersive visuals. This wide lens is perfect for capturing the beauty of landscapes, urban environments, and action-packed scenes with exceptional clarity and detail.

Moreover, the Runcam Thumb Pro offers exceptional resolution options, catering to various filming needs. Whether users require standard high-definition quality at 1080p, ultra-sharp visuals at 1440p, crisp footage at 2.7k, or cinematic clarity at 4k, this camera can be easily adjusted to match specific requirements. This adaptability makes it an excellent choice for a wide range of applications, from professional filmmakers to hobbyists seeking to capture unforgettable moments with unmatched clarity.

The built-in gyro feature is another game-changer for the Runcam Thumb Pro. The gyro function, when utilized in conjunction with the Gyroflow application, ensures that users can capture remarkably stable footage, even during dynamic movements or high-speed action sequences. This gyroscopic stabilization helps eliminate shakes and vibrations, resulting in smoother, more professional-looking footage.

Weighing in at a mere 16 grams, the Runcam Thumb Pro sets a new standard for lightweight, compact cameras in its class. Its low weight makes it an ideal choice for mounting on a variety of platforms, including drones, RC cars, helmets, and other action-oriented gear. This portability and ease of use enable users to take the Runcam Thumb Pro virtually anywhere, ensuring that they never miss out on capturing those extraordinary moments.

Fig 1. Camera



A. WiFi and *Access Point*

WiFi, the popular name for wireless local area networks based on the IEEE 802.11b standard, has become the preferred technology for wireless local area networks in both business and home environments. Although designed primarily for personal applications, WiFi is also used in public places to create hotspots, where users with built-in WiFi features can get broadband internet access. (Paul S. Henry). The access point is used to increase the range of WiFi so that connected devices can access the network in a wider area, so that in this design the UAV can transmit video according to the distance required in the video transmission design.

Lately the bandwidth of WiFi systems has been increased to meet data rate requirements. The latest 802.11 ac WiFi devices can use 80 or 160 MHz bandwidth channels. This allows precise positioning based on time. In particular, a fine timing measurement (FTM) protocol has been specified in the IEEE 802.11-2016 standard. However, FTM is not yet widely implemented in commercial WiFi devices, nor can it be used to locate the large number of existing WiFI devices. (Shenghong Li, 2019)

Indonesian Journal of Education & Mathematical Science
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Fig 2. WiFi Access Point



Fig 3. WiFi Dongle



B. NVIDIA Jetson Nano

The NVIDIA Jetson Nano, an entry-level board in the NVIDIA Jetson ecosystem, is a small, powerful single-board computer that enables parallel operation of multiple neural networks for applications such as image classification, object detection and more. audio visualization, segmentation, and processing. It has a complete development environment (JetPack SDK) and libraries developed for embedded applications, deep learning, IoT, computer vision, graphics, multimedia, and more. (Ahmet Ali Süzen)

NVIDIA Jetson Nano has a GPU with 128 cores. This resource can be used for AI applications. We can run Pandas, Numpy, Tensorflow, and Keras on a NVIDIA Jetson Nano board. We only focus on how to create AI programs. NVIDIA Jetson Nano will take over your computations. For optimized computation, make sure your program library supports Jetson Nano GPU cores. If you are interested in computer vision, you can apply NVIDIA Jetson Nano to do that. You can connect external cameras via the CSI interface to a USB canera. By installing the OpenCV library, we can use NVIDIA Jetson Nano for creating excellent vision programs by the OpenCV library provides various libraries for video image processing. We can use it directly on your programs like C/C++ and Python. Additionally, OpenCV consists of machine learning libraries facial recognition. (Kurniawan, 2021).

Indonesian Journal of Education & Mathematical Science
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Fig 4. Jetson Nano



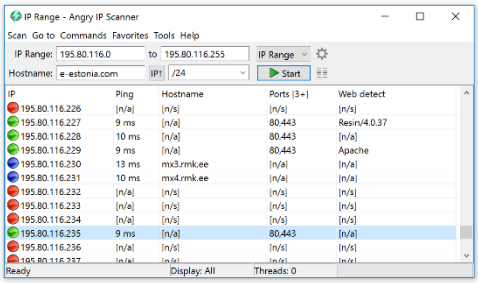
C. Angry IP Scanner

It is an application (software) that is used to scan and search for the IP on the port that is currently active and will provide information regarding that port. Sometimes Angry IP Scanner cannot detect available ports and considers it as a filter. (Emad Ebeid, 2017)

Angry IP Scanner is a versatile application used to scan and search for active IP addresses on a network and provide detailed information about the open ports on each detected device. This software is widely used by network administrators, cybersecurity professionals, and even hobbyists due to its user-friendly interface and efficient scanning capabilities. With its intuitive design, Angry IP Scanner allows users to easily configure the scanning parameters, such as the IP range, timeout settings, and specific ports to be checked. Once the scan is initiated, the application starts probing the specified IP range, looking for active devices and open ports.

Angry IP Scanner was used for collecting information about target system. Angry IP Scanner is a fast and lightweight cross-platform address and port scanner. used to analyze IP addresses in any range, it includes information about one of the ports by simply pinging each IP address to verify it is active, then possibly resolving its name by determining the MAC addresses and vendor. (Brian Cusack, 2017)

Fig 5. Angry IP Scanner



D. RealVNC Viewer

It is a system that can share a graphical desktop which allows its users to control the desktop remotely from another device and transmit it to have access to control of that desktop. With RealVNC Viewer, users can remotely connect to and take control of a graphical desktop from any compatible device, such as a laptop, smartphone, or tablet, regardless of the operating system. This cross-platform compatibility ensures that users can remotely access and manage their desktops from practically anywhere with an internet connection. As a widely used application in various industries, it has gained popularity among individuals and businesses alike for its ability to enable efficient and secure remote access to desktop environments. (All you need to know about VNC remote access technology, 2002-2022)

Indonesian Journal of Education & Mathematical Science
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Fig 6. RealVNC Viewer



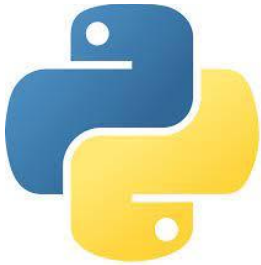
E. Python

Python is currently the fastest growing programming language in the world, thanks to its ease of use, fast learning curve and many high-quality packages for data science and machine learning. But surprisingly, Python is far behind the R programming language when it comes to general statistics and for this reason many scientists still rely heavily on R to perform their statistical analysis. (Pingouin: statistics in Python, 2018)

Python appears in a much wider range of applications such as Internet and website development, database access, desktop GUIs, scientific computation, and software and game development. There are two main Python version series, versions 2.x and 3.x, and both are not fully compatible, they are similar in most parts. Version 2.x is a legacy version, which supports, and maintenance is scheduled to end around 2020. (Jiangang Hao, 2019)

Because it is a scripting language, Python automates tasks that would otherwise have to be done manually. The main difference is that Python programs have to run slower than Java programs, but development takes much less time, according to the Python Software Foundation. although even for C++, Python code is generally one fifth to tenth the length of equivalent C++ code, and "Anecdotal evidence suggests that one Python programmer can finish in two months what two C++ programmers can't complete in a year" the Foundation's website states. (Shein, 2015)

Fig 7. Python



F. RunCam App

Runcam App is an application developed by Runcam, a company that focuses on cameras and accessories for drones, airplanes, and other photography purposes. This application is designed to make it easier for users to control and manage their Runcam cameras via mobile devices such as smartphones or tablets. By using the Runcam App, users can connect wirelessly with compatible Runcam cameras via a WiFi connection. Once connected, users can access camera features and settings remotely via an easy-to-use interface.

Indonesian Journal of Education & Mathematical Science
Vol. 5, No. 1, Januari 2024, pp. 1~11
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Fig 8. RunCam App



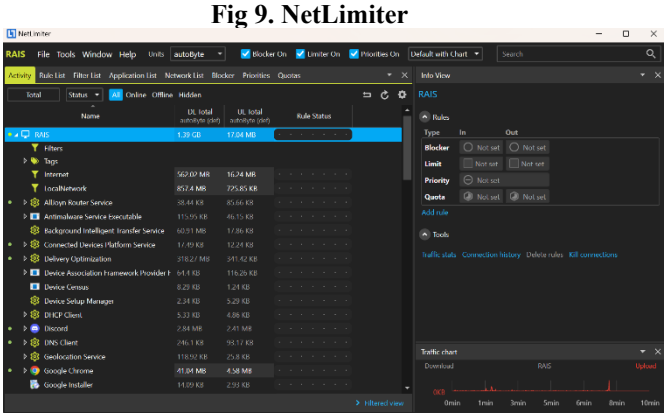
G. NetLimiter

This is an internet traffic control and monitoring tool designed for Windows. It provides full network control over the user's computer. This allows the user to decide where that application is allowed to connect and how fast this connection can be. NetLimiter currently has three versions: one has a freeware monitor, and the other has a paid version, Lite and Pro. (Grace G. Boqueo, 2019)

NetLimiter is an internet traffic monitoring and control application tool for the Microsoft Windows platform. NetLimiter combines various features such as network monitoring, connection blocking, rule editing, and scheduling, marking it as a robust network monitoring application. Most of its features are limited, but for the full version, network throttling features are included. The free version only includes network monitoring. (Hadryan Eddy, 2021)

NetLimiter is versatile software that offers the capability to regulate speed limits for application downloads/uploads or individual connections, as well as monitor internet traffic for internet cafe users. With these predefined limitations, internet cafe administrators can seamlessly manage the bandwidth of your internet connection, acting as a bandwidth shaper or controller. This function empowers users to track the historical internet traffic patterns of users. In summary, NetLimiter is a versatile tool that caters to various aspects of network control, enabling users to monitor, regulate, and manage internet traffic effectively. (Magdalena, 2013)

Fig 9. NetLimiter



2. RESEARCH METHOD

This development study uses the ADDIE method. This method consists of five phases which include analysis and design, development, implementation, and evaluation. In this development research the ADDIE method was used to produce a video transmission design that was designed in stages. (Yeni Marita Juanda, 2022)

The reason for using the ADDIE development method is because this model has advantages in systematic processing steps. Each phase is evaluated and revised from what was passed, so that the resulting product becomes a product. Moreover, the ADDIE model is very simple, but the implementation is systematic. (Purnamasari)

Indonesian Journal of Education & Mathematical Science
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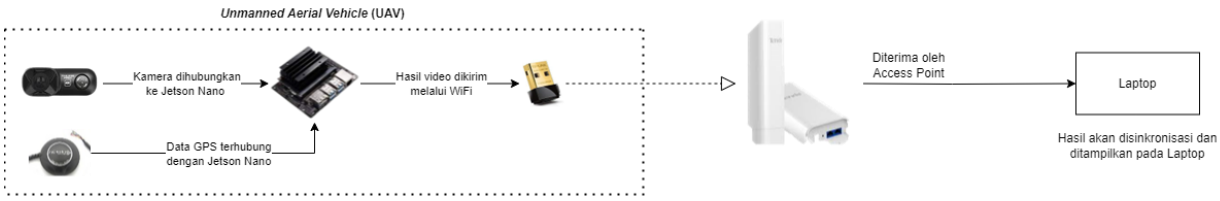
In compiling a video transmission design that will be developed using the ADDIE method which consists of five stages, namely:

- Analysis Phase is the stage of data collection that can be used as material for making products. In this case, the resulting product is a transmission video design. This information is collected in the form of requirements analysis, hardware analysis, and software analysis required to produce the product.
- The design stage is the stage of designing the design that will be built in order to facilitate the design. This design stage includes data collection criteria and flowcharts.
  a. Data collection, in designing video transmission and synchronization with GPS requires a data collection stage in the design. Data requirements consist of material that has been determined at the analysis stage.
  b. Flowchart is a diagram consisting of several symbols that show the steps or flow of a program. The working steps of the system to be made are explained with the help of a flowchart which makes it easy to make video transmission designs.
- Design development is the phase where what has been achieved is implemented in the product design stage. The result of this step is the product to be tested. At this stage product creation is carried out in the form of video delivery designs, GPS data delivery, and GPS and video data synchronization.
- Implementation stage, at this stage the products that have been produced are then implemented. Implementation is carried out on a video transmission design and then it will be tested according to predetermined criteria to find out the results of the design that has been made.
- Evaluation phase, in this phase, evaluation occurs through further development of the design that has been made so that deficiencies in the previous design development process can be identified and resolved in this evaluation process.

A. Overview of the Design System

This design concept aims to implement a video transmission system for runway inspection using an unmanned aerial vehicle (UAV) with a Jetson Nano connected via WiFi. Jetson Nano acts as a GPS and video data processing device to integrate location information in videos and send the results via a WiFi connection to a monitoring device or ground station.

Fig 10. Design System



Currently, equipment such as unmanned aerial vehicle (UAV) is not commonly used, especially in assisting inspections at airports in Indonesia. Using unmanned equipment will help when carrying out maintenance and inspection activities. In addition, the data that has been stored can be processed immediately because it is directly stored on the laptop.

B. Design Stages

The following are some of the activities carried out in the video transmission design process on the UAV.

- The main tasks of the design process consist of WiFi and access point as video sending and receiving. The WiFi dongle is connected to the Jetson Nano, a powerful on-board computing device, which acts as the drone's on-board computer. Jetson Nano processes the video data captured by camera then transmits it to the ground station the access point connected to a laptop. This configuration provides a stable, high-speed wireless connection for video streaming.
- Camera configuration is another aspect of video transmission design. The camera is equipped with artificial intelligence capabilities, allowing detection and analysis of objects in real time during the

UAV. The configuration is carried out using the RunCam App on IOS and Android platforms. After configuration, the results are encoded in form if code accessible by the Jetson Nano. This approach streamlines the data transfer process and facilitates efficient communication between the camera and the on-board computer.

- Sending GPS data to Jetson Nano. This delivery aims to synchronize which can find out the coordinates of the objects detected by AI. Synchronization is generated from the detection results of Jetson Nano with the coordinate points obtained on the GPS. The data for the GPS module will be retrieved by Jetson Nano using Ardupilot. The GPS data can be retrieved through the Mission Planner application, then the GPS data will be sent via MavLink.

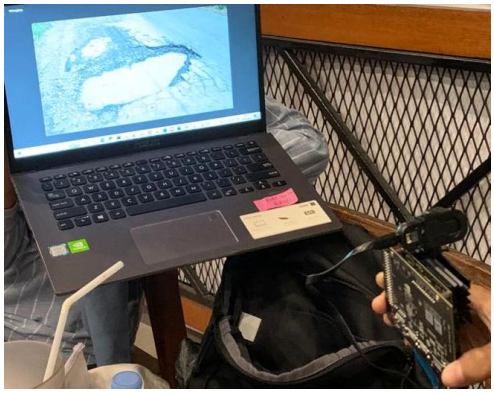
These tests evaluate various critical parameters, such as data transmission distance to assess maximum range of reliable communication, data transmission speed to measure transfer efficiency of data and synchronization between GPS and data video for the alignment of detected objects with their real coordinates.

3. RESULTS AND DISCUSSION

After the design is done, the next stage is the design trial. This trial will evaluate whether the design can work according to the specified criteria. The following are the steps in carrying out a design trial.

- Conducting trials locally, carrying out trials by connecting the jetson nano with WiFi via an Ethernet cable. Local trial results can send videos in real time but there is still a lag in sending videos.

Fig 11. Local Test



- Test video sending. The video will be sent via WiFi from the UAV and then the video will be displayed on the laptop. In the video transmission experiment that was carried out locally using a sample photo of a pothole on the road, the video that has been processed on the Jetson Nano can be sent via an access point and dongle and can be displayed on a laptop. Local trials were conducted to determine the bandwidth needed to transmit video. Checks are carried out using the Netlimiter application, where bandwidth will be regulated to determine the required bandwidth capacity. The check is carried out with several settings, namely as follows:

Table 1. High Video Quality

1080p@60FPS	
Speed	Delay
500 Kb/s	9.3 Second
10 Mb /s	8.8 Second
15 Mb /s	8.5 Second

Table 2. Medium Video Quality

1080p@60FPS	
Speed	*Delay*
500 Kb/s	8.3 Second
10 Mb /s	7.7 Second
15 Mb /s	7.3 Second

Table 3. Low Video Quality

1080p@60FPS	
Speed	*Delay*
500 Kb/s	7.6 Second
10 Mb /s	7.1 Second
15 Mb /s	6.9 Second

- Perfomed a video sending test with 540 meters, this distance was obtained because there are obstacles in the tested area such as trees, buildings, and tower. At this distance WiFi can still be received by smartphones and when the speed test is it gets 4.45 Mbps for downloads and 15.64 for uploads. However, there exist a hurdle where the Jetson Nano cannot display video on the laptop (as a ground station).

Fig. 12 Distance

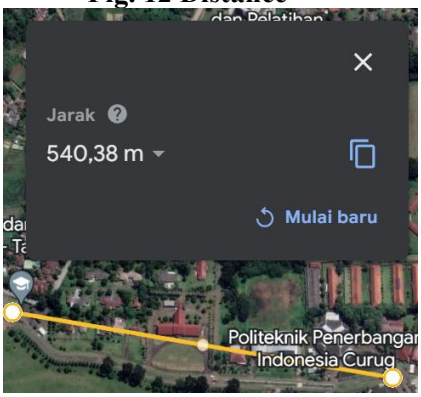
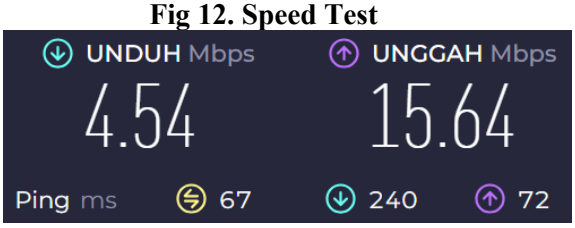


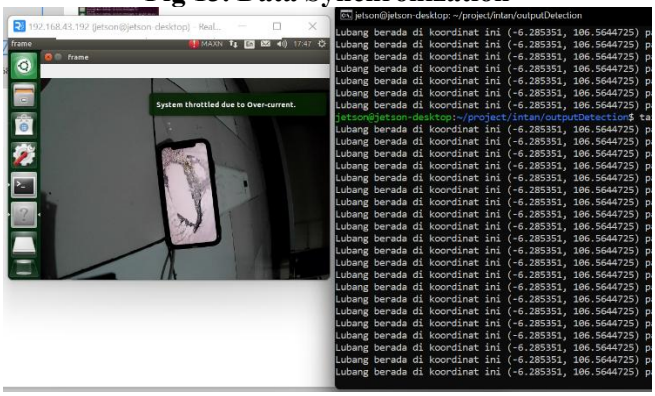
Fig 12. Speed Test



- Once the GPS and Jetson Nano modules are connected and configured, the next step is to synchronize the GPS data with the video processing time on the Jetson Nano when the UAV is at a specific coordinate point. The GPS data received from Mission Planner is still in NMEA format and needs to be reprocessed and sorted to obtain relevant information. Once the data has been parsed, it will be combined on the jetson nano using the pynmea2 library for the NMEA protocol.

Indonesian Journal of Education & Mathematical Science
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Fig 13. Data Synchronization



4. CONCLUSION

Based on the results and discussion that have been described above, it can be concluded that learning media is divided into three, namely visual-based media, audio-based media, and audio-visual-based media, where the three media both have different advantages and disadvantages but the functions of the three media remain the same, namely to facilitate and facilitate teaching and learning activities so that learning objectives can be achieved, can improve the quality of teaching and learning, can improve students' problem-solving abilities, depending on the characteristics of these students, and change the mindset and creativity of learning to be more fun . It is hoped that in this study students can use learning media well, so that they can increase their understanding of learning mathematics and can improve student achievement.

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3. To friends

The author is fully aware that this article is far from perfect. Therefore the author apologizes if there are errors in writing this article. We appreciate criticism and suggestions for improving similar writing in the future. The author hopes that this article can be useful and can be of positive value to all parties in need.

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Design of Microstrip Meander Line Antenna for Frequency Resonance 332 MHz on Portable ILS/VOR Receiver for Navigation Aids

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ABSTRACT

The Portable ILS/VOR Receiver (PIR) device is used for conducting Ground Inspection activities. The PIR antenna has traditionally employed a long-dimensioned dipole antenna. The design of the microstrip meander line antenna aims to reduce the antenna's dimensions for easy portability with the PIR device. The microstrip antenna is designed for Glidepath equipment in the frequency range of 328,6 MHz – 335,4 MHz, centered around 332 MHz. With antenna dimensions of 150 mm x 50 mm, simulation results indicate that the microstrip meander line antenna meets the desired standard specifications. At the center frequency of 332 MHz, it achieves a return loss of -19,65 dB, VSWR of 1,23. Bandwidth of 7 MHz and impedance of 48,94 Ω. Moreover, it exhibits an omnidirectional radiation pattern.

Keyword : Microstrip Antenna, Meander Line, Glidepath, ILS

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1. INTRODUCTION

Flight navigation serves as a guide and reference for pilots, aiming to ensure safety during every phase of the flight, starting from takeoff, throughout the air journey, up until the landing process at the destination airport (Irfansyah et al., 2020). ILS is one type of equipment included in flight navigation. ILS is a landing aid tool for aircraft, consisting of 3 (three) sub-system components, namely the ILS localizer, glide path, and markers. One type of ILS is the Glidepath, which operates in the UHF frequency range between 328.6 MHz – 335.4 MHz to determine the landing angle (Siddharth Saxena, 2016).

In accordance with Regulation KP 35 of 2019 concerning Maintenance and Reporting Procedures for Flight Telecommunication Facilities, this regulation addresses the necessary steps in maintaining communication facilities (Kemenhub RI, 2019). Thus, Flight Ground Inspection is required to check the maintenance of flight navigation facilities to be used at the airport. The implementation of ground inspection is carried out using a Portable Instrument Receiver (PIR) (Iswanto, 2022). The purpose of this ground inspection activity is to examine the output signals emitted by the ILS equipment, specifically the GlidePath. The antenna utilized in the PIR device is a dipole-type antenna with dimensions long enough for ease of portability. With the advancement of technology, microstrip antennas have become a choice for various electronic equipment due to their compact and portable design.

In Ester Mella's research (Mella et al., 2019), designing a microstrip dipole antenna in the frequency range of 328,6 MHz to 335,4 MHz showed simulation results that meet specifications at the center frequency of 332 MHz, with a return loss of -25,42 dB and a VSWR of 1,52. Furthermore, in As'ad Muhammad Nashrullah's study (As-ad et al., 2019), designing a microstrip meander line antenna in the UHF band with a center frequency of 924 MHz resulted in a return loss of -27,78 and a VSWR of 1,36. Based on the findings from previous research, the researcher designed a microstrip meander line antenna for the frequency range of 328,6 MHz – 335,4 MHz with a center frequency of 332 MHz for Glidepath equipment. The aim is to achieve parameter results that match the desired specifications, namely a return loss of ≤10 dB and a VSWR of < 2.

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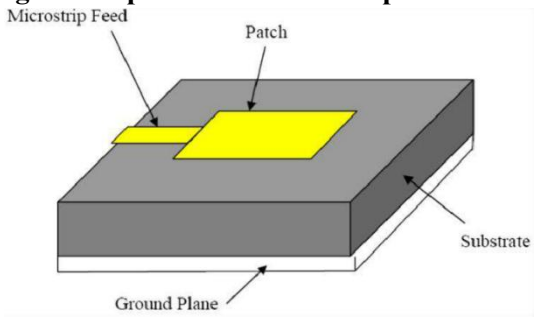
2. REASERCH METHOD

In the design of the microstrip meander line antenna, the researcher employed an experimental method with the aim of testing whether the design process can align with the desired specification standards (Hamid et al., 2021). This microstrip meander line antenna is designed using simulation software that will be created and simulated to evaluate the antenna's performance. In this simulation, the goal is to obtain desired parameter values such as Return Loss, VSWR, Bandwidth, and radiation pattern of the antenna. The design of this microstrip meander line antenna is intended to minimize dimensions for low-frequency usage while achieving parameter results in accordance with the specifications.

A. Design and Theory

In general, an antenna functions as a transducer to convert electromagnetic waves into electrical waves or vice versa (Balanis, 2005). A microstrip antenna is one type of antenna that can be utilized. This antenna consists of several elements, including a ground plane that acts as a reflector for electromagnetic waves, a substrate containing dielectric material to propagate electromagnetic waves, and a patch that serves as the element to radiate electromagnetic waves (Ardianto et al., 2019).

Fig 1. Components of Microstrip Antenna



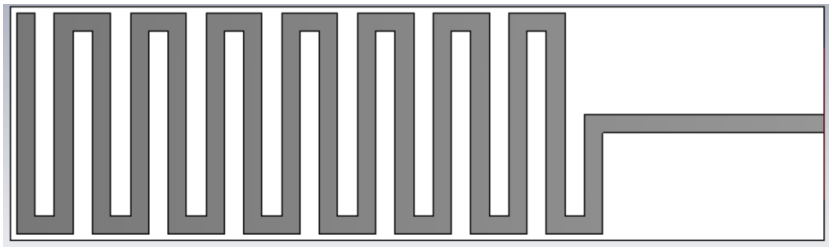
A microstrip antenna is composed of three parts (Tiara Dewi, Muhammad Amir Masruhim, 2016). The Patch is the top part of the substrate, typically made from copper, aluminum, or gold. In this section, electrical and magnetic waves will also be radiated into the air. The Substrate is also called the dielectric as it separates the patch from the ground plane. The substrate comes in various types depending on the value of the dielectric constant (Epsilon r) used, as the antenna size is inversely proportional to the value of this constant. The Ground Plane is the bottom part of the substrate, which functions as a reflector for unwanted signals. Generally, the ground plane covers the entire bottom part of the microstrip antenna.

Meander Line Antenna

Meander line antennas can be created from monopole or dipole lines that are bent to reduce their size. In general, these antennas have the capability to generate multiband signals with narrow bandwidth and low gain, which tends to result in lower efficiency (Sujith & Augustine, 2018). The meander line antenna itself doesn't have a definitive formula for calculating patch dimensions. As a reference for creating meander line antennas, calculations are done using formulas from monopole or dipole antennas (Michel et al., 2018). Once the patch length results are obtained, bending is then applied to reduce the antenna's dimensions (Michel et al., 2012).

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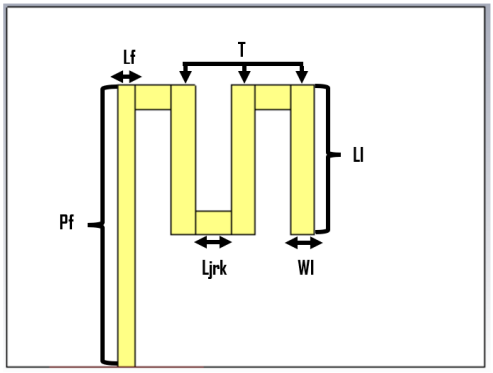
Fig 2. Microstrip Monopole Meander Line Antenna



Size and Number of Lines

The width, length, and number of lines are determined through various simulation experiments using different sizes in software. Subsequently, the results of these simulations are compared to obtain the optimal parameter dimensions (Panangian Mahadi Sihombing, 2021).

Fig 3. Design of Meander Line Antenna



Pf = Feedline Length
Lf = Feedline Width
Ljrk = Distance Between Lines
T = Number of Lines
Wl = Line Width
Ll = Line Length

Substrate and Ground Plane Dimensions

The substrate dimensions of the meander line antenna follow the number of lines on the patch, and the ground plane size is obtained through optimization. For the initial ground plane size, it is taken as 100% of the substrate length.

B. Calculation of Antenna Feedline Dimensions

The main feed of the antenna employs a feedline with a 50 Ω impedance and an SMA female connector. To calculate the width of the main feedline with a 50 Ω impedance (Utami et al., 2021), use the following equation:

$$B = \frac{60\pi^2}{Z_0\sqrt{\varepsilon_r}} = \frac{60(3{,}14)^2}{50\sqrt{4{,}3}} = 5{,}70570\ mm \quad (1)$$

The width of the 50 Ω trace can be calculated as follows:

$$W_f = \frac{2h}{\pi}\left\{B - 1 - In(2B-1) + \frac{\varepsilon_r - 1}{2\varepsilon_r}\left[In(2B-1)0{,}39 - \frac{0{,}61}{\varepsilon_r}\right]\right\}$$

$$W_f = \frac{2(1{,}6)}{3{,}14}\left\{5{,}7057 - 1 - In(2(5{,}7057)-1) + \frac{4{,}3-1}{2(4{,}3)}\left[In(2(5{,}7057)-1)0{,}39 - \frac{0{,}61}{4{,}3}\right]\right\}$$

$$W_f = 3{,}11\ mm$$

Next, to calculate the length of the feedline, use the following equation:

$$\frac{W_f}{h} = \frac{3{,}11}{1{,}6} = 1{,}9 > 1$$

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Since W = f/h > 1, to calculate the dielectric constant, use the following equation:

$$\varepsilon_{eff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[\frac{1}{\sqrt{1 + 12\left(\frac{h}{W_{50}}\right)}}\right]$$

$$\varepsilon_{eff} = \frac{4{,}3 + 1}{2} + \frac{4{,}3 - 1}{2}\left[\frac{1}{\sqrt{1 + 12\left(\frac{1{,}6}{3{,}11}\right)}}\right] = 3{,}26$$

After obtaining the value of ε_eff, use the following equation:

$$\lambda = \frac{c}{f} = \frac{3 \times 10^8}{1{,}09 \times 10^9} = 0{,}275\ m = 276mm$$

$$\lambda_d = \frac{\lambda}{\varepsilon_{eff}} = \frac{276}{\sqrt{3{,}26}} = 152{,}72\ mm$$

$$l_f = \frac{\lambda_d}{4} = \frac{152{,}72}{4} = 38{,}1\ mm$$

C. Substrate Parameters

In the microstrip meander line antenna design, the determination of substrate parameters used in antenna design is carried out.

Table 1. Substrate Material Specifications

Substrate Type	FR-4 Epoxy
Dielectric Constant	4,4
Substrate Thickness	1,6 mm
Patch thickness	0.035 mm

D. Meander Line Antenna Design Specifications

In this design, there are several antenna parameter specifications for the initial design phase. Here is a table of parameters used for the initial design of the microstrip meander line antenna:

Table 2. Predefined Meander Line Antenna Specifications

Parameter	Mark
Frequency resonance	332 MHz
Return loss	< -10
VSWR	≤ 2
Bandwidth	6.8 MHz
impedance	± 50 Ω

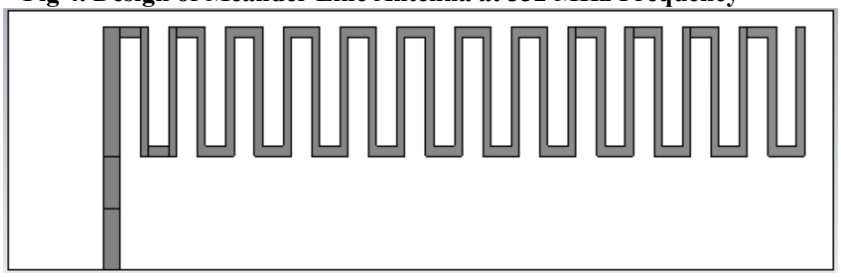
3. RESULTS AND DISCUSSION

The antenna design process is carried out in a software simulator, and then the parameter results are observed after determining the parameters.

Indonesian Journal of Education & Mathematical Science
Vol. 5, No. 1, Januari 2024, pp. 12~18
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A. Antenna Parameters

Fig 4. Design of Meander Line Antenna at 332 MHz Frequency



The above diagram is a design of a 332 MHz frequency meander line, optimized from dimension calculations using equations and formulas. To achieve optimal results, the calculated antenna dimensions are further subjected to optimization for determining the parameter values of the number of lines, line width, line spacing, and ground plane size. As an initial design for the meander line antenna, the parameters of the lines are based on the length and width of the feedline.

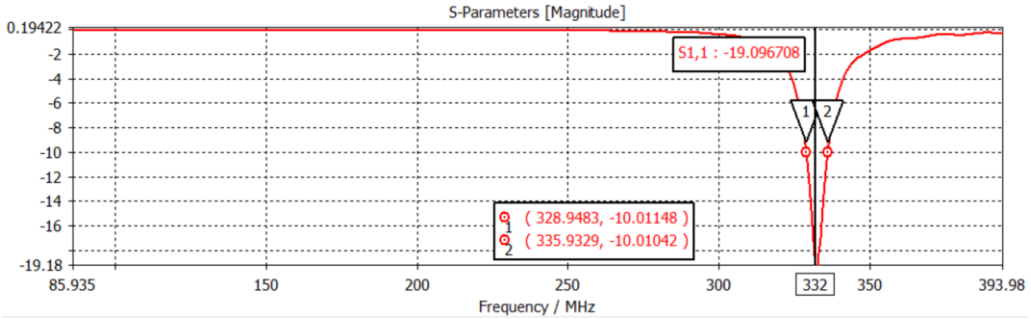
Table 3. Design of Antenna Before Optimization and After Optimization

Parameter	Before Optimization	After Optimization
Feedline length	38,1 mm	47 mm
Feedline width	3,11 mm	3 mm
Line length	19.05 mm	25 mm
Line width	3,11 mm	1,5 mm
Distance between lines	3,11 mm	4 mm
Number of lines	-	24
Substrate length	200 mm	150 mm
Substrate width	80 mm	50 mm
Ground plane length	200 mm	60 mm
Ground plane width	80 mm	2 mm
Patch thickness	0,035 mm	0,035 mm
Substrate thickness	1,6 mm	1,6 mm

B. Simulation Results

As any antenna can be characterized by parameters such as center frequency, bandwidth, radiation pattern, and impedance, we have simulated all of these parameters. The return loss, defined as the ratio of reflected power to incident power (Kumar et al., 2016), has also been simulated. At the center frequency, the return loss is -19,65 dB. With a bandwidth of 7 MHz in the frequency range of 32899 MHz to 335,9 MHz, the return loss is -10,0 dB.

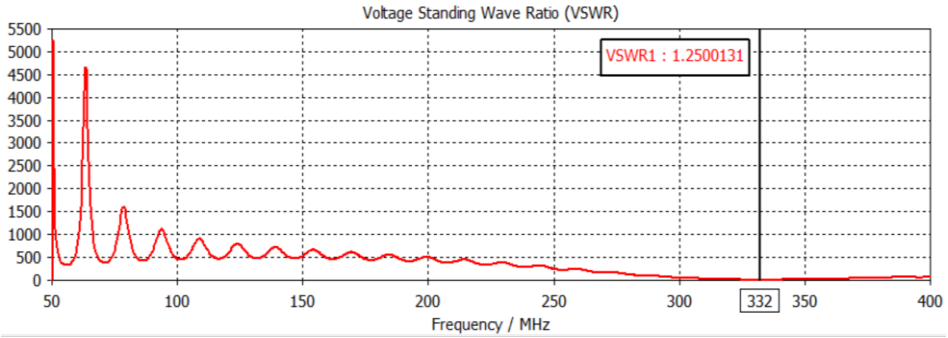
Fig 5. Simulation Results for Return Loss



Indonesian Journal of Education & Mathematical Science
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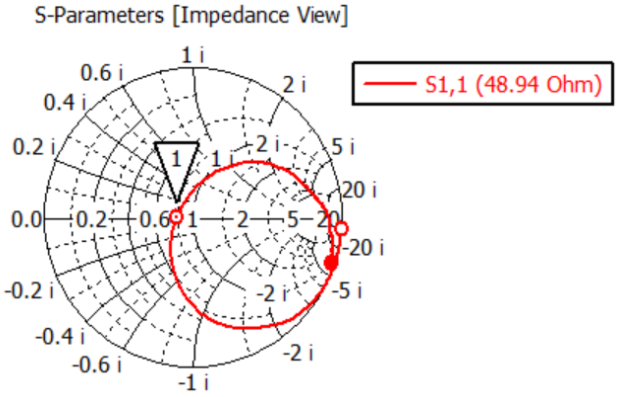
VSWR reflects the level of matching between the transmission line and the antenna. However, the optimal value considered for each antenna to function well is <2. In the simulation, the VSWR at the center frequency of 332 MHz was found to be 1,2.

Fig 6. Simulation Results for VSWR



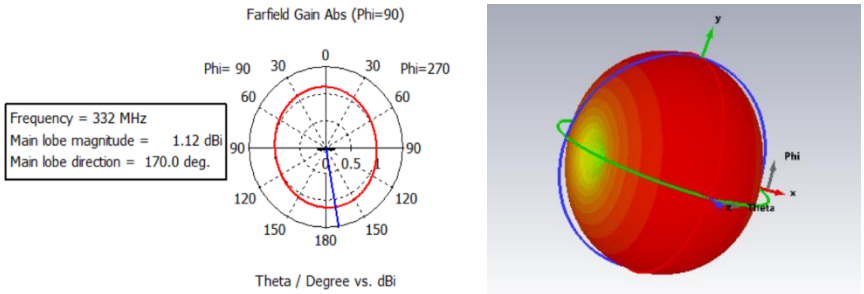
Impedance is a measure of the ratio between voltage and current, or the electric field and magnetic field that corresponds to the orientation of the antenna. The simulation results also show an impedance value obtained of 48.94 Ω. This impedance value is close to the specified specification of 50 Ω.

Fig 7. Impedance of 332 MHz Frequency Antenna



The radiation pattern is a graphical representation of an antenna's radiation characteristics in the far field, dependent on direction. In the simulated microstrip meander line antenna, an omnidirectional radiation pattern was obtained.

Fig 8. Radiation Pattern Results of Meander Line Antenna



4. CONCLUSION

The microstrip meander line antenna design has compact dimensions of 150 mm x 50 mm, with specification parameters in accordance with the defined standard for the Portable Instrument Receiver (PIR) as the Ground Check equipment for Glidepath. Simulation results at the center frequency of 332 MHz show a return loss of -19.65 dB, VSWR of 1.23, bandwidth of 7.3 MHz, and impedance of 48.94 Ω. This design also exhibits an omnidirectional radiation pattern.

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The Influence of the Cooperative Integrated Reading and Composition (CIRC) Learning Model Assisted by Audio-Visual Media on Science Learning Outcomes of Class VII Solar System Material SMPN 8 South Bengkulu

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ABSTRACT

This study aims to determine the effect of the Cooperative Integrated Reading and Composition learning model (CIRC assisted by audio-visual media) on science learning outcomes for class VII solar system material at SMPN 8 Bengkulu Selatan. This research is a quasi-experimental study with the Non-Equivalent Control Group Design Collection technique. The data in this study was carried out by observation (initial observation), tests and photographs. The data analysis technique used conditional testing and hypothesis testing. The population in this study was class VII, totaling 151 students. The sample of this study was taken by using a purposive sampling technique. The data collection method used was a multiple choice test. The data source in this study was taken from pre-test questions and post-test questions with 20 multiple choice questions. The results of the statistical test with the help of SPSS Version 26 showed the value. sig.(2-tailed) > 0.05 or 0.381 > 0.05. It can be seen that the experimental and control pretests show no significant effect. Based on data analysis using the t-test, it shows that the t-count value = 21.4 and the t-table value = 2.048 So that t-count (2.14) > t-table (2.048) with a significance level of 5%. This shows that there is a significant influence of the Cooperative Integrated Reading and Composition (CIRC) learning model assisted by picture story media on the learning outcomes of class VII science.

Keywords: CIRC Model, Audio Visual Media, Learning Outcomes

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1. INTRODUCTION

National education is an effort to provide guidance from the roots of the nation's own culture to all its citizens, so that citizens who are knowledgeable, educational, have a high mentality, have noble character, responsibility, are ready to carry out the mandate, continue the nation's struggle carried by him based on Pancasila and the 1945 Constitution In this era of development, Education is an aspect of life that is very fundamental for the development of a country's nation, this is accompanied by the development of science and technology (IPTEK) in life. Education is always closely related to science and technology which has a big contribution in life to improve human resources. The rapid development of science and technology has given rise to equipment and applications that are very easy for a teacher to learn and use as a learning medium

To see learning activities can run actively and efficiently can perform classroom actions. Classroom action research is an examination of the paid learning activities of an action, which is deliberately raised and occurs in a classroom simultaneously. One way to awaken Student activity in the learning process is to use the right learning model so that learning can make students as subjects who try to explore themselves, solve their own problems from a concept being studied Schools as one of the formal educational institutions have the responsibility to educate students. For this reason, the school organizes teaching and learning activities as a realization of educational goals that have been Set. In addition, in the teaching and learning process, teachers have the duty to encourage, guide and provide learning facilities for students. Education is not only to meet curriculum targets, but education is a need that must be met in the life of society, nation and state. Education also functions to develop the ability to shape the character and civilization of a dignified nation in order to educate the nation's life

The learning model is a form of learning that is illustrated from beginning to end which is presented typically by a teacher. In other words, the learning model is a wrapper or frame of the application of a learning approach, method, and technique. Choosing a teaching model, must adjust to existing reality and the existing classroom situation, as well as the outlook on life that will result from the process of cooperation carried out between teachers and students The component of the learning model is the media, the word "media" comes from Latin and is the plural form of the word "medium" which is literally "intermediary or introduction". The use of learning media in addition to making it easier for educators to deliver material to students also helps to increase student motivation to learn more interactively and more actively in the classroom so that there is feedback on educators and students.

One of the learning models that can be applied in junior high school is the cooperative integrated reading and composition (CIRC) learning model assisted by audio-visual media. Cooperative integrated reading and composition (CIRC) The model itself is a comprehensive program to teach reading and writing in elementary school classes at higher levels as well as in secondary schools. Educators use reading materials that contain practice questions and stories. The learners are assigned to pair up in their teams to learn in a series of activities that are cognitive while audio-visual media is a combination of Audio and Visual used in learning by using video or images and sound. Audio Visual Media is media that has elements of sound and elements of images that can be seen, such as video recordings, slides, sounds, and so on.

To achieve optimal student learning outcomes, many factors influence it, both internal and external factors. Internal factors include physical and psychological factors in students such as interests, intelligence, talents, intelligence levels and other factors. External factors include environment and instrument such as curriculum, programs, facilities, methods, models, strategies and so on. Low science learning outcomes can be caused by several things such as learning models that are less varied and internal factors in students such as lack of understanding and mastery of subject matter, student misconceptions in some subjects and lack of understanding of student learning styles Science Learning Considered able to present natural concepts and phenomena while encouraging the emergence of spirituality for those who study it. In this case the material developed is solar system matter consisting of matter as the center of the solar system, planets and other objects surrounding the sun.

Based on initial observations and interviews conducted by researchers at SMPN 8 South Bengkulu on February 6, 2022, the learning media used by teachers and students of SMPN 8 South Bengkulu is in the form of textbooks published from the ministry of education and culture, researchers found several problems related to the Learning media, that is, the material in science books has not varied to make students less interested To read the material in the book, learning media has not been equipped with audio-visual media, the method used by science teachers is a conventional method (lecture), this results in students feeling bored during learning. Therefore, an Audio Media-Assisted Cooperative Integrated Reading and Composition (CIRC) Learning model is needed Visual at the time of learning. Audio-visual media that display the reality of the material can provide real experience to students when learning it, thus encouraging self-activity (Fujiyanto Ahmad, Jayadinata Asep Kurnia, Kurnia Dadang 2016).

2. RESEARCH METHOD

This research is a type of quantitative research with a quasi-experimental pseudo-experimental approach using a Non-equivalent type of control Group design research design which in its design involves 2 groups, namely: experimental group and control group. The experimental group was given a pre-test before the treatment was imposed. Then, given a post-test after the treatment was distributed, the population in this study was all students of SMPN 8 South Bengkulu. The samples in this study were class VII C (30 people) and class VII E (31 people) while the instruments in this study were 20 multiple-choice questions. The data collection techniques in this study are through: observation, questionnaires and documentation.

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Table 1. *Desain non-Equivalent* Control Group Desaign

Class	*prettest*	Tretmen	*posttest*
Experiments	O_1	X	O_2
control	O_3	-	O_4

Information:
O1= Experimental Class Prettest
O2= Experimental Class Posttest
O3=Control Class Pretest
O4=Posttest Control Class
X = Treatment of experimental classes with Cooperative learning model

3. RESULTS AND DISCUSSION

A learning model is a pattern used as a guideline in planning learning in class and tutorials. The learning model refers to the approach to be used, including in learning objectives, stages in learning activities, and classroom management. A learning model can be defined as a conceptual framework that describes a systematic procedure for organizing learning experiences to achieve learning objectives *Cooperative Integrated Reading Composition (CIRC) is a comprehensive program to teach reading and writing in elementary school classes at higher levels as well as in secondary schools. CIRC learning educators use reading materials that contain practice questions and stories*. Learners are assigned to pair up in their teams to learn in a series of activities of a cognitive nature, including reading stories to each other, making predictions about how a story ends, summarizing each other, telling each other, writing responses to stories, and practicing pronunciation, acceptance, and vocabulary. Students also learn in teams to master main ideas and other comprehensive skills. (Arend,)

A. Cooperative learning model type Cooperative Integrated Reading Composition is divided into several phases, namely:
   1) The first phase, which is orientation. In this phase, educators perceive and initial knowledge of students about the material to be given. In addition, it also explains the learning objectives that will be carried out to students.
   2) The second phase, which is organization. Educators divide learners into groups, paying attention to academic heterogeneity. Distribute reading materials about the material to be discussed with students. In addition, it explains the mechanism of group discussions and tasks that must be completed during the learning process.
   3) The third phase, namely the introduction of concepts. By introducing a new concept that refers to the results of discoveries during exploration. This introduction can be obtained from educators' statements, package books, films, clippings, posters or other media.Fase
   4) Fourth, namely the publication phase. Students communicate the results of their findings, prove, demonstrate the material discussed both in groups and in front of the class
   5) The fifth phase, which is the strengthening and reflection phase. In this phase, educators provide reinforcement related to the material learned through explanations or providing real examples in everyday life. Furthermore, students are also given the opportunity to reflect and evaluate their learning outcomes.

B. Cooperative Learning Steps Cooperative Integrated Reading Composition (CIRC) Type

   1) CIRC learning has steps in learning, namely: Forming heterogeneous groups of four.
   2) Educators provide discourse/clippings according to the learning topic.
   3) Students work together to read and find the main idea and respond to discourse/clippings and written on paper, present or read out the results of the group.
   4) Educators make conclusions together.
   5) Learning closed

C. Audio visual

   Is a medium that has elements of sound and also elements of images. This type of media has better expertise, because it includes both types of auditive (listening) and visual (seeing) media. So, it can be concluded that audio-visual media is an auxiliary tool, audio visual which means

materials or tools used in learning situations to help writing and also spoken words in giving knowledge, attitudes, and ideas

D. Various kinds of learning media
Broadly speaking, the media is divided into:
1) Audio media, which are media that contain messages in auditive form (can only be heard) that can stimulate the thoughts, feelings, attention and ability of students to learn teaching materials. Examples include radio and voice recordings.
2) 2) Visual media, namely media that can only be seen and do not contain sound elements, such as pictures, paintings, photographs, and so on.
3) Audio visual media, namely media that contain sound elements and also have image elements that can be seen, such as video recordings, films and so on.

E. Benefits and Functions of Learning Media
One of the main functions of learning media is as a teaching aid that also affects the climate, conditions, and learning environment arranged and created by teachers. The use of learning media at the learning orientation stage will greatly help the activeness of the learning process and the delivery of messages and content lesson at that time. In addition to arousing student motivation and interest, learning media can also help students increase understanding, present data interestingly and reliably, facilitate data interpretation and condense information. Sudjana and Rivai stated the benefits of learning media in the student learning process, namely:
1) Learning will attract more students' attention so that it can foster learning motivation.
2) Learning materials will have a clearer meaning so that they can be better understood by students and allow them to master and achieve learning objectives.
3) Teaching methods will be more varied, not only verbal communication through the narration of words by the teacher so that students do not get bored and the teacher does not run out of energy especially if the teacher teaches at every lesson hour.
4) Students can do more learning activities because they not only listen to the teacher's description, but also other activities such as observing, doing, demonstrating, acting out and others.

F. Factors that affect the use of learning media that can be used as the basis for the selection activities include the following: goals to be achieved.
1) Student characteristics
2) The type of learning stimuli desired
3) The state of the setting or environment
4) The extent of the range you want to service.

G. Advantages of Audio Visual Media
Teaching materials are clearer in meaning so that they can be more easily understood by students, and allow students to master teaching objectives better.
1) Teaching will be more varied, not solely verbal communication through the narration of words by the teacher. So that teachers do not run out of energy and students do not get bored.
2) Students do more learning activities, because they not only listen to the teacher's description, but also observe, do demonstrations and others
3) Teaching will attract more students' attention so that it can foster student motivation.

H. Learning Outcomes
Understanding Learning Outcomes Activities carried out by individuals will result in changes, changes in both knowledge and attitudes and skills. That change is the result that has been achieved from the learning process. Learning outcomes are the abilities that students have after receiving their learning experience. While learning is done to strive for behavior changes in individuals who learn. Changes in behavior are acquisitions that become learning outcomes, in addition to cognitive learning outcomes obtained by students. "In general, learning is a

process of behavior change obtained from the experience of the individual concerned". (Muhamad Asrori 2009:6)

I. Factor What Affects Learning Outcomes

Each learning activity produces a distinctive change as a result of learning. Learning outcomes can be achieved by students through efforts as behavior changes which include cognitive, affective and psychomotor domains, so that the goals that have been set are achieved optimally. The learning outcomes obtained by students are not the same because there are several factors that affect their success in the process of learning. Broadly speaking, the factors that affect learning success can be divided into two major parts, namely internal and external factors

J. Internal factors

The Psychological Aspect consists of:

1) Intelligence has a huge influence on learning progress.
2) Attention To ensure good learning outcomes, students must have attention to the material they will learn. Attention is the heightened activeness of the soul, the soul is solely focused on an object (thing / thing) or a set of objects
3) Great interest has an influence on learning, because if the learning material is not in accordance with interests, students will not study seriously. d. Talent Is the potential ability that a person has to achieve success.
4) Motivation Motivation is closely related to the goals to be achieved.

K. External factors

a. Family Aspect

Family education is part of the extramural education pathway that is organized within the family and that provides religious beliefs, cultural values, moral values, and family aspect skills consisting of:

1) How Parents Educate Children The way parents educate children has a great influence on their children's learning. Parents who do not pay attention to their children's education can cause children to be less successful in learning.Home Atmosphere To make children learn well, it is necessary to create a calm and serene home atmosphere. If the atmosphere of the house is calm, a child will feel at home and the child can learn well.
2) Family Economic Situation The economic condition of the family also greatly affects children's learning.

b. School Aspects

School aspects that affect learning outcomes include:

1) Teaching methods.
2) Teacher-Student Relationship Teachers who interact less with students can cause the teaching and learning process to be less smooth.
3) School discipline is closely related to the craft of students going to school and also studying.

The large number of students as well as the characteristics of each vary, they are demanding circumstances.

L. Solar System

The solar system consists of a star that we call the sun and all the objects that surround it. The object includes eight planets, satellit-satellit natural, meteor, asteroid, comet and palnet-dwarf or dwarf planets. The solar system is believed to have formed since 4.6 billion years Last year, it was the result of the accumulation of gas and dust in space that formed the sun and then the planets that surround it. Solar System Located in the Milky Way Galaxy Galaxies are collections of stars, where stars are celestial bodies that emit their own light. The solar system itself has several components, namely: the sun, the planets, and various Celestial bodies such as satellites, comets, and asteroids. The solar system is located in the Milky Way galaxy or commonly also called the Milky Way.

This research was conducted at an educational institution located in South Bengkulu district, Kedurang sub-district. Precisely Jl Tj Besar at SMPN 8 South Bengkulu. This research was conducted on the subject of the solar system which was carried out in 2 classes, namely VII C as a control class totaling 31 students and VII E as an experimental class totaling 31

students. The following are the mean values of the experiment class and control class presented in the table below.

Table 2. Mean Student Learning Outcomes

Class	Mean Student Learning Outcomes	
	Pretest	***Posttest***
Experiments	64	82
Control	60	78
Control	60	78

The results of learning solar system material students in experimental and control classes were obtained from conducting a final test (post-test) at the end of the study. The results of this study showed that the learning outcomes between experimental classes were different from those of control class students. This is because students in the experimental class received treatment in the form of applying the Cooperative Integrated Reading and Composition learning model (*CIRC) assisted by audio-visual media, while in the control class did not get treatment in the form of applying the Cooperative Integrated Reading and Composition (CIRC) learning model assisted by audio-visual media. After the –t test at a significant level of 5% (0.05) obtained the sig value. (2-tailed) > 0.05 or 0.214 >0.05. It can be known that the experimental pretest and control showed no* There is a significant influence. Then data were also obtained from both classes from normally distributed populations with each class getting >0.05 and having homogeneous data diversity.

After being given differences in treatment, which in the experimental class uses the learning process with a model *Cooperative Integrated Reading and Composition (CIRC)* Assisted by audio-visual media while the control class uses conventional classes, the average score of the experimental class is greater than the average control which is 82 >78. From the experimental and control groups tested in the posttest, a significant difference of 5% sig (2 tailed) 0.05 or 0.831 was found; 0.05). It is clearly seen that the significance effect occurs in the posttest. The value of student learning outcomes increased after using audio-visual media. The CIRC learning model is one type of cooperative learning model that uses small groups and each group consists of 4-5 heterogeneous students. In the CIRC model, each student is responsible for his or her group assignments. Each member of the group brings out ideas to each other to understand a concept and solve it The tasks given, so that a good understanding and learning experience is formed. In the learning process, a model will be successfully applied if it follows the stages of the model. (Istarani (2015)

Similarly, CIRC type cooperative learning has several stages, starting with providing discourse in accordance with the learning topic, students work together to read and find main ideas and respond to the material provided then present the results of the group and end with making conclusions together. The CIRC learning model can be assisted by using media, one of the learning media that can be used is audio-visual media. The role of media is very important in the learning process, in addition to sebagai perantara pesan pembelajaran, juga bisa memberikan pengalaman belajar yang variatif, Fostering attitudes and creating a meaningful learning atmosphere, thus having an impact on improving student learning outcomes because students are more understanding and enthusiastic in participating in learning.

CIRC learning capital that makes students experience a meaningful learning process by exploring their own knowledge to solve a problem, the teacher only acts as a companion and facilitator. of which the CIRC learning model is one model Learning based on constructivism where in teaching and learning activities between the concepts learned are associated with their application, so that it will provide considerable opportunities in the learning process based on the initial knowledge that students already have, learning Meaningfully with students who are fully involved in teaching and learning activities make students' mastery of concepts on the material deeper, students' understanding becomes deeper when compared to learning by memorization. This CIRC learning research, in addition to Observing student learning outcomes also observing student and teacher activities using observation sheets. This aims to see the attitudes of students and teachers during the teaching and learning process. (Jatmiko 2013)

The findings in this study are supported by research conducted which emphasizes that the results of learning science material solar system students who receive learning with the Cooperative Integrated Reading and Composition (CIRC) learning model assisted by audio-visual media are different from

students who use conventional models A learning model is a pattern used as a guideline in planning learning in class and tutorials. According to Arend, the learning model refers to the approach to be used, including in learning objectives, stages in learning activities, and classroom management. A learning model can be defined as a conceptual framework which describes the systematic procedure for organizing learning experiences to achieve learning objectives Cooperative Type Integrated Reading Composition (CIRC) is a comprehensive program To teach reading and writing in elementary school classes at higher levels as well as in secondary schools. CIRC learning educators use reading materials that contain practice questions and stories. The learners are assigned to pair up in their teams to learn in a series Activities that are cognitive in nature, including reading stories to each other, making predictions about how the story will end, summarizing each other, telling each other, writing responses to stories, and practicing pronunciation, acceptance, and vocabulary Students also learn in teams to master main ideas and other comprehensive abilities (Widiasih, 2013).

4. CONCLUSION

Based on the results of research and data analysis conducted at SMPN 8 South Bengkulu, it can be concluded that there is an influence of the Cooperative Integrated learning model Reading and Compotition (CIRC) assisted by audio-visual media on solar system material on the learning outcomes of grade VII students of SMPN 8 South Bengkulu for the 2023/2024 academic year. This result can be seen in a significantly higher average score compared to the control class using conventional models (82 >78) These results were further supported by data analysis conducted using SPSS version 26, resulting in significant levels of SIG. (2 tailed) >.05 . The results of the examination obtained a t value greater than or equal to 2.14 with a significant level 5 % sig (2-tailed) 0,05 ataup p = 0.03). The final result obtained a GIS significance level (2 tailed) 0.05 or 0.831. So this reveals that the CIRC model assisted by audio-visual media has a significant influence on the learning outcomes of grade VII students of solar system material at SMPN 8 South Bengkulu

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The Influence of Peers on Student Learning Outcomes of Aqidah Akhlak Learning in Madrasah Ibtidaiyah Muhammadiyah Palak Siring South Bengkulu

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ABSTRACT

This study aims to determine the influence of peers on student learning outcomes in Aqidah Akhlak learning at Madrasah Ibtidaiyah Muhammadiyah Palak Siring Bengkulu Selatan, which consists of one class. Researchers took class IV to make a sample of 25 people. The type of research used in this research is quantitative research with a casual associative approach (casual relationship). As for the object of this research is class IV MIM Palak Siring Bengkulu Selatan, totaling 25 people, and data collection techniques through observation, questionnaires, and documentation. It was found that student learning outcomes of management data showed that students' learning outcomes in the high category of Aqidah Akhlak were 3 respondents or 12%. Medium category 18 respondents or 72%. While the low category is 4 respondents or 16%. So it can be concluded that the level of learning outcomes of Aqidah Akhlak students of MIM Palak Siring Bengkulu Selatan is in the medium category, namely 72%. The results of the study can be concluded that there is an influence of peers on student learning outcomes of Aqidah Akhlak at Madrasah Ibtidaiyah Muhammadiyah Palak Siring, South Bengkulu. It can also be proven by the results of calculating the simple linear regression equation Y = 61.25 + 0.235X, which means that for every increase in one variable X (Peer Influence), the value of the Y variable (student learning outcomes) will increase by 26.21 actions, where the influence of peers affect the learning outcomes of Aqidah Akhlak by, 26.21% seen from the performance of the determination coefficient of 73.79%.

Keywords: Influence of Peers, Learning Outcomes of Aqidah Akhlak.

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1. INTRODUCTION

Education has a very important role in creating human survival. Education is also a process to improve human dignity and dignity, for that humans need to be packaged in such a way that they are able to develop humans into perfect human beings, in the sense of humans who believe and fear Allah SWT, have noble ethics, and have knowledge and skills, physical and spiritual health, a steady and independent personality, and have a sense of community responsibility (Ngalim Purwanto, 1982: 1). Teachers are the parties who most closely relate to students in the implementation of daily education, and teachers are the parties who play the greatest role in determining student success in achieving educational goals (Alimni, dkk, 2023: 261)

School is one of the education that seeks a formal and planned teaching and learning condition for all students classically. No matter how heavy or abstract the material is, students with potential abilities that stand out from other creatures will be able to absorb and accept the understanding of the teachings well (AlFauzan Amin, 2019).

Learning outcomes are abilities that are in the lowest cognitive realm area until learning outcomes show that students have done learning actions which generally include knowledge and attitudes that are expected to be achieved by students. Learning outcomes will have a positive effect, if it shows the appearance of new abilities in students in doing assignments and questions on tests that are given properly and correctly in accordance with the instructions and time allotments that have been set (Tumulo, 2022: 438). According to Nana Sujana, learning outcomes are competencies or skills that can be achieved by students after going through learning activities designed and implemented by teachers in a particular school and class (Sudjana, 2011: 7).

Islamic education teaches humans to always do good, to fellow humans including the character of honesty (Alfauzan Amin, dkk, 2018:151). Moral education in Madrasah is listed in the subject of aqidah akhlak which emphasizes the ability to understand and maintain true beliefs or security by

practicing the values of asmaul husna. Creating an atmosphere of exemplary and habituation by practicing praiseworthy morals and Islamic civilization through the formation of examples of daily behavior. Morality has a great influence on the individual human being and on a nation (Baradza, 1992: 1).

Religion is a very important thing in life, be it children, adolescents, adults or parents (Alimni, 2017 :229). Therefore, moral aqidah education has an important meaning and role in shaping student behavior as a whole. Because with this moral aqidah education students are not directed to the achievement of happiness in life in the world, but also to the happiness of life in the hereafter.

Peers are children of approximately the same age or level of maturity (Pramono, dkk, 2011: 6). Therefore, peers are an environment where students learn to live with others. The peer environment at school can have a positive impact on the process of high learning outcomes. The peer environment has a great influence on student learning outcomes (Alimni, dkk, 2021:150).

The influence of peers can be seen from the daily lives of students who spend a lot of time with their friends. This can create similar attitudes and perceptions among them in everything including study and school. Students will be more confident if they get social motivation from fellow group members. In addition, peers are also a source of information that they do not get from their families and this information is usually about their social roles as women or men, but what is still lacking is learning with peers. The following words of Allah SWT in Sura Al-Hujurat:10 explain about the faithful flock, namely:

إِنَّمَا ٱلْمُؤْمِنُونَ إِخْوَةٌ فَأَصْلِحُواْ بَيْنَ أَخَوَيْكُمْ ۚ وَٱتَّقُواْ ٱللَّهَ لَعَلَّكُمْ تُرْحَمُونَ

Which means: "Behold, believers are brothers, therefore reconcile between your two brothers (who are at odds) and fear Allah so that you may have mercy" (Depag RI, 2012).

From the above verse it can be understood that in Islam it is taught to be brothers and sisters in religion and moral aqidah. Make peace with your brother when there are disputes and disagreements. Fear Allah when there are disputes about His laws and act as mediators, so that you may be blessed and helped by Him in making peace, as a result of your piety. Likewise, with peers, choosing peers has a meaningful influence on students' lives in the future, both positive and negative influences. This is because in childhood to adolescence, friendship relationships are established both in the school environment and the neighborhood, which includes behavior, hobbies, religious behavior, and learning outcomes of adolescents are interconnected.

The peer environment is an interaction with people who have similarities in age, social status, hobbies and similar thoughts, in interacting they will consider and prefer to join people who have similarities in these things (Pramono, dkk, 2011: 8). Based on interviews with several parents, it was explained that their children often access social media, especially Facebook, making them negligent in learning and worshiping (Alimni1, dkk, 2021:150)

The determining factor for success in learning is students as actors in learning activities. Without awareness, willpower, and student involvement, the learning process will not succeed. However, in learning each student has a different habit. In student learning requires a process, it cannot be done at one time but learning must be routinely done slowly on a regular basis, so that the learning routine will become a habit that must be done by students. Learning requires a repetitive and gradual process, often found a student who has a high willingness to learn, high learning achievement and also a family environment that supports students in learning, the possibility of learning achievement is also high. But there is also a student who has a willingness to learn, the learning outcomes are quite low because there is no support from the family environment (Soviyani, 2019: 21).

Based on the results of observations made by the author on November 12, 2022, that learning Aqidah Akhlak at MIM Palak Siring, Kedurang District, South Bengkulu Regency, researchers found that students with good learning outcomes make their peers a place for discussion and group learning. This activity in addition to making students closer to their peers also increasingly supports their learning outcomes at school. The role of peers in association has become very prominent. This goes hand in hand with an increase in individual interest in friendships as well as participation in groups. So that creating a group (group work) to make learning that students do not understand and accompanied by

teachers who have good social skills will make it easily accepted by the peer environment. Conversely, students who have inadequate social skills will have difficulty in establishing relationships with their friends. If this happens, students will feel inferior, isolated, depressed, quiet and even finally reluctant to join the environment. If there is material that is not understood, the student does not dare to ask the teacher and also his friend (Preliminary Observation, November 12, 2022).

Based on the results of questions and answers with class IV homeroom teachers at MIM Palak Siring, Kedurang District, South Bengkulu Regency, information was obtained that there is a peer relationship with learning outcomes, where it appears that children who have good peer relationships have good learning outcomes while children who do not have poor relationships, then the learning outcomes are not good.

Based on the background of the above problem, the author was motivated to raise this problem in the form of research entitled "The Influence of Peers on Student Learning Outcomes of Aqidah Akhlak Learning in Madrasah Ibtidaiyah Muhammadiyah Palak Siring South Bengkulu". From this title, there is an identification of problems that can be taken by the author, namely the peer environment is considered not to have a good influence, it is proven that many students do not listen to lessons in class because they are invited to talk to their friends when the teacher is giving assignments in class, there are students who like to be alone and do not like to gather with their friends, and there are also students who do not submit assignments at a predetermined time. To avoid confusion in this discussion, the author limits this research. Based on the description above, this research focuses on discussing the influence of peers on the learning outcomes of students of Aqidah Akhlak Learning at Madrasah Ibtidaiyah Muhammadiyah Palak Siring South Bengkulu.

2. RESEARCH METHOD

Quantitative research is a type of research that produces findings that can be achieved (obtained) using statistical procedures or other means of quantification (measurement).

The quantitative approach formulates attention to phenomena that have certain characteristics in human life which it names as variables. In the quantitative approach, the nature of the relationship between variables is analyzed using objective theory (Sugiyono, 2014: 7).

The type of research used is quantitative with a casual associative approach (casual relationship), casual associative is a causal relationship. So in this approach there are independent (influencing variables) and dependent (influenced) variables. The casual associative approach is a study that aims to determine the influence between two or more variables. Quantitative research methods can be interpreted as research methods based on philosophy, used to examine certain populations or samples, quantitative / statistical data analysis, with the aim of testing hypotheses that have been determined (Sugiyono, 2014: 7).

This research will be conducted at MIM Palak Siring, Kedurang District, South Bengkulu Regency. This research was conducted from May 29 to July 29, 2023 at Mim Palak Siring, South Bengkulu.

The population in this study was 25 students of grade IV MIM Palak Siring, Kedurang District, South Bengkulu Regency. In Quantitative research, the sample is conducted by a number of individuals representing a selected large group. The sample in this study was 25 grade IV students.

In a study, a tool or instrument is needed to obtain research data which will later play an important role in research. To get the right data, the right tool or instrument is also so that later the right and accurate research results will be obtained. The data collection techniques in this study are through: observation, questionnaires and documentation.

3. RESULTS AND DISCUSSION

After the researcher went to the field in order to conduct research at MIM Palak Siring South Bengkulu, then the researcher presented the data that had been obtained. Data results with documentation and questionnaires.

This research was conducted at MIM Palak Siring South Bengkulu from May 29, 2023 to June 29, 2023. The sample is class IV in the subject of Aqidah Akhlak.

From the results of research on the influence of friends on student learning outcomes in Madrasah Ibtidaiyah Muhammadiyah palak siring south Bengkulu with regression equation $Y = 61.25 + 0.235X$, which means that the working hypothesis (Ha) in this study is accepted, namely there is peer influence

on student learning outcomes in Madrasah Ibtidaiyah Muhammadiyah palak siring south Bengkulu. So it can be known that peers affect student learning outcomes.

Peers are a component that exists in the school environment. Basically, self-adjustment is also influenced by the environment wherever a person is. MIM Palak Siring South Bengkulu students, just like other students, also spend a lot of time at school and with their peers.

Meanwhile, the amount of peer influence on student learning outcomes in this study was 26.21%, meaning that there is peer influence on student learning outcomes, because in an effort to achieve learning goals as a whole it is not enough just to transfer knowledge from teachers to students, but also must have good peers so that it can stimulate and motivate students to be active in teaching and learning activities.

The results of this study are also supported by previous research conducted by Neni Sumarni in 2016, which resulted in a positive relationship between the Influence of Peer Interaction on Student Morals at SMP Serunting 1 Kota Bengkulu. Based on data analysis, there is a significant positive influence of peer interaction on the morals of students at SMP Serunting. This is shown by the significant value of F_{count} greater conclusion F_{table} (4.11>3.96) then reject Ho accept Ha, thus there is a significant influence between peer interactions on student morals is 30.6%. The remaining 69.4% was due to other factors. This can be interpreted as the peer social support received has a considerable impact on the process of developing students' moral adjustment abilities at SMP Serunting 1 Bengkulu City (Sumarni, 2016).

Furthermore, research conducted by Fitria Seli Afrilianti, in which Teacher Teaching Creativity can improve Student Learning Achievement in PAI Subjects at SMA Negeri 1 Bengkulu Tengah. This is shown by the increase in the average score and percentage of student success from before giving creativity actions to after giving creativity actions. The average grade point obtained by students before giving creativity actions was 52.38 while the percentage of students achieving learning completeness was 42.86%. In the first stage, the average grade point obtained by students was 64 while the percentage of students who achieved learning completeness was 61.90%. In the second stage, the average score obtained by students reached 70.57 while the percentage of student learning completeness reached 80.95% (Afrilianti, 2013).

Furthermore, research conducted by Singgih Tego Saputro and Pardiman. The results of this study are: (1) There is a positive and significant influence of Learning Discipline on Student Learning Achievement of the Accounting Education Study Program, Class of 2009, Faculty of Economics, Yogyakarta State University which is shown by a value greater than r_hitung r_tabel, namely: 7,780 > 1,984 with a coefficient of determination of 0.345 which means that 34.5% of this variable affects Learning Achievement. (2) There is a positive and significant influence of the Peer Environment on the Learning Achievement of Students of the Accounting Education Study Program, Class of 2009, Faculty of Economics, Yogyakarta State University, which is indicated by a calculated value greater than the table, namely: 5.097 1.984 with a coefficient of determination of 0.184 which means that 18.4% of this variable affects Learning Achievement. (3) There is a positive and significant influence of Learning Discipline and Peer Environment together on the Learning Achievement of Students of the Accounting Education Study Program, Class of 2009, Faculty of Economics, Yogyakarta State University, which is shown by a Fcalculate value greater than Fable, namely: 36,618 > 3,090 at the level of significance of 5% and the coefficient of determination of 0.391 which means that 39.1% of these two variables together affect Learning Achievement. Regression line equation Y= 0.017X1 +0.007X2 + 1.866 (Saputro dan Pardiman, 2012).

Partowisastro provides an understanding of peer interaction is the closeness of peer group association relationships and relationships between individuals or group members which include openness, cooperation, and frequency of relationships (Asrori, 2017).

This research is also in accordance with the opinions of Ahmadi and Supriyono who state that learning achievement results are influenced by several factors both from within the student (internal) and from outside the student (extern). External factors of the social environment, especially classmates (peers) have an influence on student learning motivation which will ultimately affect the learning outcomes of the students themselves (Ahmadi dan Supriyono, 2008: 138).

Based on the description that has been put forward, it can be stated that through peers which in its application is very effective in improving student learning outcomes. However, the various obstacles faced must be a reference as a process of improving student learning outcomes. For this reason, peers

are still conditioned so that optimal learning outcomes can be obtained. Because the high and low learning outcomes are determined by the size of peers. That is, the learning outcomes achieved by students have relationships with peers.

Research Limitations

Although researchers have tried hard to meet all the required needs, it does not mean that this research is without weaknesses and shortcomings. Some of the weaknesses and disadvantages that can be stated here include:

It is difficult to know the sincerity of respondents in working on the questionnaire. Efforts are made to minimize errors by providing an overview of the aims and objectives of this study.

Data collection in this study is only based on the results of the questionnaire so that it is possible that there are less objective elements in filling out the questionnaire. In addition, in filling out the questionnaire, it was obtained that there were the characteristics of the respondents themselves, such as honesty and fear in answering the respondents truthfully.

When taking research data, namely when distributing research questionnaires to respondents, it cannot be monitored directly and carefully whether the answers given by respondents are really in accordance with their own opinions or not.

4. CONCLUSION

Based on the results of data processing and discussion of research results, it can be concluded that the level of peer influence on the learning outcomes of students learning aqidah akhlak in Madrasah Ibtidaiyah Muhammadiyah palak siring south Bengkulu. At $\alpha = 5\%$ (confidence interval of 95%), with a simple linear regression equation $Y = 61.25 + 0.235X$ which means that every increase in one variable X (Peers) then variable Y (Learning Outcomes of Aqidah Akhlak) will increase by 0.235 actions, where peers affect the learning outcomes of aqidah akhlak students by 0.51% (0.51% seen from the calculation of the coefficient of determination). 26.21% while 73.79% influenced by other variables were not included in this study.

This means that the alternative hypothesis (Ha) in the research is acceptable, namely the learning outcomes of grade IV students in aqidah akhlak subjects at MIM Palak Siring South Bengkulu there is peer influence on student learning outcomes. Evidenced by the results of the dat frequency of midterm test scores of students in aqidah akhlak subjects of 26.21%.

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Online Frequency Distribution Application Using a Javascript-Based Blogger Platform

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ABSTRACT

This research develops an online frequency distribution application using the Javascript-based Blogger platform. The method used is a literature study, namely examining the frequency distribution of both the formulas used and descriptions in the Javascript programming language using mathematical logic. Online frequency distributions are essential for analyzing data, and by utilizing Javascript capabilities, this application allows users to easily input data and automatically generate informative frequency distributions. This article discussed the technical implementation, including the use of the Javascript programming language and its integration with the Blogger platform for online content creation. The results of this research contribute to the development of statistical applications that are easy to use and access online, thereby helping users understand and analyze their data more effectively.

Keywords: Frequency Distribution, Blogger, Javascript

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1. INTRODUCTION

Frequency distribution is a daily requirement in data processing, according to Andjarwati et al. (2021). This is considered important because it can provide a clear picture of how the data is distributed or dispersed in a sample. To provide information about data patterns and assist in decision-making, it is necessary to understand frequency distributions so that people can make better decisions in situations where data currently plays an important role. (Arham & Nasir, 2020)

There are many statistical applications that are often used to calculate frequency distributions, such as the Statistical Package for the Social Sciences (SPSS) application, which is an application program that has the ability to analyze data statistically. SPSS applications are often used in various fields such as mathematics, business, health, research, and others. This application can organize data, perform statistical analysis, and visualize the results in the form of graphs or tables. (Santoso, S., 2020:09)

According to Priyastama (2020:10), SPSS is a very popular statistical application for calculating frequency distributions. This application was developed by a large company, namely IBM. However, this application has a license and must be installed on Windows. Gio and Rosmaini (2016) Almost the same as SPSS, there are several statistical applications that have licenses, such as Minitab, Microsoft Excel, Eviews, Lisrel, Amos, and Smartpls, but all of the applications above are data visualization and analysis to help users improve decision-making and provide outlook. All statistical applications have quite expensive licenses, especially for individual users or students who may have a limited budget. SPSS license prices can vary depending on the type of license required. (Huda, 2016)

Ramachandran and Tsokos (2020:39) said that there are several statistical applications that are complete and have free licenses for calculating frequency distributions, namely R software, but these applications use a programming language so that it is sometimes difficult for new users to learn. According to Bunn (2008), every time you run an R command, you have to use scripts and too many commands. Data storage in R is stored in physical memory, and executing coding in R takes quite a long time, especially since the R installation data is large. This is a weakness of the R program, which is a statistical application. To be able to operate R software effectively, users need to learn the R programming language. This may require a longer learning time and requires programming skills.

In using statistical applications, there are several obstacles, one of which is the large amount of data and the complexity of data modeling, making it difficult to manage existing data. The more complex the data, the more complex the completion process, and almost all statistical data can be

resolved. Just like using the latest and most paid online statistics applications. (Niani CR & Lewaherilla N, 2021)

All of these statistical applications have the disadvantage that they require installation on Windows and cannot be run on Android. Therefore, it is necessary to have statistical media that can be accessed easily online, is free and responsive, and can be accessed via mobile and desktop, especially frequency distribution material using JavaScript. In particular, the JavaScript programming language for online frequency distribution development is very light, easy to use, and does not require a license to use it. The JavaScript language is very popular for use in mathematical logic, and there are few online frequency distribution applications that are easier to run in a browser. (Rhomdani, 2022)

From all the explanations above, the solution for calculating and determining frequency distribution is online and free of charge using JavaScript. JavaScript development for frequency distributions is little studied in educational institutions. Therefore, researchers are interested in developing online frequency distribution applications using JavaScript. This online frequency distribution application will be given free access and can be accessed anywhere and at any time using a responsive blogger, which can be accessed via Android, a cellphone, or a laptop for the world of education.

2. RESEARCH METHOD

This research develops online frequency distribution using JavaScript for bloggers. The method used in this research was a literature study by reviewing the frequency distribution formula and then describing it in the JavaScript programming language using mathematical logic by utilizing JavaScript's capabilities as a powerful programming language in web development so that users can access this application via their web browser without needing to install addition software. (Moreira et al., 2022)

A looping algorithm, or for loop, is a control structure in programming that is used to repeat a series of instructions repeatedly as long as certain conditions are met. In the context of algorithms, for loops are often used to automate and execute a series of instructions with variations in certain values. (Mathulhusna, Efriyanti, & Okra, 2022).

3. RESULTS AND DISCUSSION

In statistics, frequency distribution is one of the fundamental concepts used to organize and describe numerical data. This concept helps us understand how data is spread across sets of different values. The results are presented in the form of tables or graphs that provide a visual depiction of the patterns and characteristics of the data. Frequency distributions allow us to identify the most common values and specific ranges of values in the data. With a better understanding of frequency distributions, we can draw more accurate conclusions about our data and make more informed decisions in a variety of contexts, from scientific research to business analysis. (Wahyuningrum, 2020)

The selection of Blogger as a platform for developing online frequency distribution applications is based on several important considerations. Blogger is a platform that is very popular, easy to use, and has a high level of openness. This allows developers to quickly build and integrate statistical applications without requiring very advanced programming skills, so that the applications developed can be easily accessed by users from various backgrounds. The advantages of Blogger as an online publication platform include the ease of managing content. Apart from that, Blogger also provides free hosting, which allows this application to be accessed online without additional costs. Blogger also supports responsiveness, so that applications can be accessed well on devices of various screen sizes, including cellphones and tablets. (Rhomdani RW & Rahayu, L.D., 2022)

The main benefit of using Blogger in the context of statistical applications is the ability to easily disseminate data analysis results. Users can quickly publish frequency distributions generated by the application, making them available to others in an easy-to-understand form. Thus, Blogger provides an effective tool for sharing statistical information with relevant stakeholders, both in academic, business, and social contexts. (Hasan, S. et al., 2023)

One of the main roles of Javascript is to take input data from users in an interactive and responsive manner. With the help of Javascript, users can easily enter numerical data into the application, both in the form of single numbers and data sets. After receiving input data from the user, Javascript then plays a role in processing the data. This process involves counting the number of times each value appears in the dataset and then forming a frequency distribution. Javascript is also responsible for building

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informative displays, such as tables or graphs, to clearly depict frequency distributions to users. (Kurniawan, H. et al., 2023) Additionally, Javascript enables interactivity in applications. This means users can interact with the resulting frequency distribution, such as zooming or filtering the data, easily. According to Maulana, A (2023), in this way, the role of Javascript is not only limited to calculations but also to enriching the user's experience in exploring and understanding their own data. Thus, Javascript is a key component in this application, allowing the application to be more interactive, responsive, and useful in taking data input from the user and generating informative frequency distributions.

Previous Section Before this research is carried out, it is necessary to prepare study materials for the frequency distribution formula, starting from the formula for the amount of data, average, minimum and maximum value, range, number of classes, and length of class, and several supporting devices such as computers and browsers that meet the specifications for research trials. Each formula is studied to calculate the amount of data, average, minimum, and maximum value, and then described in the JavaScript programming language. From this formula, create an input box with a comma (,) separating format. like the following example:

```
input = 12,3,4,5,6,3,2,4,5,3;
var x = input.length;
var n = 0;
for(var i = 0; i<x; i++){n +=parseInt(input[i]);}
var mean=(n/x).toFixed(2);
var max = Math.max.apply(null, input);
var min = Math.min.apply(null, input);
```

The x value is the length of the input data array of n groups, which is then calculated to be the number of numbers in the input box. Next, we will recalculate the number of group data points and then determine the mean value, minimum value, and maximum value for the group data.

From the results of research trials in the computer laboratory at Muhammadiyah University of Jember, researchers were able to develop online frequency distribution using JavaScript on Blogger, starting with preparing and conceptualizing the frequency distribution formula, then creating a JavaScript application that was prepared, one of which was designing the frequency distribution concept manually, and then the researcher described it using mathematical logic. using JavaScript.

Researchers create or provide input boxes to be used as input for group data, and then with one calculation execution button, this application can calculate all solutions, namely, the maximum and minimum values, average, range, class length, number of classes, varieties or variants, standard deviation, and quartile values, including Q1, Q2, and Q3. After being able to map class length and number of classes data to group data, this application will be able to display a frequency distribution table starting from the upper and lower limits, display frequency values, and also display bar graphs, lines, and circle graphs on the results of group data analysis.

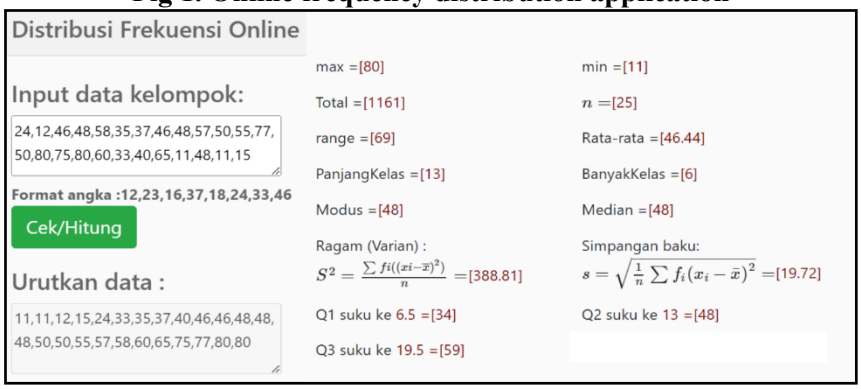
The following is the logic for calculating the amount of data, average, minimum and maximum value, range, number of classes, and class length on group data built using JavaScript as follows:

```
    <textarea id="input" rows="3" cols="30">12,3,4,5,6,3,2,4,5,3</textarea>
    <p><button id="button" onClick="Hitung()">Hitung</button>
    <p id="Tampil"/>
    <script>
    function Hitung(){
    var input = ((document.getElementById('input')).value.split(',')).sort((a,
b) => a - b);
    var x = input.length;
    var n = 0;
    for(var i = 0; i<x; i++){n +=parseInt(input[i]);}
    var mean=(n/x).toFixed(2);
    var max = Math.max.apply(null, input);
    var min = Math.min.apply(null, input);
    var range = max-min;
    var K = Math.ceil(1 +(3.3* (Math.log10(x))));
    var P = Math.round(range/K);
    document.getElementById('Tampil').innerHTML = 'Banyaknya data = ' + x +
'<br>Jumlah data = ' + n + '<br>Rata-rata = ' + mean + '<br>Nilai max = ' + max
```

Indonesian Journal of Education & Mathematical Science
Vol. 5, No. 1, Januari 2024, pp. 33~39
ISSN: 2715-985X, DOI: 10.30596/ijems.v5i1.16768

```
+ '<br>Nilai min = ' + min + '<br>Jangkauan = ' + range + '<br>Banyak kelas = '
+ K + '<br>Panjang kelas = ' + P;
    }</script>
```

Fig 1. Online frequency distribution application



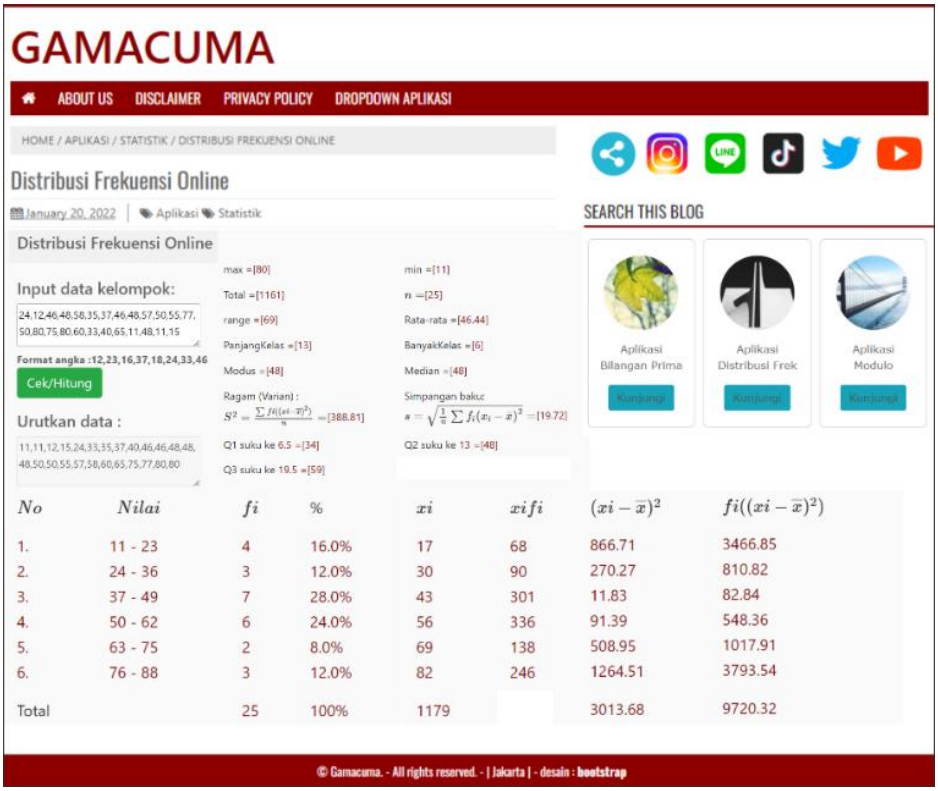
The algorithm above is used to calculate group data and successfully displays the amount of data, average, minimum and maximum value, range, number of classes, and class length using JavaScript. Furthermore, in the next script, the researcher will calculate the quartile values with the formula Q1 = (x(n+1))/4, Q2 = (x(2n+1))/4, and Q3 = (x(3n+1))/4 using JavaScript as follows:

```
var x = input.length;
if (x%2==1){
var s1=(x-(-1))/4;var s2=2*(x-(-1))/4;var s3=3*(x-(-1))/4;
}else{
var s1=(x+2)/4;var s2=(2*x+2)/4;var s3=(3*x+2)/4;}
var v = input.sort((a, b) => a - b);
for(var i = 0; i<x; i++){
if(s1%2==1 || s1%2==0){ if(i<s1){q1 =(v[i]);}
}else{var t1=s1-1.5; var u1=s1-0.5;
if(i==t1){var t11 =(v[i]);}
if(i==u1){var u11 =(v[i]);}
q1=(t11-(-u11))/2;}
if(s3%2==1 || s3%2==0){ if(i<s3){q3 =(v[i]);}
}else{var t3=s3-1.5; var u3=s3-0.5;
if(i==t3){var t33 =(v[i]);}
if(i==u3){var u33 =(v[i]);}
q3=(t33-(-u33))/2;}}
document.getElementById("kuartil").innerHTML =
'The 1st quartile value in the th term '+s1+' = '+q1+'<br>'+
'2nd quartile value in the 2nd term '+s2+' = '+q2+'<br>'+
'Quartile value 3 in term '+s3+' = '+q3+'<br>';
```

Next, the researcher displays several distribution table calculations using JavaScript; the rest of the advanced algorithm is on the gamacuma.blogspot.com page, as follows: The algorithm used is a loop, or for loop, which is a control structure in programming that is used to repeat a series of instructions or blocks of code repeatedly as long as certain conditions are met. Next, to display distribution data, researchers use the 'for' loop algorithm. In JavaScript programming, looping algorithms using 'for' loops are one effective way to repeat a certain task a certain number of times.

Fig 2. Online frequency distribution application with the Blogger platform

Indonesian Journal of Education & Mathematical Science
Vol. 5, No. 1, Januari 2024, pp. 33~39
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The for loop is a very useful tool for automating tasks that require repetition, such as processing arrays, examining data, or performing repetitive operations that allows developers to run code efficiently without needing to rewrite the same task repeatedly to automate repetitive tasks or execute a set of instructions with variations in certain values. The researchers then worked out the following formula:

Fig 3. Code formula Loop

```
<script>
function tabel(){
var input = document.getElementById('input');
var maka = input.value.split(',');
var n = maka.sort((a, b) => a - b);
var total = 0;
var banyak = n.length;
for(var i = 0; i<banyak; i++){total +=parseInt(n[i]);}
var max = Math.max.apply(null, n);
var min = Math.min.apply(null, n);
var range = max-min;
var bkelas=1 +(3.3* (Math.log10(banyak)));
var Bkelas=Math.ceil(bkelas);
var Pkelas=Math.ceil((range)/bkelas);
var arr = n;
function inRange (x) {return this[0] <= x && x <= this[1]}
let no='';
for(i=1;i<=Bkelas;i++){no+=i+'.<br>';}
var a=min;n=a+Bkelas;b=Pkelas;b1=Pkelas-1;let dkelas='';let frekx='';
for(i=a;i<n;i++){
kiri=i*b-a*b+a;kanan=i*b-a*b+a+b1;
dkelas+=kiri+' - '+kanan+'<br>';
frekx += arr.filter(inRange, [kiri,kanan]).length+"<br>";}
document.getElementById("no").innerHTML = no;
document.getElementById("dkelas").innerHTML = dkelas;
document.getElementById("frek").innerHTML = frekx;
}
</script>
```

```
    <textarea id="input" rows="3"
cols="30">55,65,76,78,55,47,89,89,89,70,77</textarea><br>
    format N = 55,65,76,78,55,47,89,89,89,70,77
    <p><button id="button" onClick="tabel()">Click</button>
    <br>
    <table border="1">
    <tr>
    <td>No</td><td align ="center">Nilai</td>
    <td><center>Frekuensi</td>
    </tr>
    <tr>
    <td><p><p id="no"></p></td>
    <td align ="center"><p id="dkelas"></td>
    <td align ="center"><p id="frek"></p></td>
    </tr>
    </table>
```

This online frequency distribution no longer uses the straight or tally method; everything is run by a mathematical logic programming language using JavaScript. More details about the continuation of the JavaScript algorithm are on the gamacuma.blogspot.com page. Researchers have made innovations as well as additions and modifications for the next article. Then the researchers used bar graphs with Chart.js, which is a JavaScript programming language for visualization of statistical data that supports chart types, namely bar charts for displaying frequency data. Chart.js was created by Nick Downie in 2013, a London-based web developer, but now Chart.js is maintained by the GitHub community and is the second most popular JavaScript charting library on GitHub based on the number of stars after D3.js. then Chart.js is much easier to use and very responsive and customizable. Chart.js is rendered in HTML5 canvas, supports all browsers, and is widely sought after as one of the best data visualization libraries. (Downie, 2013).

4. CONCLUSION

In this research, an online frequency distribution application has been successfully developed using the Blogger platform and based on the Javascript programming language. This application makes it easy for users to analyze data by automatically generating frequency distributions. Integration with the Blogger platform allows users to publish analysis results online, making them easier to access and use by others.

Thus, this application is a useful solution for supporting statistical data analysis, especially for those who do not have a strong technical background. Users can quickly understand patterns in their data and share them with others via the Blogger platform. This application creates new opportunities to spread statistical understanding and increase engagement in data analysis online. More details about the continuation of the JavaScript algorithm are on the gamacuma.blogspot.com page. Researchers have made innovations as well as additions and modifications for the next article. Especially in this digital era, developing this kind of application has the potential to provide great benefits for various fields, from education to business.

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Implementation of Augmented Reality (AR) in the Development of Space Building Modeling Learning Media for Elementary School Students 040481 Juma Raja Village

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ABSTRACT

A geometric shape or also called a geometric shape is a three-dimensional shape that has space and is limited by sides. Spatial structure is a characteristic of concrete objects that we often encounter every day. Rapid technological advances in the world of information technology and computers also have an impact on the world of education, which offers various conveniences and innovations. Augmented Reality or often abbreviated as AR is a technology that is able to combine real and virtual situations at one time which is displayed in real time. With AR technology, it is hoped that it can provide innovation and new learning experiences in recognizing and studying spatial shapes, so that it can attract the interest of students who are studying it.

Keywords: Augmented Reality (AR), Building Space, Learning Media

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1. INTRODUCTION

In mathematics subjects, one of the materials studied is spatial figures. Space construction material has been taught since elementary school, but in reality students' ability to understand space construction is still relatively minimal. Each spatial structure has a different type, shape, formula, area and volume. So many elementary school students don't feel interested in studying spatial structure material because they feel it is difficult and don't understand clearly how each spatial structure looks.

To provide a solution to this problem, a medium is needed to implement material about mathematical spatial structures, one of which is utilizing Augmented Reality (AR) as a learning medium to make it easier for students in the learning process and increase interest in learning.

One of the hardware used in human interaction with computers is a webcam. With a webcam, humans can interact with other humans via computers. However, this interaction model is not natural, as humans interact directly with each other. Humans want a more natural use of hardware as a demand for the development of computer technology itself. Therefore, a technology called Augmented Reality (AR) emerged combining 3D objects into the real world so that humans can interact with computers more naturally. Augmented Reality (AR) is a technology that combines two-dimensional or three-dimensional virtual objects into a real three-dimensional environment and then projects these virtual objects in real time. Augmented Reality (AR) prioritizes reality because this technology is closer to the real environment. Augmented Reality (AR) allows users to interact in more real-time with the system. Augmented Reality (AR) technology is developing very quickly so that its development can be applied in all fields, including education. One of them is learning mathematics material.

Observing the importance of using technology in the field of education, the author is interested in introducing Augmented Reality (AR) technology to students at SDN 040481 Juma Raja Village. In order to help students in learning mathematics, especially in geometric material. So in this research we will try to create a solution to this problem by developing learning media using Augmented Reality (AR) technology, namely technology that combines two-dimensional or three-dimensional virtual objects into a real environment and then projects these virtual objects in real time

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Vol. 5, No. 1, Januari 2024, pp. 40~46
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2. RESEARCH METHOD

According to Ronald T. Azuma (1997) defines Augmented reality as a combination of real and virtual objects in a real environment, running interactively in real time and there is integration and virtuality is possible with appropriate display technology, interactivity is possible through certain input devices, and good integration requires effective explanation. Meanwhile, according to Stephen Coward and Mark Faila in their book entitled Augmented reality a partial guide, they define Augmented reality as a natural way to explore 3D objects and data, AR is a concept that combines visual reality with world reality.

So that with 2-dimensional (2D) AR technology virtual objects, users can see the real world around them with the addition of computer-generated virtual objects. In the book "Hand Book of Augmented reality", Augmented reality aims to simplify the user's life by bringing virtual information that is not only for the surrounding environment , but also for any direct viewing of real-world environments, such as live streaming video. AR improves the user's perception and interaction with the real world. According to the explanation of Haller, Billinghurst and Thomas (2007), Augment Reality research aims to develop technology that allows real-time integration of computer-generated digital content with the real world. Augmented reality allows users to see two-dimensional or three-dimensional virtual objects projected onto the real world. (Emerging Technologies of Augmented reality).

In making this research I used the Multimedia Development Methodology. One of them is according to Sutopo (2003), who believes that the multimedia development methodology consists of 6 stages, namely concept, design, material collecting, assembly, testing and distribution as in the picture below:

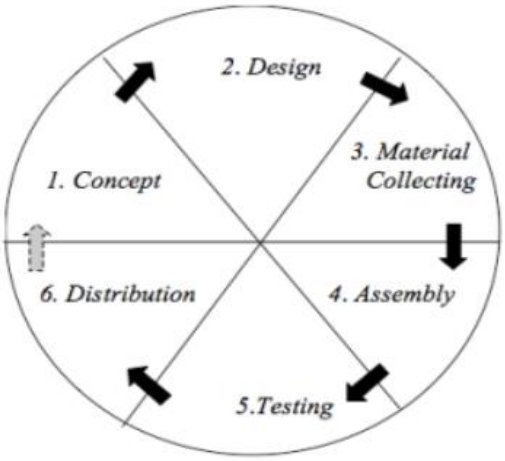


Fig 1. Multimedia Development Methodology

1. Concept. The concept stage is the stage for determining the objectives and who the users of the program are (audience identification). Apart from that, determine the type of application (presentation, interactive, etc.) and the purpose of the application (entertainment, training, learning, etc.).
2. Design. Design (design) is the stage of making specifications regarding program architecture, style, appearance and material requirements for the program.
3. Material. Collecting Material Collecting is the stage where materials are collected according to needs. This stage can be carried out in parallel with the assembly stage. In some cases, the Material Collecting stage and the Assembly stage will be carried out in a linear, non-parallel manner.
4. Assembly. The assembly (manufacturing) stage is the stage where all objects or multimedia materials are created. Application creation is based on the design stage.
5. Testing. This is done after completing the assembly stage by running the application/program and seeing whether there are errors or not. This stage is also known as the alpha testing stage (alpha test) where testing is carried out by the manufacturer or the manufacturer's own environment.

6. Distribution. This stage is where the application is stored on a storage medium. At this stage, if the storage media is not sufficient to accommodate the application, compression of the application is carried out.

The stages of the research method used in this research are:

1. Identification.
   Problem identification is a research process which can be said to be the most important among other processes. In this stage, the author tries to identify existing problems. This stage is the initial stage in preparing this research. The results of this identification become the background for formulating the problem that will become the object of research. The problem identified is how to design a 3-dimensional spatial modeling learning media for elementary school students by utilizing augmented reality technology.
2. Literature Study
   A literature review was carried out to obtain the basic theories needed. The author packages the existing material into an application scheme which will later be made into an interesting learning media application.
3. System Requirements Specification Analysis
   After the data is collected, then this analysis is carried out to find out what is needed in designing a learning media application about 3-dimensional spatial modeling. for elementary school students using augmented reality technology, so that the designed application can create a more interesting and interactive learning method.
4. PPL Method (Software Development)
   a. Concept
      This application is an interactive application, namely the user is controlled by the teacher and the audience is elementary school students starting from grade IV and the purpose of this application is as a learning media application in the mathematics subject of modeling building a 3-dimensional space.
   b. Design
      The specifications and appearance in making this application are designed according to the special learning needs of elementary schools, which includes first discussing with one of the elementary school teachers about what material is presented in modeling the 3-dimensional space and the appearance in it. This application is full color and in general children of elementary school age enjoy playing with colors.
   c. Material Collecting
      The collection of materials in making this application was by discussion with the mathematics teacher at the Babakanjawa I state elementary school. Mathematics teaching materials about 3-dimensional spatial modeling for class IV which can later be used as a learning medium up to class VI.
   d. Assembly All materials and objects Multimedia materials for making this application were created using several software, including: Google SketchUp 8, OpenSpace 3D Editor, Ogre Scene and Scol Voy@ager. And making the application is based on the design stage.
   e. Testing. Testing for this application is by distributing questionnaires to the elementary school environment.

Distribution. This stage of the application that has been created is stored in storage media. And this application is stored on a CD as a learning media application.

3. RESULTS AND DISCUSSION

Creating 3D objects using blender software. There are many choices of objects that can be created and modified according to your needs.

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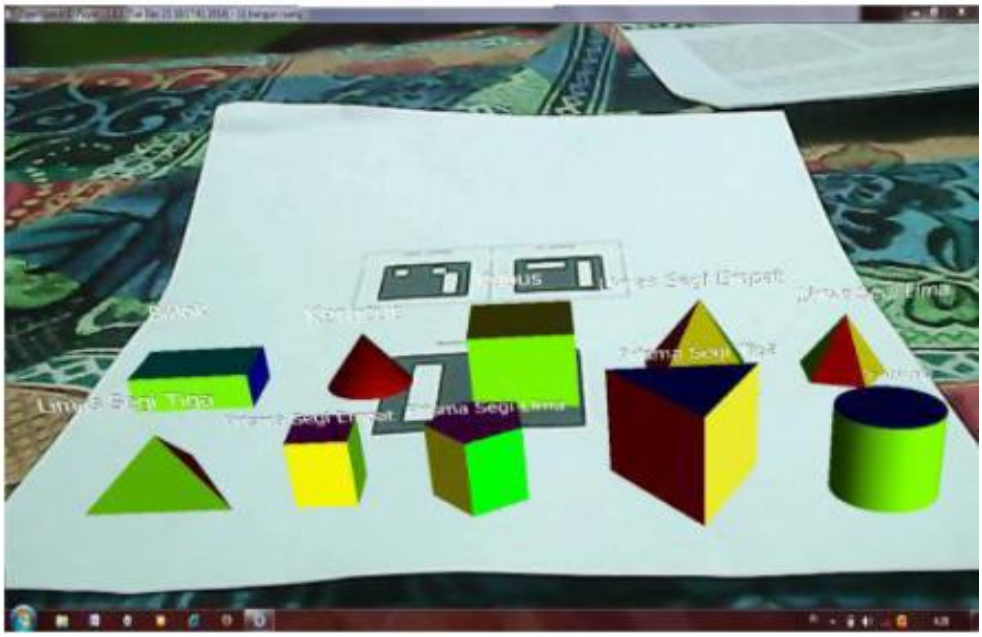


Fig 2. AR display of 10 spatial shapes

The image above shows the ten spatial shapes. AR 10 View of this spatial structure, for an initial introduction to understanding 3-dimensional spatial modeling. There are Zoom In and Zoom Out markers.



Fig 3. AR display of a cone shape

The AR display above is the appearance of a cone shape, where there is a statement "t" which means the height of the cone along with a formula for finding the area and volume. There are Zoom In and Zoom Out markers.

Indonesian Journal of Education & Mathematical Science
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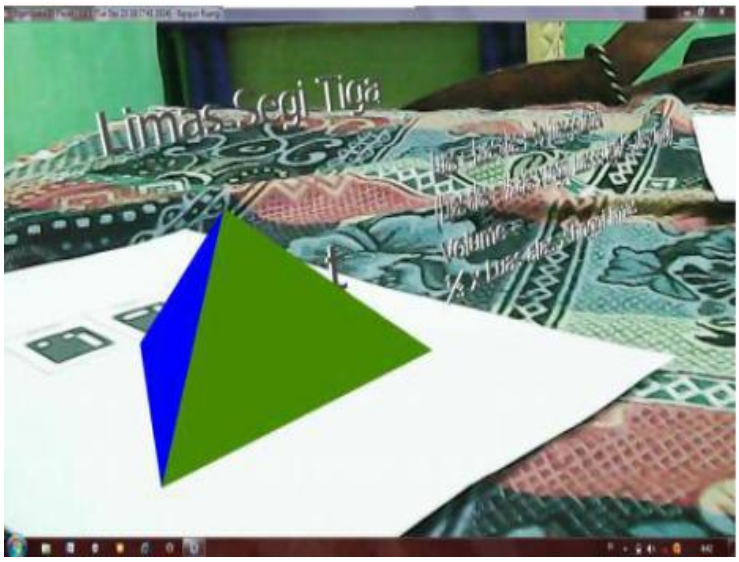


Fig 4. AR display of the triangular pyramid shape

The AR display above is the appearance of the triangular pyramid shape, where there is a statement "t" which means the height of the triangular pyramid along with a formula for finding the area and volume. There are Zoom In and Zoom Out markers.



Fig 5. AR View of Building a Cube Room

The AR display above is a grid of cube space structures which consists of 3 stages, the first stage is a pattern, the second stage is a semi-finished pattern and the third is a finished space structure. There are Zoom In and Zoom Out markers.

Indonesian Journal of Education & Mathematical Science
Vol. 5, No. 1, Januari 2024, pp. 40~46
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Fig 6. AR display of building a pentagon prism space

The AR display above is a grid of building a pentagonal prism space which consists of 3 stages, the first stage is a pattern, the second stage is a half-finished pattern and the third is a finished space. So. There are Zoom In and Zoom Out markers.

4. CONCLUSION

Augmented reality (AR) as a learning medium can be used as a teaching aid for geometric modeling of spatial shapes that are displayed visually in 3 dimensions. Due to the ability to process data quickly and in real time, as well as a display that is easy for users to understand and is interactive in 3 Dimensional mode. The material regarding special spatial modeling at elementary school level is designed with 3 Dimensional visuals that utilize the sophistication of Augmented Reality (AR) technology which is able to provide a contribution. to the world of education, namely that it can be used as a learning medium. The Augmented Reality-based 3D spatial modeling model which is used as a learning medium is able to create a new, more interactive atmosphere in mathematics learning which usually seems boring for elementary school students.

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Analysis of Mathematical Communication of Students through AIR Model at SMAN 1 Driyorejo Gresik

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ABSTRACT

The learning model during the Covid-19 pandemic has reduced students' mathematical communication because students are very dependent on gadget facilities. In this study, researchers used a learning model, namely Cooperative Auditory Intellectually Repetition (AIR). This study aims to determine the effect of Cooperative AIR learning model on students' mathematical communication on the material of System of Linear Equations of Three Variables (SPLTV) at SMAN 1 Driyorejo Gresik. This research method is quantitative research with data collection techniques that apply the test process using normality test, homogeneity test, and continued with hypothesis testing. The test instrument used was a post-test on students' mathematical communication as many as two questions. Based on the calculation result of students' mathematical communication test, it was found that students' mathematical communication using Cooperative AIR learning model was better than students' mathematical communication using Cooperative Jigsaw learning model with t_count>t_table or H_0 rejected, so it can be concluded that there is an effect of Cooperative AIR learning model on mathematical communication of class X students at SMAN 1 Driyorejo Gresik on SPLTV material.

Keywords: AIR Learning Model, quantitative research, mathematical communication

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1. INTRODUCTION

Based on Law Number 20 Year 2003 article 31 paragraph 2, learning from home through digital *platforms* has the function of providing educational facilities for citizens who do not receive face-to-face lessons. In addition, the school used for research, SMAN 1 Driyorejo Gresik, is located in Java, so in accordance with Inmandegri Regulation Number 35 of 2021, it states that Face-to-Face Learning for areas that are at level 3 PPKM is limited with a maximum capacity of 50%. Based on (Kemdikbud RI 2020), SMAN 1 Driyorejo Gresik conducts face-to-face meeting activities by dividing learning time into two sessions. To achieve the desired mathematics learning at level 3 of PPKM, mathematical communication is needed.

On the *National Council of Teachers of Mathematics* (in Ritonga, 2017) explained, mathematical communication is a way for students to discover mathematical concepts and strategies, solve mathematical problems through various learning models, and become a place to interact in expressing their opinions. Mathematical communication according to Kendal (2015) is a place for students to express something they know through interaction in the classroom environment, with the transfer of messages such as formulas, concepts, and ways to solve problems.

To assess the mathematical communication test, it is based on mathematical communication indicators which will be formed in scoring the mathematical communication test. Indicators of mathematical communication include the way students express mathematical ideas orally, in writing, or visually, students' skills in learning, channeling, and arguing mathematical ideas orally, in writing, or in other visual forms, and students' skills in applying mathematical notations to be presented in various models. Mathematical communication will be achieved when using an effective learning model.

Before the *Covid-19 pandemic,* SMAN 1 Driyorejo Gresik had used the *Cooperative Jigsaw* learning model. According to (Handayani et al. 2022), the disadvantages of the *Cooperative Jigsaw* learning model include students getting bored quickly, especially for students who have higher abilities. They lack respect for other students' opinions. In addition, they also look more prominent, resulting in a lack of equal distribution of information. The learning model that is expected to be effective is *Cooperative AIR*. Wahyudin in Akmalia (2019) *Cooperative AIR* learning model is a learning style

Indonesian Journal of Education & Mathematical Science
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whose effectiveness is through three situations, namely *Auditory (*hearing), *Intellectually* (thinking), and *Repetition*. As a result, students get deeper abilities regarding creativity, activeness, problem solving, and strong memory. The *Cooperative Auditory Intellectually Repetition* learning model can be explained according to its meaning. *Auditory* means related to hearing, such as listening to the information obtained. *Intellectually* means learning to overcome problems by trying or creating something new. *Repetition* means repeating what has been learnt.

From all the responses above, the researcher interprets the *Cooperative Auditory Intellectually Repetition* learning model as a learning style that links three points of view, namely *auditory, intellectually, repetition,* which means exploring the material, mastering the material, and stabilising the material by repetition in the form of tasks. The following are the stages in conducting the *Cooperative Auditory Intellectually* Repetition learning model, among others: (1) *Auditory* Stages; (2) *Intellectually* Stages; (3) *Repetition* Stages.

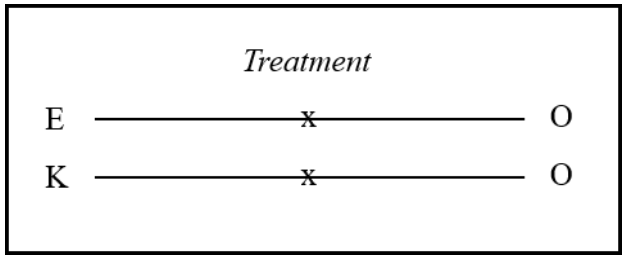
Agustiana (2017) argues that the *Cooperative AIR* learning model has some advantages and disadvantages. The first advantage, which is familiarising the function of hearing and creating the courage of students when sharing their opinions. Second, it provides opportunities for learners to solve problems in creative and innovative ways. Third, it familiarises learners to re-memorise the material that has been listened to at school. Fourth, the *Cooperative AIR* learning model forms students as individuals who are more enthusiastic in learning. As for the shortcomings, when implementing learning, it is done with a long time because it involves three aspects contained in the learning model, *Auditory, Intellectually, and Repetition*. In addition, with the learning model listed above, many of the learners cannot understand the material and commands directly, so it requires repetition of delivery until the learners understand.

Based on the above description, the researcher conducted a study on the analysis of mathematical communication of grade X students through *Cooperative Auditory Intellectually Repetition (AIR)* learning model at SMAN 1 Driyorejo Gresik. This research is expected to be applied in other learning and international-based schools. Research on the *Cooperative Auditory Intellectually Repetitiom (AIR)* learning model was also conducted by (Ain and Kamaluddin 2020; Alan and Afriansyah 2017; Apriliani 2020; Bonatua, Mulyono, and Febriandi 2021; Hidayati and Darmuki 2021; Kamsurya and Saputri 2020; Nisarohmah, Rochmad, and Rosyida 2021; Permatasari and Sulistyaningtyas 2023; Rohayati 2018; Sarniah, Anwar, and Putra 2019; Zulherman, Arifudin, and Pratiwi 2020)

2. RESEARCH METHOD

This research is a form of quantitative research using the *Quasi Experimental Design* method with *Post-test Only Control Group Design* classification. This study uses two classes, namely the experimental class and the control class. According to Sugiyono (2016, p. 76), the effect of treatment is tested with different methods using *t-test* statistics, with a picture as below:

Fig 1. Research implementation design



Description:
E : Experimental class through *Cooperative AIR* learning model
K : Control class through *Cooperative Jigsaw* learning model
O : Post-test

The population determined in the study was all students of class X SMAN 1 Driyorejo Gresik. Samples were taken in two classes including class X IPS 3 as the experimental class and class X IPS 4 as the control class. Before the research, both classes were given different learning models. The operation of

Indonesian Journal of Education & Mathematical Science
Vol. 5, No. 1, Januari 2024, pp. 47~52
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realized the test was that the experimental class is delivered with the *AIR Cooperative* learning model, while the control class is delivered through the application of the *Cooperative Jigsaw* type. Data collection was obtained by conducting a mathematical communication test of two description questions in both classes with the same number and questions. The scoring of mathematical communication test is presented in the form of the following table:

Table 1. Assessment of Mathematical Communication Test

Indicators	Student Response about the Problem	Value
Writing down everything known in the problem	Did not write everything known in the problem	0
	Write down everything known in the question but many are incomplete	1
	Writing down everything known in the question but a little incomplete	2
	Write everything known in the question accordingly and completely	3
Write down everything that is asked	Did not write everything that was asked in the question	0
	Write down everything that is questioned in the question, but many are incomplete	1
	Write down everything that is questioned in the question, but a little incomplete	2
	Write everything that is asked in the question appropriately and completely	3
Write down the answers to the questions distributed	Did not write down the answer	0
	Writing inappropriate answers to the questions distributed	1
	Writing answers according to the questions distributed but less precise	2
	Write the answer according to the question that was distributed correctly	3
Write down the conclusions obtained from the answers to the questions distributed	Did not write the conclusion	0
	Writing conclusions does not match the answers to the questions shared	1
	Writing conclusions according to the answers to the questions shared but not quite right	2
	Write conclusions according to the answers to the questions distributed	3

Source: (Siti Fitriani 2015)

The descriptive question test was initially run using a validity test and reliability test and then distributed to students. Validity and reliability testing was carried out with other classes, not experimental or control classes. Regarding the calculation results obtained $r_{count} > r_{table}$, so that both questions are valid. The results of the reliability calculation with the two-split technique are r_{11}= 0.608 which can be classified in high reliability. Furthermore, to test the data, it used normality test, homogeneity test, and finally hypothesis testing. The normality test required the *Chi Kuadrat* table in both classes to determine normally distributed data. The homogeneity test used the F table to find out homogeneous or inhomogeneous data. Hypothesis testing required t-test in order to find whether there is a difference in mathematical communication in the class with the *AIR Cooperative* learning model, as well as the class through the application of the *Cooperative Jigsaw* type.

3. RESULTS AND DISCUSSION

Based on the results of the assessment of students' mathematical communication tests in experimental and control classes, different calculation results were obtained. The results of the normality test calculation in both classes are compared with the following table.

Indonesian Journal of Education & Mathematical Science
Vol. 5, No. 1, Januari 2024, pp. 47~52
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Table 2. Mathematical Communication Test Results and Data Normality Test

Data	*Cooperative AIR Model*	*Jigsaw Cooperative* Model
Minimum Value	53	46
Maximum Value	98	98
Mean	84,58	78,61
Standard Deviation	12,22	13,13
χ^2_{hitung}	1,23	-7,32
χ^2_{tabel}	12,591	14,067
Number of students	36	36

According to Table 2 above, it is found that both classes are normally distributed. The class with *AIR Cooperative* model has a minimum value of 53 while the class with *Jigsaw Cooperative* model is 46. For the maximum value, it has the same value of 98. The class with *AIR Cooperative model* had a mean value of 84.58, while the class with *Jigsaw Cooperative* model was 78.61. The mathematical communication score of the class with *Cooperative AIR* learning model is higher than the class through the application of *Cooperative Jigsaw* type.

After the tested data is normally distributed, proceed with testing homogeneity to check whether the experimental class and control class have homogeneous conditions. The calculation is evidenced in the following table.

Table 3. Data Homogeneity Test

Class	Total	Variance	F_{hitung}	F_{tabel}
Experiment	36	149,45	1,15	1,76
Control	36	172,44		

From the calculation of table 3, it has been obtained F_{count}=1.15 and F_{table}=1.75 which means $F_{count} \leq F_{table}$, so the data is homogeneous.

Hypothesis testing was done utilising t-test with the formulation that: $H_0: \mu_1 = \mu_2$ (there is no difference in mathematical communication between the class with *Cooperative AIR* learning model and the class through the application of *Cooperative Jigsaw* type). While, $H_0: \mu_1 \neq \mu_2$ (there is a difference in mathematical communication between classes with *AIR Cooperative* learning model and classes through the application of Cooperative *Jigsaw* type). The following is a table of t-test data analysis results:

Table 4. Hypothesis Testing with t-Test

Class	Total	S_G	t_{hitung}	t_{tabel}
Experiment	36	12,68	2,147	1,994
Control	36			

Based on Table 4, we found that $t_{hitung} > t_{tabel}$ or H_0 is rejected. This is because there are differences in students' mathematical communication in the experimental and control classes. In the data collection, this study used a sample of X IPS 3 class as an experimental class of 36 students and X IPS 4 class as a control class of 36 students with SPLTV material. To prove the effect of *Cooperative AIR* learning model, different treatments were given to the two classes. Furthermore, the data was tested using data normality test, homogeneity test, and hypothesis test. The experimental class used *Cooperative AIR*

model, while the control class used *Cooperative Jigsaw* model. Furthermore, a *post-test* was conducted with questions that had been tested for validity and reliability.

Based on Table 1, it is found that the average experimental class is 84.58 and the control class is 78.61. So, it can be concluded that students in the experimental class have more maximum mathematical communication test scores. After the implementation of the data normality test and homogeneity test with the results of normal distribution and homogeneous data. According to the t-test data analysis obtained t_{hitung}= 2.147 and with a classification of 0.05 obtained t_{tabel}= 1.994, because $t_{hitung} > t_{tabel}$ then H_0 rejected, so there is a difference in mathematical communication between the class with the *AIR Cooperative* learning model and the *Cooperative Jigsaw* learning model class.

4. CONCLUSION

Based on the explanation above, students' mathematical communication with Cooperative AIR learning model is better than students' mathematical communication with Cooperative Jigsaw learning model. This is because the average value in the post-test of the experimental class, the class that applied the AIR Cooperative learning model, was more optimal than the control class, the class that applied the Jigsaw Cooperative learning model, namely the experimental class was 84.58, more optimal than the control class which was 78.61. According to the t-test data analysis, obtained t_hitung= 2.147 and t_tabel= 1.994, or t_hitung>t_tabel, then H_0 rejected. So, it can be concluded that there is an effect of Auditory Intellectually Repetition (AIR) Cooperative Learning Model on mathematical communication of class X students at SMAN 1 Driyorejo Gresik. Suggestions that can be given by the author for further research are the need to conduct research with other Cooperative Models, so that more learning models can be found or applied that can help students to think creatively and innovatively, with more efficient time.

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Android-Based Interactive Multimedia Development Using ISpring Suite 11 in Informatics Engineering Class X Senior High School

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ABSTRACT

This research focuses on developing interactive multimedia based on the Android platform for the eyes Information Technology lessons in class X high school (SMA). In an era marked by the growing role of technology in education, this research aims to create innovative and engaging learning tools that fit the curriculum while leveraging the capabilities of Android devices. This research followed a systematic development process, including needs analysis, design, development, implementation, and evaluation. This multimedia content combines various interactive elements such as quizzes, simulations, and multimedia presentations to improve students' understanding and retention of information technology concepts.
This study also evaluates the usability, effectiveness and satisfaction of both students and teachers with the Android-based interactive multimedia that has been developed. The findings of this research indicate that the use of Android-based interactive multimedia has been proven to be highly valid in terms of validity and practicality testing. This Android-based interactive multimedia has proven to be very suitable, both in terms of its content, appearance, and how it is used in accordance with the needs and characteristics of students. This research ultimately aims to improve the quality of Information Technology education at the high school level through the use of innovative Android-based interactive multimedia

Keyword : Interactive Multimedia, Android-based

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1. INTRODUCTION

Education is a crucial aspect in the development of individuals and society. In the increasingly developing digital era, education must also adapt to rapid technological changes. Informatics Engineering subjects are an important part of the educational curriculum which equips students with knowledge and skills in information technology. However, in facing these challenges, there is a need to introduce learning methods that are more innovative and relevant to an increasingly connected world. One potential learning method is the development of interactive multimedia based on Android. The Android platform has dominated the mobile device market with the number of users continuing to increase. Therefore, Using Android as a basis for developing interactive multimedia in the classroom can be an effective approach to improving the quality of learning. This technology allows students to learn in a more interesting and engaged way, which in turn can improve their understanding of Informatics Engineering concepts.

However, despite its great potential, there has not been much in-depth research regarding the use of Android-based interactive multimedia in the context of learning Information Engineering at the high school (SMA) level, especially in class X. Therefore, this article aims to describe the development and application of multimedia Android-based interactive on Engineering subjects. Informatics at high school level. It is hoped that this research will provide a clearer view of the potential and benefits of this learning approach and provide a basis for further development in this field. With this innovation, it is hoped that learning about Informatics Engineering in high school can become more interesting, interactive and effective in preparing the younger generation to face the demands of the ever-growing digital world.

2. RESEARCH METHOD

The Research and Development (R&D) model is an approach used to develop or enhance products, processes, or technologies. Sugiyono (2011:297) writes that research and development methods are

Indonesian Journal of Education & Mathematical Science
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research methods used to produce a product and test the effectiveness of the product. The development model used is the model according to Thiagarajan, namely the 4D model which consists of 4 stages, namely definition, design, development and dissemination.

The validity test of Android-based interactive multimedia products was tested on media experts and material experts. Meanwhile, the practicality test of Android-based interactive multimedia products was tested on 33 students of X.E4 SMA N 1 Suliki District. In this research, the researcher chose the subject of Informatics Engineering with material on Computer Networks and the Internet. The material discusses computer networks, types of computer networks, internet networks, and internet connections.

Table 1. Assessment Categories by Validator

Achievement level	Category
1	Very bad
2	Not good
3	Pretty good
4	Good
5	Very good

To find out the average score given by the validator, you can get it using the formula:

$$NA = \frac{S}{SM} \times 100\%$$

The criteria for making media validation decisions can be seen in table 2 as follows:

Table 2. Validity Criteria

Level achievement	Category
81-100%	Very bad
61-80%	Not good
41-60%	Pretty good
21-40%	Good
>20%	Very good

$$\text{Eligibility Value} = \frac{\text{Number of scores obtained}}{\text{Maximum number of scores}} \text{ X } 100\%$$

Next are the calculations to get practicality data:
The criteria for making media practicality decisions can be seen in table 3 as follows:

Table 3. Practicality Criteria

Level achievement	Category
81-100%	Very valid
61-80%	Valid
41-60%	Fairly valid
21-40%	Not valid
>20%	Very invalid

3. RESULTS AND DISCUSSION

A. Research Results

In this research, a multimedia interactive Android-based application has been successfully developed for the subject of Computer Engineering in grade X of high school, which can enhance students' understanding. The presentation of research results follows the steps in developing research using the 4-D model, namely the definition, design, development and dissemination stages. In this

Indonesian Journal of Education & Mathematical Science
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research, the focus is on the development stage because the main goal is to create interactive multimedia products for Informatics Engineering subjects, computer network and internet material.

1) Definition Stage (Define)

The definition stage in this research includes several important steps. First, through curriculum analysis, researchers found that SMA N 1 Suliki District uses an independent curriculum which encourages students to be more active in learning. Furthermore, student analysis revealed that many students did not pay attention when the teacher explained the material due to the lack of variety in the use of learning media. In addition, concept analysis highlights the complexity of Informatics Engineering material, especially in the topic of Computer Networks and the Internet, which involves a number of important concepts. Finally, in formulating learning objectives, the main goal is for students to be able to explain the basic concepts of computer networks, including types of networks, topology, and the main components used in forming networks.

2) Design Stage (Design)

Creating an initial interactive multimedia design that refers to the concept that has been created. The media was created using iSpring Suite 11 Software. The display presented in the interactive multimedia consists of: (1) opening intro scene,(2) main menu scene, (3) media developer profile scene, (4) learning objectives scene, (5)). guide scene, (6) material content scene, (7) quiz scene. In the finishing stage, the media format was changed to Android. The Android-based interactive multimedia design can be seen in the following image:

Fig 1. Based Interactive MultimediaAndroid



3) Development Stage (Development)

This development research produces a product in the form of interactive multimedia based on Android as a learning medium for Information Engineering in class X SMA N 1 Suliki District which is suitable for use. The results of this research can be seen from the validation results provided by the validator as well as practical results to see student responses to the product being developed.

a. Validity test

1) Media and Materials Expert

The following will explain the results of media experts' assessments of the products being developed, which can be seen in tables 4 and 5.

Table 4. Media and Material Validator Assessment

Source	Average	Percentage	Categories
Nofri henry, S.Pd, M.Pd	4,93	98,75%	Very valid
Septriyan Anugrah, S.Kom, M.Pd	4,93	98,75%	Very valid
Oktavia Suci Rahma, S.Pd	4,86	97,33%	Very valid

b. Practicality Test

1) Students

Indonesian Journal of Education & Mathematical Science
Vol. 5, No. 1, Januari 2024, pp. 53~57
ISSN: 2715-985X, DOI: 10.30596/ijems.v5i1.16783

The following will explain the results of student assessments of the products developed which can be seen in table 7.

Table 5. Practicality assessment

No	Aspects	Sum	Average	Overall average	Overall percentage	category
1	Activeness and independence of learning	144	4,36	4,56	91%	Very practical
2	Easy understanding of the material	148	4,48			
3	Interest in learning	150	4,55			
4	Means of interacting teachers with students	154	4,67			
5	Fostering curiosity	155	4,70			
6	Communicative language	150	4,55			
7	Exact typeface and size	153	4,64			
8	Good media quality	145	4,39			
9	Interesting media	154	4,67			
10	Media awakens the importance of technology	153	4,64			

4) Dissemination Stage
After the product has been developed, the next step is this stage. At this stage, the product will be integrated into a larger context. The interactive multimedia that has been created can be accessed by installing applications that have been distributed through groups between classes, with the help of each student's homeroom teacher. Apart from that, interactive multimedia will also be distributed to other Informatics Engineering teachers at SMA N 1 Suliki District.

4. CONCLUSION

Based on the discussion above, it can be concluded that learning media using interactive multimedia in the Informatics Engineering subject can be used in the learning process as a learning resource for class X SMA students in accordance with the media eligibility criteria. The aim of this development research in the learning context is to create a more interesting learning experience and be able to arouse students' interest and motivation so that they are more active in the Informatics Engineering learning process. Android- based interactive multimedia is able to create a more dynamic and enjoyable learning experience by using various types of media, such as video, images, sound and animation. This helps students to be more actively involved in the learning process. Besides that, Interactive multimedia can also provide instant feedback and exercises that can help students test their understanding. With the right approach in designing and implementing interactive multimedia, education can become more interesting, effective and relevant for today's digital generation.

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Indonesian Journal of Education & Mathematical Science
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Application of Integrals in Calculating Ball Volume using GeoGebra

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ABSTRACT

Integral Calculus is a form of mathematics learning that can be applied in everyday life. One application is in calculating the volume of rotating objects. In this research, we combine integral concepts in calculus with the numerical and visualization capabilities provided by GeoGebra software. The aim of this research is to apply the concept of integral calculus in calculating the volume of a rotating object in the form of a ball. The method used is a qualitative descriptive method that uses literature studies to search for formulas and to construct spherical shapes to determine their volume. The experimental method is used to find manual calculation results on real objects. The research results show that the integral concept used in calculating the volume of a ball using software assistance in the form of the GeoGebra application can produce quite accurate results.
Keywords: Calculus, Integral, GeoGebra

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1. INTRODUCTION

Integral Calculus is a part of mathematics learning that uses an analytical approach. Integral applications in everyday life are varied and can cover various fields at once. Solving problems encountered in everyday life is often connected to the concept of mathematical problem solving in finding a way out of a problem (Lusiana, Lusiana, and Nila Kesumawati, 2023).

Calculus is also a mathematical topic where the algorithmic manipulation of symbols is easier than understanding the basics. Therefore, in the search for a solution to the problem, a medium is needed that can help explain the main concepts and not just explain the algorithmic manipulation of the symbols (Shodikin, A., 2015).

Technological developments require all levels of society to interact directly with technology which causes almost all parts of learning problem solving to be adapted to lifestyles, including solving mathematical problems (Caligaris et al, 2015). Technology used appropriately can have an impact on exploration space to enrich mathematical knowledge. Mathematical exploration space can also be included in digital literacy in mathematical applications in the presentation of calculations and visualization of figural presentations quickly and precisely. One application software also facilitates the development of mathematics, one of which is Geogebra (Meldi, et al. 2022; Nasution et al. 2020). Apart from that, there is also several software that can facilitate and make it easier to recommend as a tool to help solve mathematics, including, Maple Calculator, Desmos, GeoGebra, Mathematical, Matlab, Texas Instruments Graphing Calculator and Helwett Packard Graphing (Meldi, et al. 2022; Dhani, Siti Rahma, et al. 2022; Subagio et al, 2021; Irvan, 2023).

GeoGebra is a computer program (software) used for mathematics, such as studying geometry and algebra. Even in its development, GeoGebra can also be used to search for other mathematical problems such as vectors and integrals. This makes it easier for all groups who have difficulty drawing function graphs as limits in determining the volume of rotating objects. GeoGebra software can be a key solution in solving integral calculus mathematical problems (Hohenwarter, Markus, et al. 2008; Mushlihuddin, R., et al. 2020).

Developing technology is utilized in various aspects, including in solving mathematical problems. In this case, the software in the form of the Geogebra application is one of the software which is expected to work significantly in solving integral calculus application problems. Likewise, solving the problem of calculating the volume of a rotating object in the form of a ball will be solved using an integral solution. In line with research by [9] which discusses solving the volume of a rotating object in

Indonesian Journal of Education & Mathematical Science
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the form of a tambourine, in this research we will discuss the solution in calculating the volume of a rotating object in the form of a ball using the supporting media GeoGebra software.

With this, we will prove the volume of the ball in several ways that can be done in everyday life with several formulas that will also be tried. The ball that will be used as a sample in research is a plastic ball which is usually used as a football in children's games with a diameter of cm

2. RESEARCH METHOD

The method used in this project is a qualitative descriptive method that uses literature studies to search for formulas and to construct spherical shapes to determine the volume of the ball (Sugiyono, 2013). Experimental method to find calculation results manually using a spherical geometric formula in the form of a formula $\frac{4}{3}\pi r^3$.

3. RESULTS AND DISCUSSION

Basically, the knowledge learned in the teaching and learning process aims to help each individual develop in everyday life. Likewise with integral sub-materials that can be applied to everyday life. A ball is a spatial shape whose shape is often found in everyday life.

A. Origin of the volume of a sphere

As we know, the formula for the volume of a ball is :

$\mathbf{V=\frac{4}{3}\pi r^3}$

Initially, the volume of the ball is derived from the integral formula Center P(0,0) and radius r then $x^2 + y^2 = r^2 \rightarrow y^2 = r^2 - x^2$.

Then the integral formulation is obtained in the form:

$$V = 2\pi \int_0^r (r^2 - x^2)dx$$

$$V = 2\pi(r^2x - \frac{1}{3}x^3)\Big|_0^r$$

$$V = 2\pi(r^2r - \frac{1}{3}r^3) - (0 - 0))$$

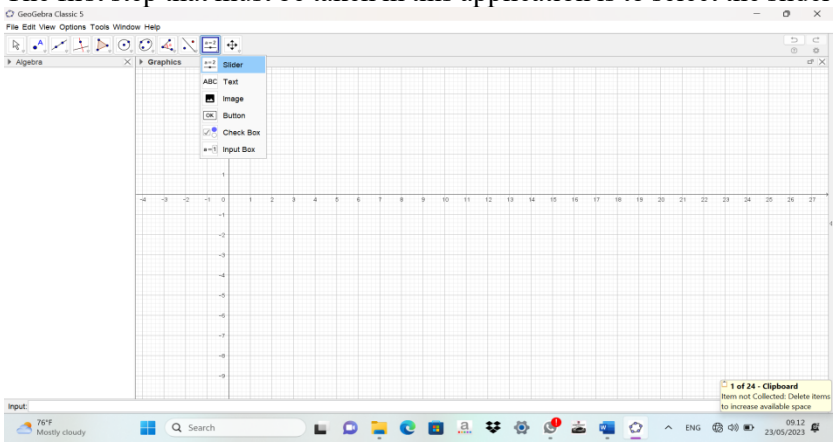
$$V = 2\pi\frac{2}{3}r^3 \rightarrow V = \mathbf{\frac{4}{3}\pi r^3}$$ □

B. Calculating the Volume of a Ball with Geogebra

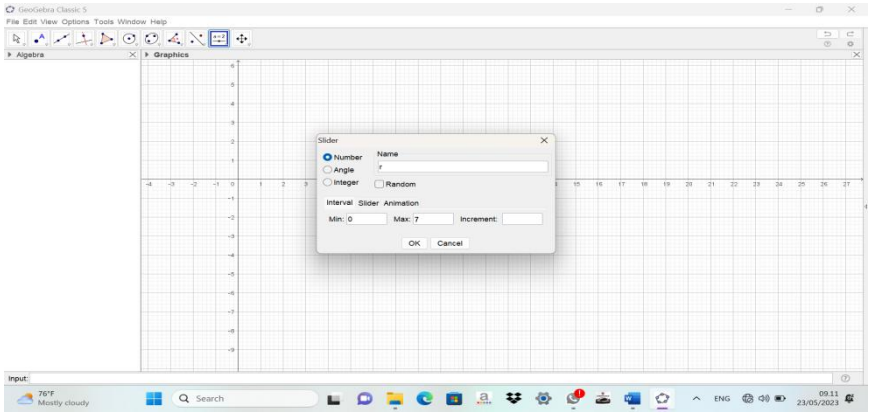
In finding the volume of a ball using the GeoGebra software, 2 forms of formula are used which will then be proven that the integral formula is a formula that will produce the same results as the spherical shape formula which is often used so far. Furthermore *Zulnaidi, Hutkemri, and Effandi Zakaria* (2012) explains that stated in their research that the use of GeoGebra software is effective in helping to develop levels of conceptual and procedural knowledge.

Indonesian Journal of Education & Mathematical Science
Vol. 5, No. 1, Januari 2024, pp. 58~63
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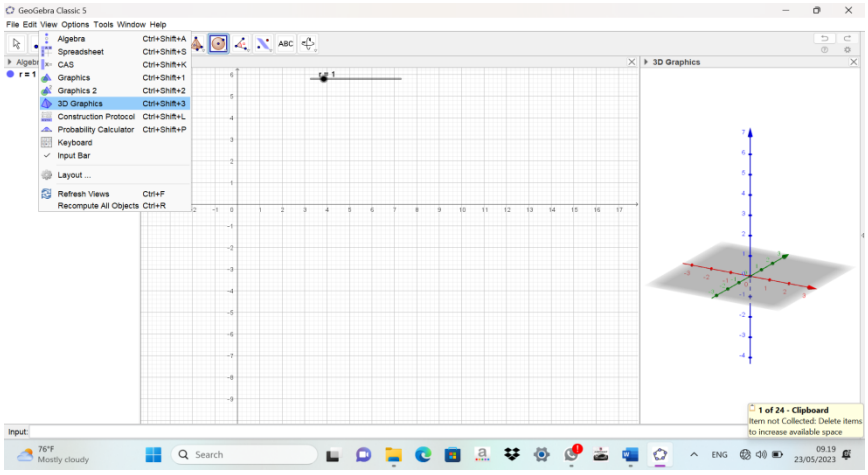
1. The first step that must be taken in this application is to select the slider menu as in the image below.



2. Next, click on any point on the graph and enter the required options as in the image below.

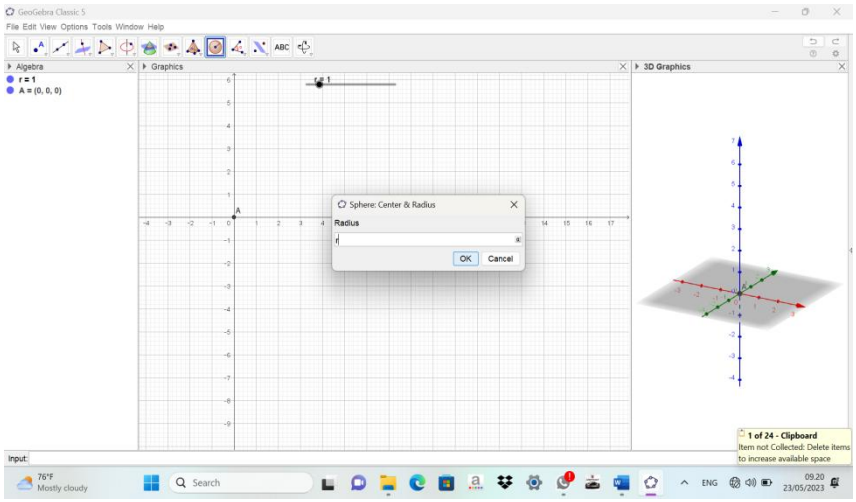


3. Next, click the "view" menu, then select the "3D Graphics" menu which will appear as in the image below.

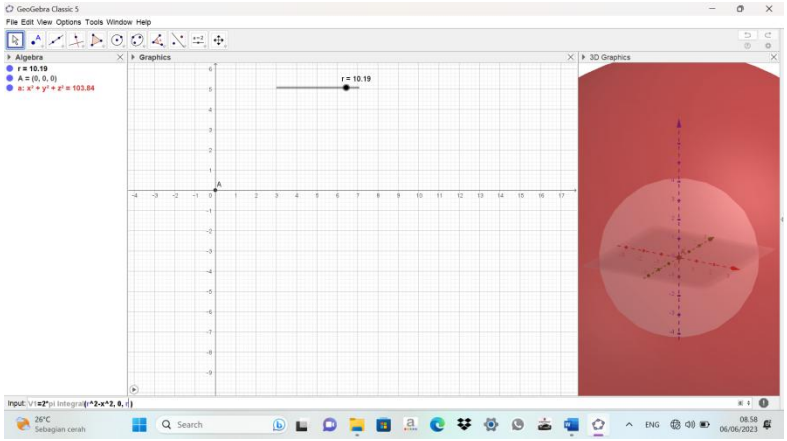


4. Next, select the "sphere: center & radius" menu then click on the point (0,0,0) in the 3D image and name it "r" as in the picture.

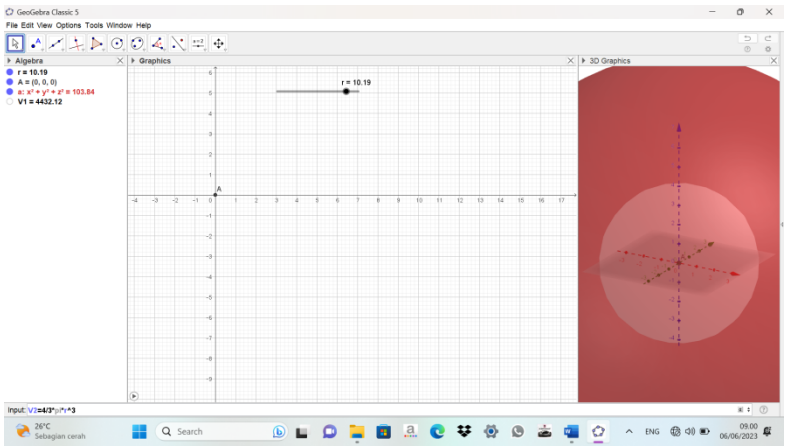
Indonesian Journal of Education & Mathematical Science
Vol. 5, No. 1, Januari 2024, pp. 58~63
ISSN: 2715-985X, DOI: 10.30596/ijems.v5i1.16783



5. To calculate the volume of a ball using the integral formula, input the volume formula as shown in the image in the form: $2\pi \int_0^r (r^2 - x^2)dx$which is then input into GeoGebra with the 2*pi Integral formula $(r^2 - x^2, 0, r)$and then after Enter, the volume of the ball will immediately appear.



6. To determine the volume of the ball, we can also input the formula in the input menu at the bottom like this 4/3*pi*r^3



Supported by research by Tonra (2021) where the volume of rotating objects of various shapes can be represented in the GeoGebra application. It can be seen that the GeoGebra application can be an effective tool in finding the volume of a ball using either the integral formula or the general formula for the volume of a ball. This supports the statement that using these two different formulas can produce

the same results. With this, to measure the volume of a football, you can find it using the volume formula only.

C. Calculating the Volume of Real Rotating Objects

Below, a plastic football is taken which will be used as a sample with a ball radius of 10 cm. With this, the volume will be found with the help of the Geogebra application by inputting the integral formula



Steps to calculate the volume of a plastic football:

1. The football is cut into the necessary parts so that it can be filled with water to measure its volume.
2. The ball is filled with water and then it will be measured how many liters of water can fill the ball's space as its volume.
3. Then, using the existing formula, it will be proven that the integral can be used to calculate the volume of a ball.

If the circumference of the ball is 64 cm, then the ball has a radius of 10.2 cm. then the volume of the ball is 4426.8 ml. In line with research Brahier, Danie (2020) to determine volume is to fill a container with something until it is full and then pour it into a holding container and then fill it again until it is full.

The volume of the ball is calculated in real terms using a simpler volume formula, namely the formula $\frac{4}{3}\pi r^3$. Based on the results of calculating the volume of the ball, it was found that the ball can be filled with a water dose of 1500 ml + 1500 ml + 1250 ml + 177 ml = 4427 ml. The results obtained from volume calculations with real objects can only be close to the results obtained from spherical volumes from calculations with GeoGebra. This is due to the lack of tools for calculating liters of water where the concept of volume is in decimal form.

4. CONCLUSION

The ball is a form of space that is often used every day. One thing that can be researched scientifically is calculating the volume using various forms of concepts that can be applied. One of the sub-discussions in the application of integral calculus is the concept of calculating the volume of rotating objects, including balls. If we look at the ball formula which is generally used, the calculation results show that the volume of a ball with a circumference of 64 cm and a radius of 10.2 cm is 4426,8 cm^3. The same results were obtained when calculating with the help of GeoGebra software and then almost the same results were obtained when calculating real objects. Among the various aspects of calculating spheres, you can use the GeoGebra application with effective results in accordance with the concept of geometric volume. The big advantage that can be obtained from using the GeoGebra application is that all groups can solve various geometric mathematics problems with just one click.

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Vol. 5, No. 1, Januari 2024, pp. 58~63
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