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Development and Implementation of Teaching Aid Guide Based on Discovery Learning Models on Optical Telescope Materials at Lokon St. Nikolaus Tomohon High School

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ABSTRACT

Mario Violendt Kojongian. This study aims to produce the development and implementation of teaching aids based on discovery learning models on optical telescope materials. This study refers to the research implementation procedure "Research and Development" developed by Borg and Gall (1989: 784). Research data from media experts shows that 92.5% is in the Very Strong category, and from material experts it is 92.5% in the same category. The empirical test consisted of 10 students in the small group and 28 students in the large group. Analysis using paired sample t-test shows the sig. (2-tailed) of 0.000 <0.05 which means that the development and implementation of teaching aids based on discovery learning models on optical telescope materials is good. Where there is an increase in the average value of students after following the practicum guide. This shows that the learning process using teaching aids based on the discovery learning model on the optical telescope material for Class X SMA Lokon St. Nikolaus can improve student learning outcomes.

INTRODUCTION

Learning activities carried out by looking at needs and well planned will create a pleasant classroom atmosphere and give birth to meaningful learning. Increased results from education will be achieved if the learning process held in class is truly effective and useful for achieving the expected knowledge, attitudes and skills. Because basically the teaching and learning process is the core of the whole educational process. But to improve the quality of education there are still problems or obstacles in the learning process faced by teachers at school, causing low student learning outcomes. Education plays an important role in producing quality human resources. Through education, humans are required to learn. In the whole process of school education learning process activities are educational goals depending on how the learning process is experienced by students as students to increase student enthusiasm for learning. Improving the quality of learning is one of the important things that must be considered in a learning process to improve the quality of education. This is the duty of each school and the most important thing is for teachers as teaching staff. Teachers must always be creative and innovative in conducting learning so that students more easily understand the material presented and enthusiastic in participating in the teaching and learning process, so that the learning carried out is of high quality and the achievements achieved by students are satisfactory. In the learning process the teacher is expected to be able to innovate in implementing a learning process that is effective, efficient, fun and able to motivate students (Paat 2013, in Paat, 2021: 469) by applying a relevant learning model to help and facilitate and facilitate students in mastering concepts which can support and increase student motivation to understand the lesson,

One of the ways taken in improving the quality of learning and student learning outcomes depends on the teaching and learning process. One of the supporters of the success of learning and learning outcomes is to use visual aids in the teaching and learning process. Teaching and learning activities in the classroom are a separate world of communication where teachers and students exchange ideas to describe their ideas and insights. Therefore, learning by using visual aids in this discussion is considered positive or a good thing to help students make it easier to understand the material. (Subadi, 2013).

Seeing the world's developments regarding telescopes today, NASA launched the largest and most powerful space telescope ever. The James Webb Space Telescope sees the universe in a light invisible to the human eye. This light is called infrared radiation, and we can feel it as heat. The James Webb Telescope will use its infrared camera to see through the dust in the universe. The James Webb Space Telescope will look back at the early stages of the universe, gather views of the formation of early stars and galaxies, and provide insight into the formation of planetary systems, including our solar system. The James Webb Space Telescope, or JWST, was developed through a partnership between NASA and European and Canadian space agencies.

The Webb telescope collects its scientific data in the form of infrared light. To detect faint signals from objects billions of light years away, the instruments inside the telescope must be kept cool, otherwise the infrared signal can be lost in the heat of the telescope. Engineers account for this with several systems designed to keep instruments cool and keep them cool.

The Webb telescope's orbit around the Sun - being about 1 million miles (1.5 million kilometers) from Earth at Lagrange 2 - keeps the spacecraft quite far from the heat of our planet, but that's not enough. To reduce the temperature of the instruments, the spacecraft will lay out a tennis court-sized sun visor that will block light and heat from the Sun, Earth, and Moon using five layers of specially coated materials. Each layer will block incoming heat, and any heat that does get in will be diverted away from the sides of the sun visor. Additionally, a vacuum between each layer provides insulation.

The Webb telescope can reveal even more using spectroscopy. Light from a star produces a spectrum, which shows the intensity of light at different wavelengths. When a planet orbits its star, some of the light from the star passes through the planet's atmosphere before reaching the Webb telescope. Because all elements and molecules, such as methane and water, absorb energy at specific wavelengths, the spectrum of light passing through a planet's atmosphere may contain dark lines known as absorption lines, which tell scientists when a certain element is present. (jpl.nasa.gov)

With the rapid development of the world about telescopes, further understanding is needed for students to know more about telescopes. In the learning process in the classroom, there are several factors that underlie researchers raising this problem, namely looking at the needs and lack of a learning process using teaching aids in Binoculars Optical Equipment Material, so researchers consider it important to raise this issue, so that it can produce improvements in terms of learning creative and meaningful.

Based on the results of observations at Lokon St Nikolaus Tomohon High School, it shows that students' learning outcomes in Science Physics are low, especially in the material for optical instruments. From the results of interviews with the Physics Science teacher, the material test scores, especially the optical telescope device, have not reached the average standard. This is because teachers only apply conventional learning models to pursue curriculum targets. Apart from that, the researcher conducted interviews with several students in informal situations and asked what the obstacles were so that they got scores below the average standard. They said that it was difficult for them to understand the material because the teacher immediately gave the material in a monotonous manner so that the learning process became less interesting and boring.

ByTherefore, there needs to be an effort to improve learning outcomes, especially the material for Optical Telescope Tools with various strategies, for example by applying learning models that can support the achievement of learning mastery. There are many learning models that provide opportunities for students to be active in learning, one of which is the discovery learning model. learning.

Therefore, there needs to be an effort to improve learning outcomes, especially the material for Optical Telescope Tools with various strategies, for example by applying learning models that can support the achievement of learning completeness. There are many learning models that provide opportunities for students to be active in learning, one of which is the learning model. discovery learning.

According to Bell in Agus Cahyo (2013) some specific goals of discovery learning are as follows:

a. In discovery students have the opportunity to be actively involved in learning. The fact shows that the participation of many students in learning increases when discovery is used.

b. Through discovery learning students can find patterns in concrete and abstract situations, students also extrapolate a lot of additional information provided.

c. Students also learn to formulate non-ambiguous question-and-answer strategies and use question-and-answer to obtain useful information in finding.

d. Learning by discovery helps students form effective ways of working together, sharing information, and hearing and using the ideas of others.

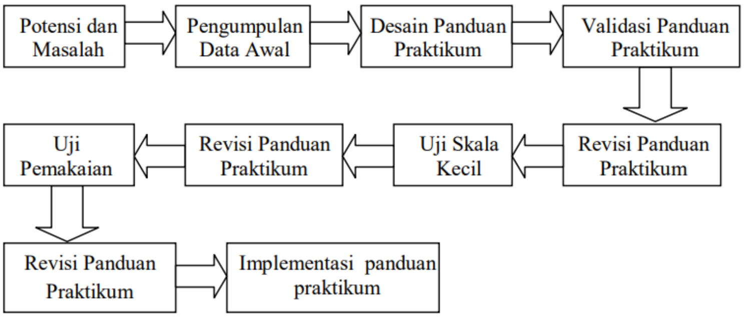
e. There are several facts that show that the skills and skills, concepts and principles learned through discovery are more meaningful.

f.Skills learned in discovery learning situations are in some cases more easily transferred to new activities and applied in new learning situations. (Cahyo, 2013).

Based on this background explanation, the researcher examines a problem through development research (R&D) with the title "Development and Implementation of Discovery Learning Model-Based Teaching Aids Guide on Optical Instrument Material (Telescopes) at Lokon St Nikolaus Tomohon High School".

METHOD

The research carried out is development research or known as the type of research "R & D" developed by Borg and Gall (1989: 784).



Research Steps R&D Development of Practicum Guidelines (modified from Sugiyono, 2012)

Development Procedure

1. Preliminary research/study (Research and Information Collecting)

The research was conducted at SMA Lokon St Nikolaus Tomohon. In the early stages, researchers analyzed needs, reviewed literature and made observations in class, then identified and collected problems as well as supporting and inhibiting factors during learning.

2. Research Planning (Planning)

At this stage, the researcher begins to determine the design of the product model. The things that are planned by the researcher include defining and making a design description of the product model design to be developed, identifying all activities to be carried out at each stage of the research and conducting feasibility tests on the model design on a limited scale. The products resulting from this research are development and Implementation of Discovery Learning Model-Based Teaching Aids Guide to Telescope Optical Instruments.

3. Design Development (Develop Preliminary From of Product)

At this stage the researcher begins to compile the initial form of the model and tools needed. The initial product was in the form of a practicum guide, analyzing teaching materials for telescope optics adapted to practicum guidelines, determining the type of telescope props to be used during practicum, namely the Celestron StarSense Explorer LT 127AZ Telescope, then determining practice questions. The research process at this stage was carried out by validating the model design by media experts and props experts. The results of the validation are reviewed and then corrected before being tested again.

4. Testfield (Preliminary Field Testing)

After the device and model are ready for use, the next activity is to test the module design. This trial involved around 6-10 student respondents. This is done to anticipate errors that may occur during the implementation of the ongoing model. In addition, with small-scale trials it is useful to analyze the constraints that may be encountered and try to reduce these constraints when implementing the next model. Researchers at this time can collect data in the form of observation sheets and questionnaires. The data obtained is then analyzed and evaluated to improve the application of the model at a later stage.

5. Revision of Limited Field Test Results (Main Product Revision)

The main product revision was carried out based on the results of the first stage of product trials with improvements and improvements. By analyzing the deficiencies that were obtained during the product trial, so that these deficiencies can be corrected as soon as possible.

6. Main Field Testing

After revisions were made, product testing was carried out on a larger scale. At the time of this field trial, researchers collected quantitative and qualitative data and began to evaluate the teaching aids based on the discovery learning model on optical telescope materials. By giving a response questionnaire and filling it out for the purposes of product improvement so that it is truly feasible and ready for use in schools.

7. Wider Field Test Results Revision (Operational Product Revision)

Conducting the second phase of revision, namely improving and perfecting the product based on input and suggestions from wider field trials. This is done if there are new constraints that have not been thought of at the time of design.

8. TestFeasibility (Operational Field Testing)

Conduct field implementation tests by involving more students. At this stage, data collection was carried out using observation sheets, interviews, and questionnaires. Then the data obtained is then analyzed and reported as a whole

9. Final Revision of Due Diligence Test Results (Final Product Revision)

Before the product is published more broadly, a revision is made to the final product, based on suggestions and input in the last field implementation test to correct things that are still not good.

10. Dissemination and Implementation of Final Products (Dissemination and Implementation)

The final stage of research and development is to report the products produced at scientific meetings or scientific journals

RESULTS AND DISCUSSION

Development research was carried out by conducting a site survey, namely at Lokon St Nikolaus High School, so that information was obtained that there was a lack of use of visual aids in the learning process activities that were included with practicums. Based on the results of observations at school, the students were very enthusiastic about getting to know and learning about optical instruments, especially telescopes. Along with this, information is obtained regarding the material to be used for the development of practicum guidelines to be used.

Furthermore, a literature study was carried out by collecting learning materials through books and other information for the development of teaching aids guides so that there was an increase in learning outcomes for students, from the cognitive, affective, and psychomotor domains.

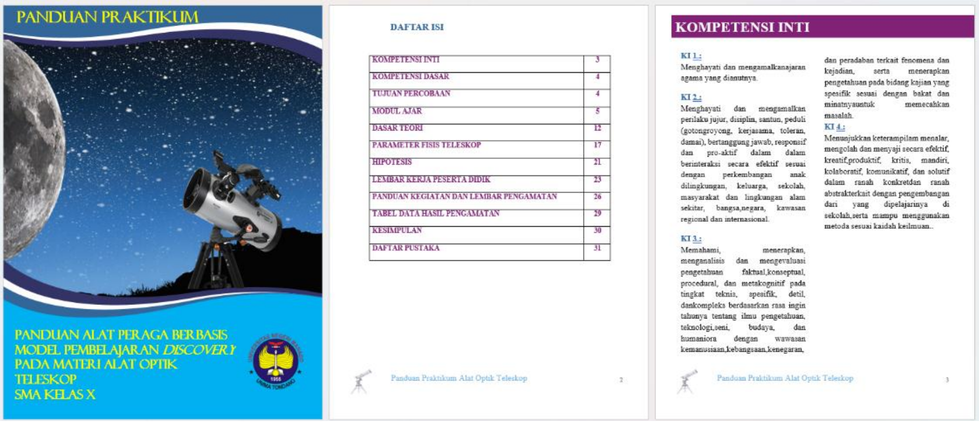
After making improvements, a small-scale trial was carried out at SMA Lokon St Nikolaus Tomohon class X with the Development and Implementation of a Discovery Learning Model Based Teaching Tool Guide on Optical Instrument Material (Telescopes) with a total of 10 students. The data collection instrument used was a student response questionnaire. Trial in this small group is very supportive in product improvement to determine the quality of the product produced.

The validation of the development and implementation of teaching aids based on the Discovery Learning Model on optical instruments (telescopes) was carried out by media experts and material experts.

Table 1. The results of the Feasibility Validation of Teaching Aids

Data	**Expert**	
	Material	**Media**
Presentation	92.5%	92.5%
Criteria	Very Worth Using	Very Worth Using

Based on the results of the feasibility validation carried out by material and media experts, the Development and Implementation of Teaching Aid Guide Based on Discovery Learning Models on Optical Instrument Material (Telescopes) is very feasible to use in the learning process. This is shown by the acquisition of a percentage of 92.5% from material experts and 92.5% from media experts with each criterion being very feasible to use.



PANDUAN PRAKTIKUM

PANDUAN ALAT PERAGA BERBASIS
MODEL PEMBELAJARAN *DISCOVERY*
PADA MATERI ALAT OPTIK
TELESKOP
SMA KELAS X

DAFTAR ISI

Panduan Praktikum Alat Optik Teleskop 2

KOMPETENSI INTI

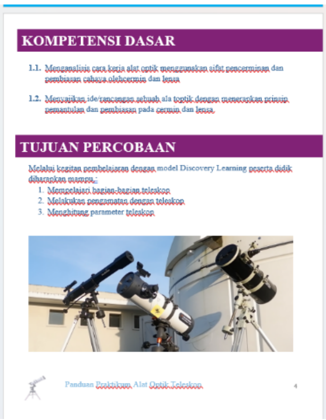
KI 1.:
Menghayati dan mengamalkanajaran agama yang dianutnya.

KI 2.:
Menghayati dan mengamalkan perilaku jujur, disiplin, santun, peduli (gotongroyong, kerjasama, toleran, damai), bertanggung jawab, responsif dan pro-aktif dalam dalam berinteraksi secara efektif sesuai dengan perkembangan anak dilingkungan, keluarga, sekolah, masyarakat dan lingkungan alam sekitar, bangsa,negara, kawasan regional dan internasional.

KI 3.:
Memahami, menerapkan, menganalisis dan mengevaluasi pengetahuan faktual,konseptual, procedural, dan metakognitif pada tingkat teknis, spesifik, detil, dankompleks berdasarkan rasa ingin tahunya tentang ilmu pengetahuan, teknologi,seni, budaya, dan humaniora dengan wawasan kemanusiaan,kebangsaan,kenegaran, dan peradaban terkait fenomena dan kejadian, serta menerapkan pengetahuan pada bidang kajian yang spesifik sesuai dengan bakat dan minatnyauntuk memecahkan masalah.

KI 4.:
Menunjukkan keterampilam menalar, mengolah dan menyaji secara efektif, kreatif,produktif, kritis, mandiri, kolaboratif, komunikatif, dan solutif dalam ranah konkretdan ranah abstrakterkait dengan pengembangan dari yang dipelajarinya di sekolah,serta mampu menggunakan metoda sesuai kaidah keilmuan..

Panduan Praktikum Alat Optik Teleskop 3



KOMPETENSI DASAR

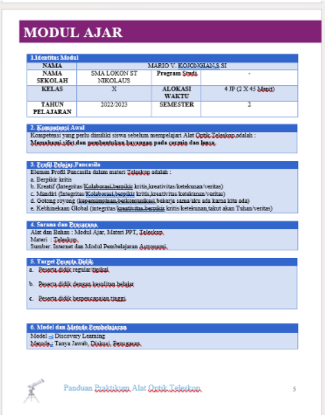
1.1. Menganalisis cara kerja alat optik menggunakan sifat pencerminan dan pembiasan cahaya olehcermin dan lensa

1.2. Menyajikan ide/rancangan sebuah ala toptik dengan menerapkan prinsip pemantulan dan pembiasan pada cermin dan lensa.

TUJUAN PERCOBAAN

Melalui kegitan pembelajaran dengan model Discovery Learning peserta didik diharapkan mampu :
1. Mempelajari bagian-bagian teleskop
2. Melakukan pengamatan dengan teleskop
3. Menghitung parameter teleskop

Panduan Praktikum Alat Optik Teleskop 4



MODUL AJAR

1.Identitas Modul			
NAMA	MARIO V. KOJONGIAN,S.SI		
NAMA SEKOLAH	SMA LOKON ST NIKOLAUS	Program Studi	-
KELAS	X	ALOKASI WAKTU	4 JP (2 X 45 Menit)
TAHUN PELAJARAN	2022/2023	SEMESTER	2

2. Kompetensi Awal
Kompetensi yang perlu dimiliki siswa sebelum mempelajari Alat Optik Teleskop adalah :
Memahami sifat dan pembentukan bayangan pada cermin dan lensa.

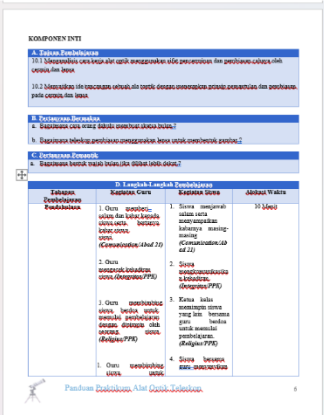
3. Profil Pelajar Pancasila
Elemen Profil Pancasila dalam materi Teleskop adalah :
a. Berpikir kritis
b. Kreatif (Integritas/Kolaborasi,berpikir kritis,kreativitas/ketekunan/veritas)
c. Mandiri (Integritas/Kolaborasi,berpikir kritis,kreativitas/ketekunan/veritas)
d. Gotong royong (kepemimpinan,berkomunikasi,bekerja sama/aku ada karna kita ada)
e. Kebhinekaan Global (integritas/kreativitas,berpikir kritis/ketekunan,takut akan Tuhan/veritas)

4. Sarana dan Prasarana
Alat dan Bahan : Modul Ajar, Materi PPT, Teleskop.
Materi : Teleskop.
Sumber: Internet dan Modul Pembelajaran Autonomi.

5. Target Peserta Didik
a. Peserta didik regular/tipikal
b. Peserta didik dengan kesulitan belajar
c. Peserta didik berpencapaian tinggi

6. Model dan Metode Pembelajaran
Model : Discovery Learning
Metode : Tanya Jawab, Diskusi, Penugasan.

Panduan Praktikum Alat Optik Teleskop 5



KOMPONEN INTI

A. Tujuan Pembelajaran
10.1 Menganalisis cara kerja alat optik menggunakan sifat pencerminan dan pembiasan cahaya oleh cermin dan lensa

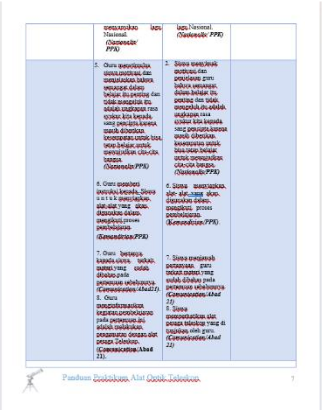
10.2 Menyajikan ide/rancangan sebuah ala toptik dengan menerapkan prinsip pemantulan dan pembiasan pada cermin dan lensa

B. Pertanyaan Bermakna
a. Bagaimana cara orang dahulu membuat sketsa bulan ?
b. Bagaimana teleskop pembiasan menggunakan lensa untuk membentuk gambar ?

C. Pertanyaan Pemantik
a. Bagaimana bentuk wajah bulan jika dilihat lebih dekat ?

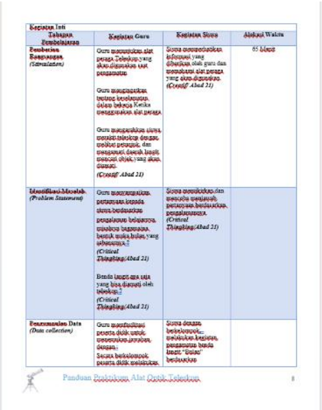
D. Langkah-Langkah Pembelajaran			
Tahapan Pembelajaran	Kegiatan Guru	Kegiatan Siswa	Alokasi Waktu
Pendahuluan	1. Guru memberi salam dan kabar kepada siswa serta bertanya kabar siswa. siswi. (Comunication/Abad 21) 2. Guru mengecek kehadiran siswa (Integritas/PPK) 3. Guru membimbing siswa berdoa untuk memulai pembelajaran dengan dipimpin oleh seorang siswa. (Religius/PPK) 1. Guru membimbing siswa untuk	1. Siswa menjawab salam serta menyampaikan kabarnya masing-masing (Comunication/Abad 21) 2. Siswa mengkomunikasikan kehadiran. (Integritas/PPK) 3. Ketua kelas memimpin siswa yang lain bersama guru berdoa untuk memulai pembelajaran. (Religius/PPK) 4. Siswa bersama guru menyanyikan	10 Menit

Panduan Praktikum Alat Optik Teleskop 6



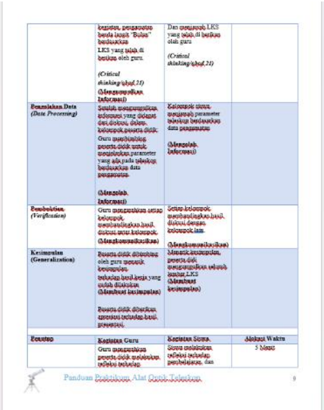
	menyanyikan lagu Nasional. (Nasionalis/ PPK)	lagu Nasional. (Nasionalis/ PPK)	
	5. Guru memotivasi siswa motivasi dan menjelaskan bahwa semangat dalam belajar itu penting dan tidak mengeluh itu adalah ungkapan rasa syukur kita kepada sang pencipta karena masih diberikan kesempatan untuk bisa tetap belajar untuk mewujudkan cita-cita bangsa. (Nasionalis/PPK) 6. Guru memberi instruksi kepada Siswa untuk menyiapkan alat-alat yang akan digunakan dalam mengikuti proses pembelajaran. (Kemandirian/PPK) 7. Guru bertanya kepada siswa terkait materi yang sudah dibahas pada pertemuan sebelumnya. (Communication/Abad21). 8. Guru menginformasikan kegiatan pembelajaran pada pertemuan ini adalah melakukan pengamatan dengan alat peraga Teleskop. (Communication/Abad 21).	5. Siswa menyimak motivasi dan penjelasan guru bahwa semangat dalam belajar itu penting dan tidak mengeluh itu adalah ungkapan rasa syukur kita kepada sang pencipta karena masih diberikan kesempatan untuk bisa tetap belajar untuk mewujudkan cita-cita bangsa. (Nasionalis/PPK) 6. Siswa menyiapkan alat- alat yang akan digunakan dalam mengikuti proses pembelajaran. (Kemandirian/PPK). 7. Siswa menjawab pertanyaan guru terkait materi yang sudah dibahas pada pertemuan sebelumnya. (Communication/Abad 21) 8. Siswa memperhatikan alat peraga teleskop yang di tunjukan oleh guru. (Communication/Abad 21)	

Panduan Praktikum Alat Optik Teleskop 7



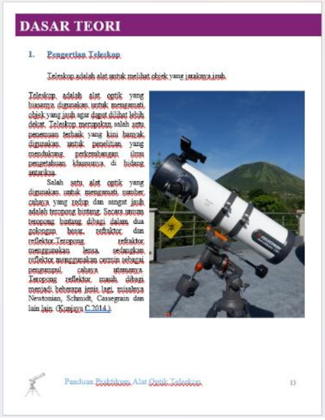
Kegiatan Inti			
Tahapan Pembelajaran	Kegiatan Guru	Kegiatan Siswa	Alokasi Waktu
Pemberian Rangsangan (Stimulation)	Guru menunjukan alat peraga Teleskop yang akan digunakan saat pengamatan Guru mengingatkan tentang keselamatan dalam bekerja Ketika menggunakan alat peraga Guru mengarahkan siswa merakit teleskop dengan melihat petunjuk, dan mengamati daerah langit mencari objek yang akan diamati. (Creatif/ Abad 21)	Siswa memperhatikan informasi yang diberikan oleh guru dan memahami alat peraga yang akan digunakan. (Creatif/ Abad 21)	65 Menit
Identifikasi Masalah (Problem Statement)	Guru menyampaikan pertanyaan kepada siswa berdasarkan pengalaman belajarnya, misalnya bagaimana bentuk muka bulan yang sebenarnya ? (Critical Thingking/Abad 21) Benda langit apa saja yang bisa diamati oleh teleskop ? (Critical Thingking/Abad 21)	Siswa memikirkan dan mencoba menjawab pertanyaan berdasarkan pengalamannya. (Critical Thingking/Abad 21)	
Pengumpulan Data (Data collection)	Guru memfasilitasi peserta didik untuk menemukan jawaban dengan : Secara berkelompok peserta didik melakukan	Siswa dengan berkelompok melakukan kegiatan pengamatan benda langit "Bulan" berdasarkan	

Panduan Praktikum Alat Optik Teleskop 8



	kegiatan pengamatan benda langit "Bulan" berdasarkan LKS yang telah di berikan oleh guru. (Critical thinking/abad 21) (Mengumpulkan Informasi)	Dan menjawab LKS yang telah di berikan oleh guru (Critical thinking/abad 21)	
Pengolahan Data (Data Processing)	Setelah mengumpulkan informasi yang didapat dari diskusi dalam kelompok peserta didik. Guru membimbing peserta didik untuk menjelaskan parameter yang ada pada teleskop berdasarkan data pengamatan. (Mengolah Informasi)	Kelompok siswa menjawab parameter teleskop berdasarkan data pengamatan (Mengolah Informasi)	
Pembuktian (Verification)	Guru mengarahkan setiap kelompok membandingkan hasil diskusi antar kelompok. (Mengkomunikasikan)	Setiap kelompok membandingkan hasil diskusi dengan kelompok lain. (Mengkomunikasikan)	
Kesimpulan (Generalization)	Peserta didik dibimbing oleh guru menarik kesimpulan terhadap hasil kerja yang sudah dilakukan (Membuat kesimpulan) Peserta didik diberikan apresiasi terhadap hasil presentasi.	Menarik kesimpulan, peserta didi mengumpulkan seluruh lembar LKS (Membuat kesimpulan)	
Penutup	Kegiatan Guru	Kegiatan Siswa	Alokasi Waktu
	Guru mengarahkan peserta didik melakukan refleksi terhadap	Siswa melakukan refleksi terhadap pembelajaran, dan	5 Menit

Panduan Praktikum Alat Optik Teleskop 9



DASAR TEORI

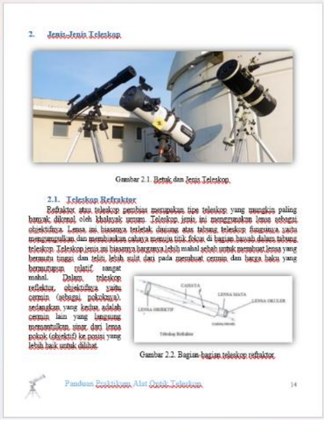
1. Pengertian Teleskop

Teleskop adalah alat untuk melihat objek yang jaraknya jauh.

Teleskop adalah alat optik yang biasanya digunakan untuk mengamati objek yang jauh agar dapat dilihat lebih dekat. Teleskop merupakan salah satu penemuan terbaik yang kini banyak digunakan untuk penelitian yang mendukung perkembangan ilmu pengetahuan khususnya di bidang antariksa.

Salah satu alat optik yang digunakan untuk mengamati sumber cahaya yang redup dan sangat jauh adalah teropong bintang. Secara umum teropong bintang dibagi dalam dua golongan besar, refraktor dan reflektor.Teropong refraktor menggunakan lensa, sedangkan reflektor menggunakan cermin sebagai pengumpul cahaya utamanya. Teropong reflektor masih dibagi menjadi beberapa jenis lagi, misalnya Newtonian, Schmidt, Cassegrain dan lain lain. (Kunjaya C.2014.)

Panduan Praktikum Alat Optik Teleskop 13



2. Jenis-Jenis Teleskop

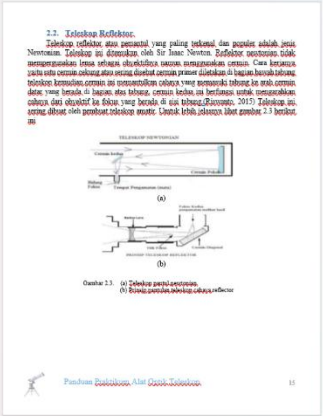
Gambar 2.1. Betuk dan Jenis Teleskop.

2.1. Teleskop Refraktor

Refraktor atau teleskop pembias merupakan tipe teleskop yang mungkin paling banyak dikenal oleh khalayak umum. Teleskop jenis ini menggunakan lensa sebagai objektifnya. Lensa ini biasanya terletak diujung atas tabung teleskop fungsinya yaitu mengumpulkan dan membiaskan cahaya menuju titik fokus di bagian bawah dalam tabung teleskop. Teleskop jenis ini biasanya harganya lebih mahal sebab untuk membuat lensa yang bermutu tinggi dan teliti lebih sulit dari pada membuat cermin dan harga baku yang bermutupun relatif sangat mahal. Dalam teleskop reflektor, objektifnya yaitu cermin (sebagai pokoknya), sedangkan yang kedua adalah cermin lain yang langsung memantulkan sinar dari lensa pokok (objektif) ke posisi yang lebih baik untuk dilihat.

Gambar 2.2. Bagian-bagian teleskop refraktor.

Panduan Praktikum Alat Optik Teleskop 14

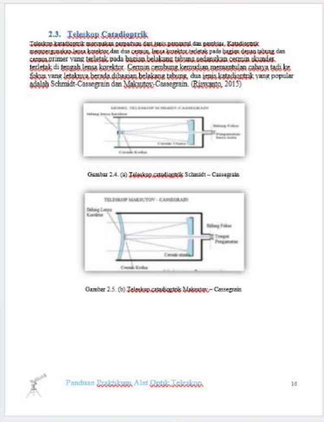


2.2. Teleskop Reflektor.

Teleskop reflektor atau pemantul yang paling terkenal dan populer adalah jenis Newtonian. Teleskop ini ditemukan oleh Sir Isaac Newton. Reflektor newtonian tidak mempergunakan lensa sebagai obyektifnya namun menggunakan cermin. Cara kerjanya yaitu satu cermin cekung atau sering disebut cermin primer diletakan di bagian bawah tabung teleskop kemudian cermin ini memantulkan cahaya yang memasuki tabung ke arah cermin datar yang berada di bagian atas tabung. cermin kedua ini berfungsi untuk mengarahkan cahaya dari obyektif ke fokus yang berada di sisi tabung.(Riswanto, 2015) Teleskop ini sering dibuat oleh pembuat teleskop amatir. Untuk lebih jelasnya lihat gambar 2.3 berikut ini

Gambar 2.3. (a) Teleskop pantul newtonian.
(b) Prinsip pantulan teleskop cahaya reflector

Panduan Praktikum Alat Optik Teleskop 15



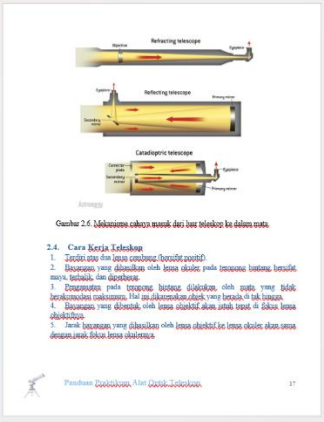
2.3. Teleskop Catadioptrik

Teleskop katadioptrik merupakan perpaduan dari jenis pemantul dan pembias. Katadioptrik mempergunakan lensa korektor dan dua cermin, lensa korektor terletak pada bagian depan tabung dan cermin primer yang terletak pada bagian belakang tabung sedangkan cermin skunder terletak di tengah lensa korektor. Cermin cembung kemudian memantulkan cahaya tadi ke fokus yang letaknya berada dibagian belakang tabung, dua jenis katadioptrik yang popular adalah Schmidt-Cassegrain dan Maksutov-Cassegrain. (Riswanto, 2015)

Gambar 2.4. (a) Teleskop catadioptrik Schmidt – Cassegrain

Gambar 2.5. (b) Teleskop catadioptrik Maksutov – Cassegrain

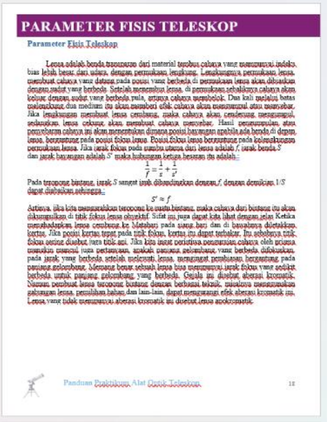
Panduan Praktikum Alat Optik Teleskop 16



Gambar 2.6. Mekanisme cahaya masuk dari luar teleskop ke dalam mata.

2.4. Cara Kerja Teleskop
1. Terdiri atas dua lensa cembung (bersifat positif).
2. Bayangan yang dihasilkan oleh lensa okuler pada teropong bintang bersifat maya, terbalik, dan diperbesar.
3. Pengamatan pada teropong bintang dilakukan oleh mata yang tidak berakomodasi maksimum. Hal ini dikarenakan objek yang berada di tak hingga.
4. Bayangan yang dibentuk oleh lensa objektif akan jatuh tepat di fokus lensa objektifnya.
5. Jarak bayangan yang dihasilkan oleh lensa objektif ke lensa okuler akan sama dengan jarak fokus lensa okulernya.

Panduan Praktikum Alat Optik Teleskop 17



PARAMETER FISIS TELESKOP

Parameter Fisis Teleskop

Lensa adalah benda transparan dari material tembus cahaya yang mempunyai indeks bias lebih besar dari udara, dengan permukaan lengkung. Lengkungnya permukaan lensa membuat cahaya yang datang pada posisi yang berbeda di permukaan lensa akan dibiaskan dengan sudut yang berbeda. Setelah menembus lensa, di permukaan sebaliknya cahaya akan keluar dengan sudut yang berbeda pula, artinya cahaya membelok. Dua kali melalui batas melengkung dua medium itu akan memberi efek cahaya akan mengumpul atau menyebar. Jika lengkungan membuat lensa cembung, maka cahaya akan cenderung mengumpul, sedangkan lensa cekung akan membuat cahaya menyebar. Hasil pengumpulan atau penyebaran cahaya ini akan menentukan dimana posisi bayangan apabila ada benda di depan lensa, bergantung pada posisi fokus lensa. Posisi fokus lensa bergantung pada kelengkungan permukaan lensa. Jika jarak fokus pada sumbu utama dari lensa adalah f, jarak benda S dan jarak bayangan adalah S' maka hubungan ketiga besaran itu adalah :

$$\frac{1}{f}=\frac{1}{s}+\frac{1}{s'}$$

Pada teropong bintang, jarak S sangat jauh dibandingkan dengan f, dengan demikian $1/S$ dapat diabaikan sehingga :

$$S' \approx f$$

Artinya, jika kita mengarahkan teropong ke suatu bintang, maka cahaya dari bintang itu akan dikumpulkan di titik fokus lensa obyektif. Sifat ini juga dapat kita lihat dengan jelas Ketika menghadapkan lensa cembung ke Matahari pada siang hari dan di bawahnya diletakkan kertas. Jika posisi kertas tepat pada titik fokus, kertas itu dapat terbakar. Itu sebabnya titik fokus sering disebut juga titik api. Jika kita ingat peristiwa penguraian cahaya oleh prisma mungkin muncul juga pertanyaan, apakah panjang gelombang yang berbeda difokuskan pada jarak yang berbeda setelah melewati lensa, mengingat pembiasan bergantung pada panjang gelombang. Memang benar sebuah lensa bisa mempunyai jarak fokus yang sedikit berbeda untuk panjang gelombang yang berbeda. Gejala ini disebut aberasi kromatik. Namun pembuat lensa teropong bintang dengan berbagai teknik, misalnya menggunakan gabungan lensa, pemilihan bahan dan lain-lain, dapat mengurangi efek aberasi kromatik ini. Lensa yang tidak mempunyai aberasi kromatik ini disebut lensa apokromatik.

Panduan Praktikum Alat Optik Teleskop 18

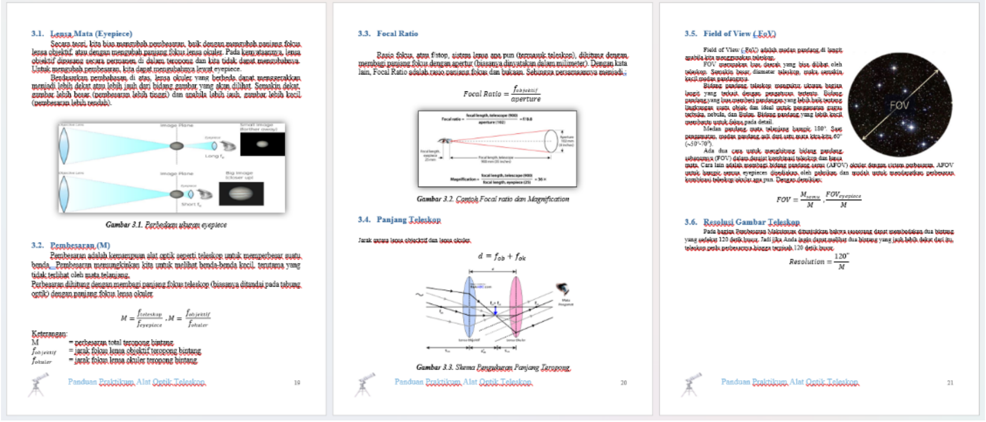


Figure 1. Display of Practicum Guide Media

The next hypothesis test using the SPSS version 26 application uses the Paired Sample t-Test analysis. The data analysis technique used is the t test technique. The t test is used to determine the difference in the mean of two related or paired samples (paired sample t-test). Through this test it can be seen the significance of the difference in the mean of the sample groups that are interconnected.

Hypothesis testing criteria:

If the value of Sig (Significance) <0.05 then reject H0 (accept H1)

If the value of Sig (Significance) > 0.05 then accept H0 (reject H1)

With

H0 = The average learning outcomes of students who are taught before using the Discovery Learning Model-Based Teaching Aids Guide on Optical Instrument Material (Telescopes) are smaller or equal to the average learning outcomes before learning.

H1 = The average learning outcomes of students who are taught after using the Discovery Learning Model-Based Teaching Aids Guide in Optical Instrument Material (Telescopes) are greater than the average learning outcomes before learning.

The results of the T-test analysis via the Paired Sample t-Test in class can be seen in the table below:

Table 4.9 Class t-test results

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Means	std. Deviation	std. Error Means	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Pretest Results - Posttest Results	-54.17857	9.65729	1.82506	-57.92328	-50.43387	-29,686	27	.000

Based on the test using SPSS version 26, the output of the Paired Samples Test is obtained, the discussion of Pair 2 is from the Sig. (2-tailed) of 0.000 <0.05) then H0 is rejected and H1 is accepted. So it can be concluded that using the Discovery Learning Model-Based Teaching Tool Guide on Optical Instrument Material (Telescopes) can improve student learning outcomes in class X SMA Lokon St. Nikolaus Tomohon.

In data collection conducted at SMA Lokon ST Nikolaus Tomohon, the average value of the pretest (20.78) and posttest (74.96)there is a significant difference. This shows that the average difference in the increase in pretest and posttest results in the class is 54.17 by using the productdevelopment and implementation of teaching aids based on discovery learning models on Optical Telescope MaterialsFurthermore, this study took data on student motivation with student response questionnaires which were distributed, then analyzed with a percentage of 92%.which refers to the percentage range table and Very Good criteria.

Conclusion

Based on the results of this study, it can be concluded:

1. The development and implementation of teaching aids based on the discovery learning model in the Optical Telescope Material are good and suitable for use in the learning process so that they can improve the learning outcomes of class X students at SMA Lokon St Nikolaus Tomohon.
2. The use of optical aids, especially telescopes, can increase student motivation in learning.

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