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Design of Physics Learning Media Using Mind Map-Based Cloud Persentation in Optical Instruments Material

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Abstract: Mind map provide a creative display of topic network under discussion in learning process. Therefore, the integration of mind map in learning media is an alternative way to increase student's interest. We designed mind map-based learning media to deliver optical instruments material and evaluate its properness in XI grade of SMA N 15 Padang. This is an R&D research using modified Brog and Gall development used a mixed method between qualitative and quantitative approach. Learning media was validated by material expert, media expert and a physics teacher. The validation results from three validators are obtained with an average of 88%, 93% and 88% which is categorized as very worthy and this media is feasible to be applied. Student responses on media assessment showed very agree with 46.63%, agreed with 41.6%, only 9.49% chose Less Agree and 2% chose Disagree. Students admitted that the mind map was interesting, easy to use, and helpful. Therefore, the mind map learning media in optical instrument is appropriate to apply in learning process.

Keywords: Cloud presentation; Learning media; Mind map; Optical instruments material

Introduction

The ability in the remembering information is important to construct better understanding from learning process. In the learning process, student have to understand, comprehend and save the information as a knowledge (Dewi & Indrawati, 2014). The information or the concept must be kept in mind until a certain time when it is needed like an exam or being a long-term memory. Therefore, remembering and saving information in a period of time is crucial to be maximized for student so it can become a knowledge (Heryani et al., 2021).

Supportive learning media greatly influences students to understand, retain, and remember the information during the learning process (Ediyani et al., 2020). It is very important to serve a learning media that facilitate the student to memorize and understand the materials (Widodo, 2018). Learning media is divided into 3 based on how it transfers information, which are audio, visual and audio-visual. The audio-visual presents a wide range of information that can be delivered in various way.

Multimedia presentation is one form of audio-visual media that widely used in learning process. It can display the animation, pictures or videos that help student understand the basic concept (Widhayanti & Abduh, 2021). However, so far, multimedia presentation has only been used as a medium to display materials. Therefore, the utilization of multimedia presentation has not been maximized, especially to improve students' ability to comprehend the concept.

Consequently, an innovation is needed in multimedia presentation to maximize its role and can boost student`s interest and ability to remember material (Nur et al., 2024; Pascaeka et al., 2023). One solution for this need is to combine multimedia with mind-map.

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Mind mapping model is the creative way of taking notes and was first developed by Tony Buzan, a psychologist from England (Alhusein et al., 2023; Davies, 2011). It helps students solve problems, brainstorm creative ideas, remember new vocabulary, take notes, enhance their reading skills, organize the tasks and prepare presentations (Buran & Filyukov, 2015). Mind mapping can be interpreted as a mapping process to connect problem concepts where branches of nerve cells form concept correlations to form understanding and the results are expressed in the form of animations that are liked and easy to understand by the creator (Buzan, 2012). So the results are an illustration of how the connections in the brain work (Aprinawati, 2018). If the model applies in the learning process, students should be able map it themselves everything about the material learning and it effect the student motivation (Gagić et al., 2019; Jones et al., 2012). With mind mapping, long lists of information can be converted into colorful diagrams, organized and easy to remember (Akanbi et al., 2021; Astra, 2023; Fadhilaturrahmi, 2017). Mind mapping improves the learning of key concept taught over a specified period (Gavens et al., 2020), improves critical thinking skills (Polat & Aydın, 2020), promote Higher Order Thinking abilities (Chang et al., 2016), wise to saving the information in their mind and recall when the information is needed (Shi et al., 2023). Mind maps are displayed main topics that positioned in center which then spread into smaller parts called branches and are decorated with keywords, images and colors. Traditionally, mind map is created on a paper using pen or coloring pencils. By the advanced technology, mind map can be designed digitally using computer software and can be attached into multimedia presentation. Mind map also suitable for various learning model (Muhali & Sukaisih, 2023) such as guided inquiry model (Alhaj, 2024), problem-based learning (Meidiana & Pertiwi, 2024).

The designed mind map is expected to facilitate the explanation of the topic being discussed. For example, by observing and clicking the keywords in mid map branches, the complete material related to the topic should be displayed clearly. Therefore, the use of software such as Microsoft Power Point is very supportive because it can be used to create mind map structural branches, as well as it has a link or hyperlink feature to jump to a particular slide. Furthermore, the use of online package of google workplace also can be used to create a flexible learning material (Hidayat et al., 2021; Khaeruddin et al., 2022; Ningrum & Jumadi, 2024).

In addition, one of the requirements of good learning media is that it can be shared and distributed effectively and efficiently. Media sharing through file transfer is not effective because there are some computers that are not compatible with the designed file. Furthermore, students generally use mobile phones which not all can open presentation files. Therefore, it is necessary for media to be always ready and can be accessed at any time. This can be done with the cloud presentation.

Optical instrument is important materials in physics subject in grade XI Senior High School. This material consists of applications of geometrical optics concepts implemented in technology and objects in daily life. Therefore, clear and sufficient media are needed to describe this material, especially in the part of light travel in the optical instrument. With the presence of mind map-based presentation media, students should learn this material optimally and understand the concept and application of the optical material.

Physics learning should be happy and enjoyable by using various learning material both in theory and experiment learning (Hidayat et al., 2023; Susanti et al., 2025). The assistance of mind map in physics material make student enjoy the learning process and easy to understand physics concept (Putri et al., 2024). Therefore, mapping teaching approach is a good solution in physics teaching (Onah et al., 2022).

Based on the background, we develop the interactive learning media using mind map-based cloud presentation in optical instrument materials.

Method

This is an R&D research using modified Brog and Gall development steps (Sugiyono, 2015). The development step uses the modified Borg and Gall step which explained in the following diagram.

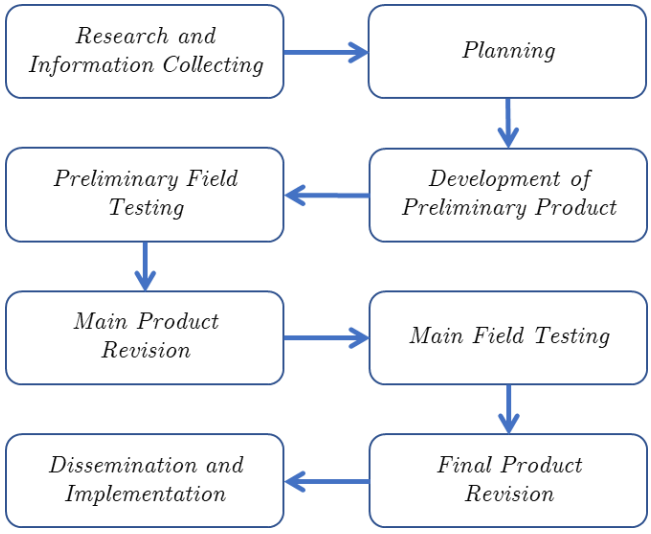


Figure 1. Product development steps

This research used a mixed method approach between qualitative and quantitative approach. Data collection was performed trough obtaining numerical information and text information that served final information both in quantitative and qualitative form (Emzir, 2015). The instruments used were check list questionnaires and interviews rubrics. Data analysis was carried out descriptively. The product development was limited into the revision stage after limited scale trials. The research took place in SMA N 15 Padang with the XI grade teacher and students are being the subject and object of the research.

The development step begins with a preliminary study by collecting information and problems occurring in the field by conducting interviews with physics teachers in class XI SMA N 15 Padang. Interviews were mainly focused on issues related to flexible learning media that can increase student mastery of optical instrument material. Next step, planning the solution of problem stated in previous step was conducted by collecting resource and reference from Physics textbook of Class XI SMA, Physics for Class XI SMK/MAK with Field of Expertise of Internet Technology and Engineering, internet-based figure and video relating to the optical instrument material.

The Third step is the prototype designing the preliminary product. The mind map-based presentation media is designed using Google Slide. Branches and topic were connected using feature served by Google Slide and collaborating it with pictures and videos. Learning media then was validated by experts in material and media field. Instrument used was questionnaire that encompassed the validation aspects that is assessed by means of rating scores that is assessed by score rating. The scores obtained were translated into qualitative criteria as presented in Table 1 (Sugiyono, 2015).

Table 1. Product assessment criteria

Score	Category
5	Very good
4	Good
3	Quite good
2	Less good
1	Very bad

The scores obtained by each aspect were then averaged to obtain the overall score and then converted into percentage by using the formula.

$$\% = \frac{\bar{x}}{X} \times 100\% \quad (1)$$

Where:
$\bar{x}$: average score
X: maximum score

The percentage signify the validation results that was subsequently interpreted into criteria based on Table 2.

Table 2. Interpretation of learning resource assessment scores (Akbar, 2013)

Range of Data (%)	Criteria
80–100	Very worthy
60–79	Worthy
40–59	Quite worthy
20–39	Not worthy
0–19	Very inadequate

The preliminary product that have been validated was improved by using suggestions from validators in main product revision stage.

The next stage was main product testing on teacher and student in class XI SMAN 15 Padang. Mind map-based learning media are presented to students as media during learning process. At the end of class, the students were provided with questionnaires to assess the media that just used. The questionnaire covers aspect of material, presentation, language and design which the assessment scale was also translated from qualitative assessment scale as presented in Table 1. The scores of each aspect were analyzed and translated into feasibility criteria as shown in Table 2.

Teacher and student questionnaires are analyzed to determine the practicality of the learning media and detect any deficiencies in the products.

Result and Discussion

Interviews conducted with XI grade teachers of SMA N 15 Padang resulted in a need for learning materials that could serve whole materials and could accommodate in the form of summaries and images. Furthermore, the media could be opened or studied later at home or outside the classroom. This need could be addressed by developing the mind map-based cloud presentations as learning material.

Figure 2. Initial display of learning media on Google Slides

The results of planning and designing the preliminary product are shown in Figure 2. The media was placed in google drive cloud storage and can be accessed via customized link https://bit.ly/mind-map-based-cloud-presentation-on-optical-instrument-material

The learning media was created in Google Slide presentation and it consists of 3 parts, which are the instructions section, the mind map section, and the material description. Figures 2, 3, and 4 show the media display for each part in Google Slides.

Figure 2 shows the initial display on Google Slides when students access the learning media via link. This section contains the instructions how to use the learning media and how to move to the mind map page, as well as how to see material explanations and to return into the home page. In summary, this page is a navigation page.

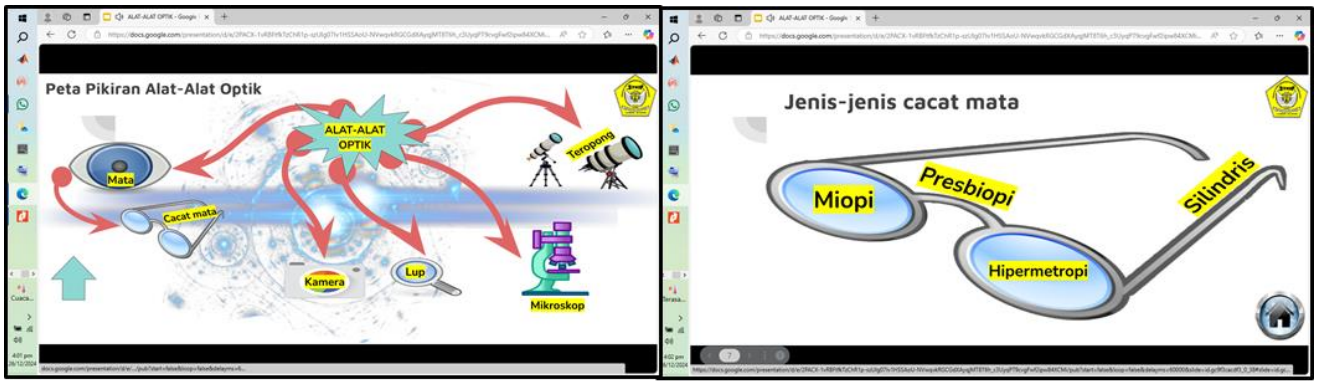


Figure 3. Mind map section of learning media on Google Slides a). Mind map of material, b). mind map of sub-material

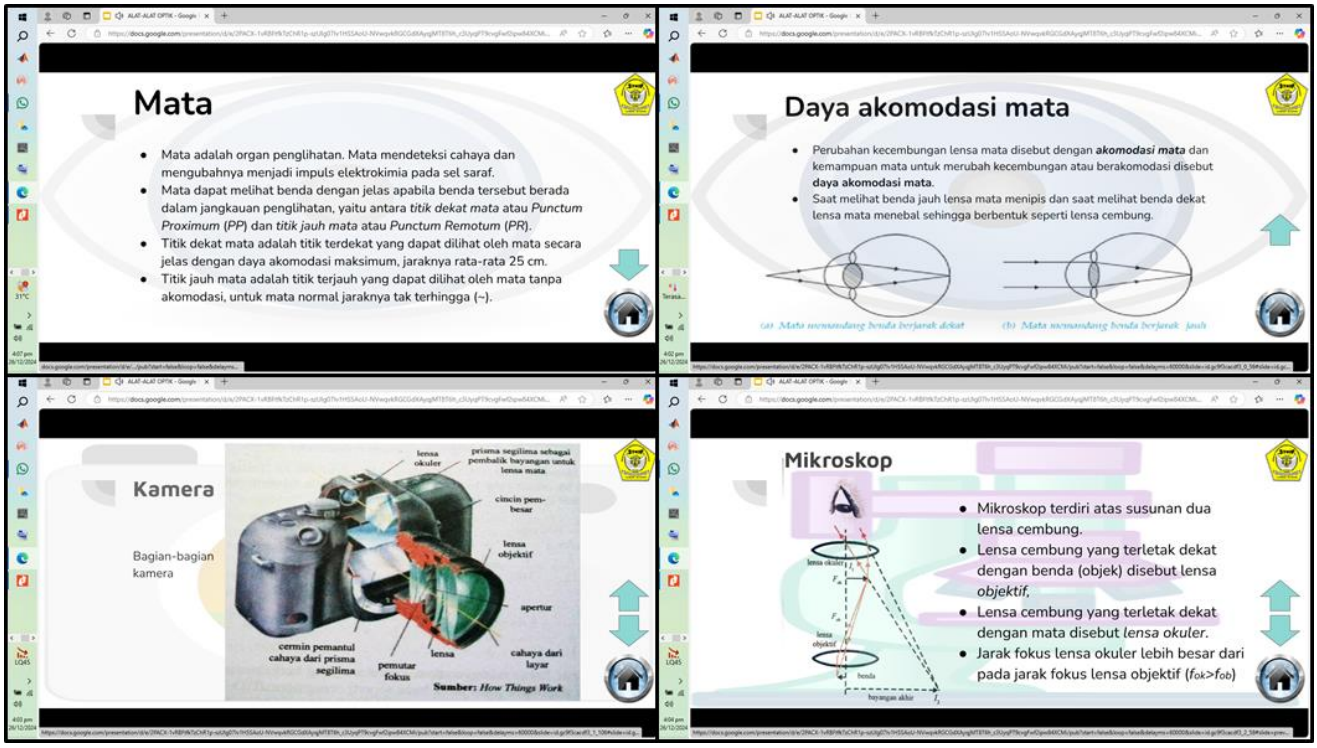


Figure 4. Learning material description of learning media on Google Slides

Figure 3 shows the mind map section that contains an outline of the material and sub-material composed of icons and captions which are eyes, binoculars, glasses, camera, microscope, magnifying glass, and telescope. Each icon can be clicked and will be connected to the material explanation slide as presented in Figure 4.

Table 3. Validation result from material expert

No	Assessment aspect	Score (%)	Criteria
1.1	Suitability of material with basic competencies	100	Very worthy
1.2	Suitability of material with learning indicators	100	Very worthy
1.3	Suitability of material with learning objective	100	Very worthy
1.4	Student interaction with media	80	Very worthy
1.5	Increment of student motivation	100	Very worthy
1.6	Materials update	100	Very worthy
1.7	Sufficiency of Vocabularies	80	Very worthy
1.8	Completeness of Vocabulary	80	Very worthy
1.9	Convenience in relating vocabulary	80	Very worthy
1.10	Depth of vocabulary	80	Very worthy
1.11	Easiness in understanding materials	80	Very worthy
1.12	The vocabularies are easy to understand	80	Very worthy
1.13	Clarity of learning instruction	100	Very worthy
1.14	Correctness of vocabulary	80	Very worthy
1.15	Efficiency of vocabulary	80	Very worthy
1.16	Feedback	80	Very worthy
Average		88	Very worthy

Table 3 shows the validation results of material experts from a lecturer. Overall, all aspects in the validation assessment obtained the score in range of 80 to 100% with an average of 88% which is categorized as very worthy. Of the 16 material validation criteria, there are 6 criteria that get the maximum value, which are number 1.1, 1.2, 1.3, 1.5, 1.6, and 1.13. Aspects no. 1.1 to 1.3 assessed the suitability between material in the media and the main points of learning standards, such as basic competency, learning indicators, and learning objectives. The values of these three aspects indicate that the material in this media is very feasible for learning equipment.

In addition, aspect number 1.5 also acquired maximum score which evaluated the role of media in the upgrading the student motivation in learning process. This is in accordance with the advantages of mind map that including images, colors and branches that make the material more interesting and can be understood comprehensively (Amin & Hina, 2018).

Validation result from media expert was presented in Table 4. In general, the media field obtained a higher average score than the other two validations with score of 93%. This score indicates the advantage of mind map-based presentation media because mind maps provide various graphics, pictures and diagrams. This combination resulted in better appearance of a learning media compared to full text learning sources and correlated to better understanding of material (Arsyad et al., 2024).

Table 4. Validation result from media expert

No	Assessment Aspect	Score (%)	Criteria
2.1	Ease for use	100	Very worthy
2.2	Interaction with users	60	Worthy
2.3	Language use	100	Very worthy
2.4	Color composition	100	Very worthy
2.5	Layout design	100	Very worthy
2.6	Image and animation quality	100	Very worthy
2.7	Text format	100	Very worthy
2.8	Mind map display	80	Very worthy
2.9	Backsound effect	80	Very worthy
2.10	Ease of navigation	100	Very worthy
2.11	Systematic presentation	100	Very worthy
The average score		93	Very worthy

Of the 11 aspects, there are 8 aspects that get the maximum score which are related to color composition, design, image and presentation. However, the aspect that assesses the display of the mind map itself still gets a score of 80%. This is because the creation of mind maps still uses features from Google Slides. More interesting results might be obtained by using a special application to create digital mid maps such as MindMup, Google Drawings, MidMeister or Mir.

Table 5. Validation result from physics teachers

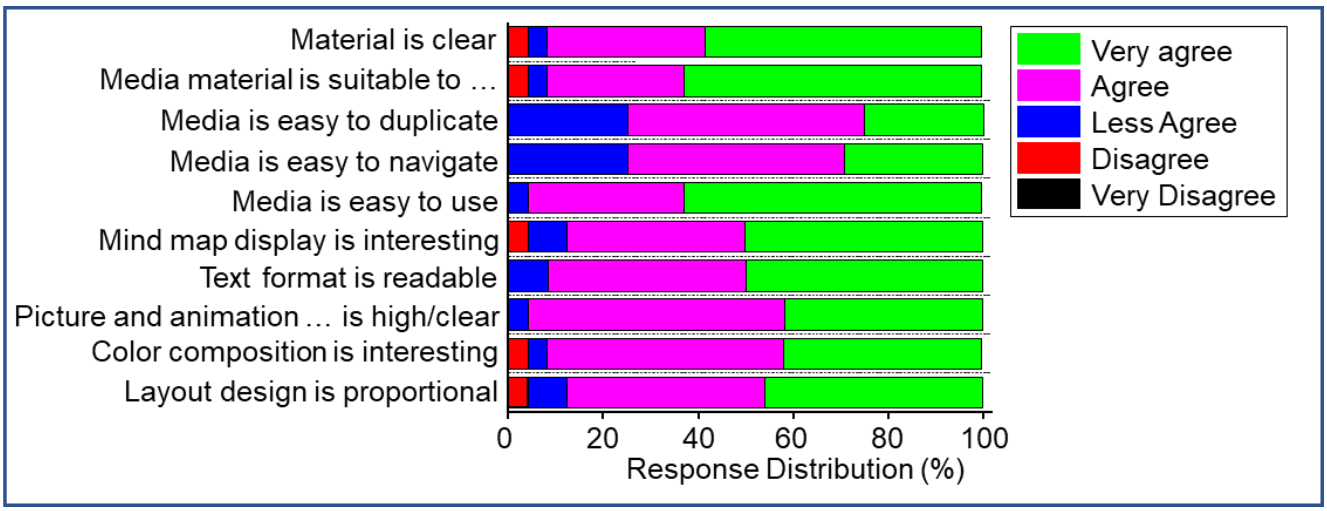
No	Assessment Aspect	Score (%)	criteria
3.1	Layout design	100	Very worthy
3.2	Color composition	100	Very worthy
3.3	Picture and animation quality	100	Very worthy
3.4	Text format	80	Very worthy
3.5	Mind map display	80	Very worthy
3.6	Ease for use	80	Very worthy
3.7	Easy for navigation	80	Very worthy
3.7	Easy of media duplication	80	Very worthy
3.9	Suitable of material	80	Very worthy
3.10	Clarity of material	80	Very worthy
3.11	The role of mind maps	80	Very worthy
3.12	Help learning process	100	Very worthy
3.13	Increasing student motivation	100	Very worthy
The average score		88	Very worthy

Unfortunately, there is one aspect that received a score of 60%, that is score number 2.2 which is related to interaction with users. So far, the media still has limitations in terms of interaction with users due to the limitation of software tools and devices. However, this aspect is still in the valid category because it can still provide interaction with the user.

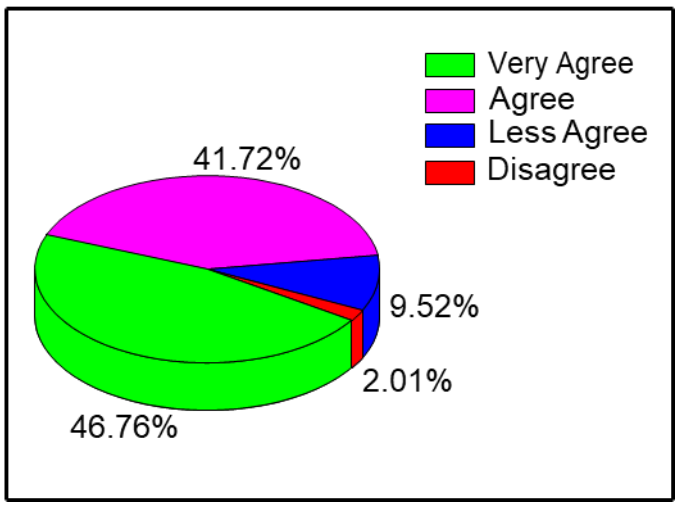
Product feasibility test by physics teachers achieved score of 88% as presented in Table 5. This score signifies the media is feasible to be applied. Of the 13 aspects, there are 5 aspects that get the maximum score, which

are scores number 3.1 to 3.3, 3.12 and 3.13. The aspects that get the maximum score are related to the media features in the design, color and animation sections. This is in accordance with the results obtained from media validation where this aspect also gets the maximum score. In addition, the ability of this media to help students in learning is also described in aspect 3.12. This is because the media can be accessed from anywhere using a web browser, either from a cellphone or a laptop. Thus, students can access it both when in the classroom and while do the homework at home. The ability of this media to increase motivation is also confirmed by the validation results by this physics teacher. Students' motivation will increase with the presence of colors, images and comprehensive materials. And this is what is presented in the mind map.

The learning media was tested on class XI MIA 4 students at SMA Negeri 15 Padang and the result was presented in two form. Firstly, student's response distribution as presented in the Figure 5 and student response in score as presented in Table 6.



(a)



(b)

Figure 5. Student response distribution about mind map-based cloud presentation media

Figure 5 (a) shows the distribution of student responses to mind map-based cloud presentation media for each aspect. Based on the picture, of 10 assessment aspects, students chose the options ranging from disagree to very agree on 5 aspects, and the rest gave answers ranging from less agree to very agree. Meanwhile, there is no student chose very disagree. Figure 5 (b) shows distribution of average percentage of student responses on media assessment. Students chose strongly agree had the largest portion with 46.63%. at the second place, the percentage of those who agreed was 41.6 and only 9.49% chose less agree and 2% chose disagree.

The score of student response for each aspect was then presented in Table 6. Overall, student responses to mind map-based learning media shows an average score of 87%. This score indicates that the learning media is in very worthy category. This finding had correlation with the work that have done by Balım (2013) who stated that learning media using concept maps was useful and engaging. This happens because the learning media is interesting in a mind map model design. Students involve more than one sense so that the information conveyed is more concrete. The mind map model helps students recall the material they have studied. This is in line with Amin & Hina (2018) statement that students believe that the mind mapping technique helps them in improving the understanding level, academic efficiency and memory, in summarizing information and organizing notes.

An aspect gained the highest score is number 4.2 relating to the ease of media usage with percentage of 92%. This is because utilization of the media only require device such as computer or smartphone. At the second rank, the aspect stating the suitability of material with the learning objective with percentage score of 90%. This is in accordance with the validation results that done by the experts.

Table 6. Student responses to mind map-based learning media

No	Assessment Aspect	Score (%)
4.1	Layout design is proportional	86
4.2	Color composition is interesting	86
4.3	Picture and animation quality are high/clear	88
4.4	Text format is readable	88
4.5	Mind map display is interesting	87
4.6	Media is easy to use	92
4.7	Media is easy to navigate	81
4.8	Media is easy to duplicate	80
4.9	Media material is suitable to learning objectives	90
4.10	Material is clear	89
Average score		87

The aspect number 4.10 assess the clarity of material obtained score of 89%. This score depicts the ease of material to be remembered. Mind maps played the role in presenting the material in clear and complete form, leading to ease of student to mastery the concept (Aprinawati, 2018). Mind map helps student in compiling their own concept connection in a short time. Therefore, it can be concluded that the use of mind maps in physics learning can improve student learning outcomes (Yusniza et al., 2023). In comparison, the type of mind map that has the greatest influence is the type of tree roots. In other words, tree root-type mind maps can present physics material that is more easily understood by students (Astra, 2023). It was recommended that physics teachers should incorporate mind mapping teaching approach in teaching (Onah et al., 2022).

The aspect of layout design, color composition, picture and animation quality can attract students so they are motivated to discuss in more dept about the material which is proven by student response in these three aspects. This is the same as what was reported by Gagić et al. (2019) that the implementation of mind maps in teaching physics in primary schools can increase students' motivation for learning physics and lower their mental effort. Some research also reported that combining mind map in learning model like guided discovery and problem based learning (PBL) enhance the student motivation and student learning outcomes in physics (Lestari et al., 2017), even more can improve the critical thinking skills and problem-solving skills (Novita et al., 2018). The aspect with the lowest point is easy to navigate and duplicate with the point are 81% and 80% this is because students still need adaptation. However, the student response over all shows that the media is very worthy to apply in learning process.

Conclusion

Development of mind map based-cloud presentation as learning media has been performed. The media developed from the need of effective learning material that serve whole materials and could accommodate in the form of summaries and images. Furthermore, the media could be opened or studied later at home or outside the classroom. Assessment by three validators resulted the score 88, 93, and 88% that signify the media developed has very worthy criteria. Furthermore, assessment conducted by students of XI grade of SMA N 15 Padang gave the report of student`s response distribution of very agree with 46.63%, agreed with 41.6%, only 9.49% chose less agree and 2% chose disagree. Overall, students gave the average score for all criteria of 87% which resulted in very worthy category. Based on several assessment steps above, it can be concluded that the media is suitable to be applied in learning process.

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Authors Contribution

All authors in this article contributed to the process of completing the research. L. collecting initial research data, processing data, and writing draft of article. E.S. directing research flow, validating data collection instruments, methodology, and reviewing article. N.E. and R.F. directing

research flow, methodology, reviewing article. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest
The authors declare no conflict of interest.

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