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Requirements Analysis of Media Development Interactive Multimedia-Based Learning on Three Dimensional Geometry Materials

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Abstract: Three-dimensional geometry is one of the branches of Mathematics that is considered difficult by students. This is indicated by the low score of the National Examination achieved compared to other Mathematics materials, one of the causes of the difficulty is the problem of visualizing the materials in three-dimensional geometry. This study aims to analyze the need for the development of interactive multimedia-based learning media combined with mind mapping learning methods on three-dimensional geometry material. The research method was conducted in the form of distributing questionnaires to 28 teachers and 101 students. Based on the results of the questionnaire conducted for teachers, data obtained as much as 89.29% had difficulty in conveying three-dimensional geometry material, which is caused by the difficulty of students in imagining the material without using visual aids (33.93%). In the learning process 92.86% only use the blackboard as a learning medium. Teachers agree 100% interactive multimedia tools will help visualize three-dimensional geometry material. Students also view that even this material is difficult by 77%, the biggest cause is that it is difficult to imagine (visualize) by 39.42%. Based on the results of the questionnaire, it was also found that 65.35% of students had used multimedia-based aids, 75.24% of students were interested (if any) using multimedia-based teaching tools related to three-dimensional geometry, 63.37% of students thought it could increase motivation and 68.32% will improve learning outcomes.

Keywords: Three dimensional geometry, Mind mapping, Interactive multimedia.

Preliminary

Background

Geometry is one of the important branches of mathematics to be mastered well by students, considering that this subject always appears at every level of education. At the elementary school (SD) level, students are introduced to flat shapes and spatial shapes. At the Junior High School (SMP) level, students learn flat shapes, space shapes, angles, and use them to solve problems. At the high school level (SMA) distances and angles are studied in spatial shapes. Although it appears at every level of education, it turns out that geometry is a subject that is considered quite difficult by students, this is indicated by the low score of the National Examination achieved,

Based on Table 1, it is clear that the percentage of mastery of UN questions for geometry is the lowest compared to other materials. This shows that geometry is a difficult subject. For the high school level, geometry material is known as three-dimensional geometry.

In the mathematical encyclopedia as St. Notonegoro, "Building space is called a three-dimensional wake, because it contains three elements, namely length, width, and height. Another page in this encyclopedia says that if a figure does not lie entirely in the plane, then the shape is called a spatial figure.

Objects in three-dimensional geometry are thought objects that are abstract in nature (Djoko, 2001). These objects, namely points, lines, planes of blocks, cubes, spheres and so on are thought objects obtained through the process of abstraction and idealization of concrete or real objects in everyday life.

Table 1. Percentage of Mastery of Mathematics National Examination Questions for SMAN 1 Prambanan Sleman Students from 2013 to 2014

No	Materi	2013	2014
1	Logika Matematika	59,21	64,64
2	Statistika Peluang	49,21	53,90
3	Eksponen, barisan, dan deret fungsi	68,86	55,28
4	Lingkaran, suku banyak, dan komposisi fungsi	65,13	40,85
5	Matriks, vektor, dan transformasi	63,95	48,78
6	Persamaan dan pertidaksamaan	64,48	60,57
7	Geometri	38,82	35,98
8	Trigonometri	50,44	46,34
9	Kalkulus	55,92	44,98

The learning process in three-dimensional geometry begins with three-dimensional real objects, then these objects are realized in the form of images (two-dimensional) that look like wakes. For example, to introduce the shape of blocks to students, starting with real objects in everyday life that resemble blocks like bricks, then in learning three-dimensional geometry these real objects are made into a model or in the form of props and realized in image form. The image here is an image on a flat plane (paper, blackboard), so that the block image which is a three-dimensional shape looks like a two-dimensional shape.

Based on this, it can be seen that the difficulty of three-dimensional geometry material is seen. This is because students are not only required to be able to understand the concept but also must be able to visualize the shapes that exist in three-dimensional form which are manifested in images in a field. The learning process in schools in general only relies on learning aids in the form of whiteboards, markers, and teaching aids in the form of frameworks from three-dimensional geometric shapes so that students have not been optimally assisted in the visualization process.

To overcome this, both teachers and students need the innovation of learning media. The learning media innovation is used to improve the quality of learning. One of the technological products that can be used as an innovation in learning is interactive multimedia.

Destination

The purpose of this study is to analyze the need for the development of interactive multimedia-based learning media that is integrated with mind mapping learning methods on three-dimensional geometry material.

Theory Review

Three Dimensional Geometry

Geometry is a branch of mathematics that studies points, lines, planes and space objects and their properties, sizes and their relationship to one another. So, geometry can be seen as knowledge that learns about space, this material is studied by class X High School / Madrasah Aliyah students, including:

1) Position of Point Against Line
   a. Point A lies on line g, if the point A is passed by line g.
   b. Point A does not lie on line g, if the point is not crossed by line g.

2) Position of Point Against Field
   a. Point Located on the Field
      Point A lies on the plane if it can be passed by the plane
   b. Out of Field Point

Point A does not lie in the plane if the point is not traversed by the plane

3) Position of a Line Against Other Lines
   a. Two Intersecting Lines
   The lines g and h are said to intersect if the two lines lie in the same plane and have a common point.
   b. Two Parallel Lines
   The lines g and h are said to be parallel if they lie in the same plane and have no common points.

   c. Two Crossing Lines
   The lines g and h are said to cross if they do not lie in the same plane.

4) Position of Line Against Field
   a. Lines Located in the Field
   The line g is said to lie in the plane g and the plane has at least two common points.
   b. Parallel Lines
   The line g is said to be parallel to the plane, if the line g and the plane have no common points.
   c. Line Intersects or Crosses Field
   A line g is said to intersect (through the plane), if the line g and the plane have a common point.

5) Position of the Field Against Other Fields
   a. Two Fields Close
   If every point that lies in the plane also lies in the plane (or vice versa) then the plane and plane are said to coincide.
   b. Two Parallel Planes
   The planes are said to be parallel if the two planes do not have a common point.
   c. Two Intersecting Fields
   The plane and plane are said to intersect if the two planes have exactly a common line.

6) Point to Point Distance

The distance between point A and point B is determined by the length of the line segment connecting the two points, the distance between points A and B in Figure 1 is AB.

Image 1. Distance from Point A to Point B

7) Point to Line Distance

For a point that is outside the line, then there is a distance between the point to the line. The distance from point A to line g (point A is outside line g) is the length of the line segment connecting point Ato the line with the projection of point A on the line gIn the figure below the distance is the length AB

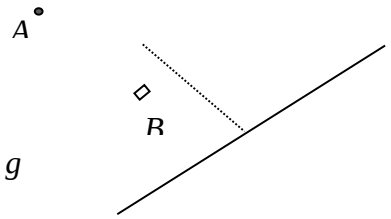


Figure 2. Distance from Point A to Line g

8) Point to Field Distance

For a point that is outside the plane, then there is a distance between the points to the plane. The distance of point A to the plane (point A is outside the plane) is the length of the line segment connecting point A with the projection of point A on the plane. In the figure below the distance from point A to the plane is AB

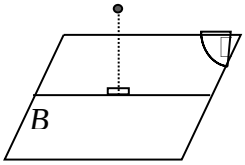


Figure 3. Distance of Point A to Plane

9) Distance of Two Parallel Lines

The distance between the line g and the parallel line h is the length of the connecting line segment that intersects the line perpendicular to line g and line h. AB is the length of the parallel line g and h

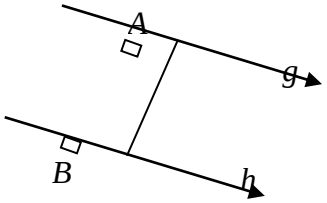


Figure 4. The Distance between the Plane of the Line g and h

10) Distance of Two Crossing Lines

The distance between the line g and the line h that intersect is the length of the connecting line segment that intersects the line perpendicular to line g and line h. The distance between the lines g and h in the figure below is AB.

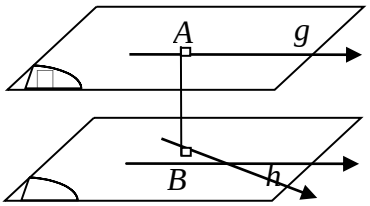


Figure 5. The Distance between the Lines g and h

11) Distance of Two Parallel Planes

The distance between the plane and the parallel plane is equal to the distance of one point on the plane to the plane, or vice versa. Suppose the point on the plane is then, then the distance between the planes and is AB

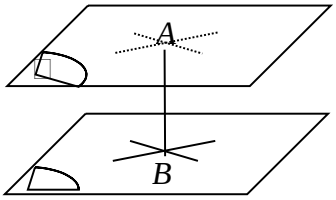


Figure 6. The Distance Between the and Planes

12) Indoor corner

The angles that occur in three-dimensional geometry are angles that occur because of the relationship between lines and planes in three-dimensional geometry. The angles are as follows.

13) The angle between two intersecting straight lines.

The angle between two intersecting lines is the acute or right angle formed by the two intersecting lines. The lines g and h in Figure 7 intersect at point A, the angle formed between the lines g and h is angle.

Figure 7. The Angle between Two Intersecting Lines

14) The angle between two intersecting lines.
The angle between two intersecting lines is an acute angle or a right angle formed by the two intersecting (not parallel) lines. If a and b intersect two lines, then the measure of the angle between the two lines is equal to the measure of the angle between a' which is parallel to b and parallel to a, and b, or vice versa, between b' which is parallel to a and parallel to b, and a.

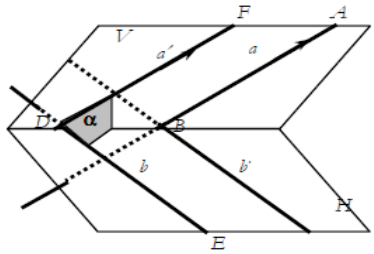


Figure 8. The Angle between the Intersecting Lines

15) Angle between line and plane
The angle between line g and plane H is the acute angle formed by line g with its projection on plane H (line g').

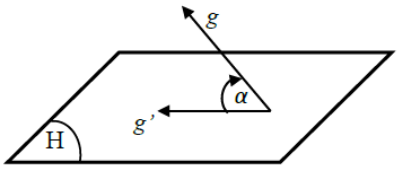


Figure 9. Angle between Line and Plane

In Figure 9, it can be seen that the g line intersects the H plane, and the g' line is the projection of the g line on the H plane. The angle formed between the H plane and the g line is the angle.

16) Angle Between Two Intersecting Planes
The angle between two intersecting planes is the angle formed by two intersecting lines (a line in the first plane and a line in the second plane), those lines are perpendicular to the intersection line between the two planes.

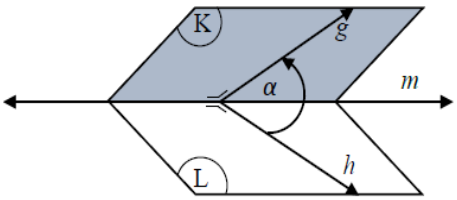
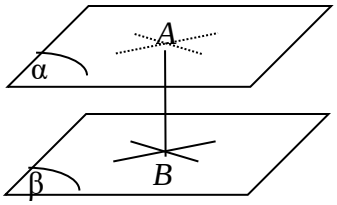


Figure 10. Angle between Two Planes

In Figure 10, it can be seen that the K and L planes intersect at m, the angle formed from the intersecting K and L planes is the angle,



Mind Map

It has been discussed previously, that one of the difficulty factors in this three-dimensional geometry material is the problem of visualization, one of the learning methods that can overcome this is the mind mapping learning method. Mind mapping was first developed by Tony Buzan in 1970, a psychologist from England. Mind mapping is a learning method by applying a sequential way of thinking about a problem, how it can occur until it is solved.

Teaching through mind mapping is presented in the form of a scheme that has a causal and mutually influential relationship.

Mind Mapping is a creative thinking tool that reflects the natural workings of the brain. Mind Mapping allows the brain to use all the images and their associations in a radial and networked pattern as the brain was designed.

Some of the important things in making a mind map are below, namely:

1) Make sure the main theme is in the middle.
2) From the main theme, there will be derivative themes that are still related to the main theme.
3) Look for relationships between each theme and mark them with lines, colors or symbols.
4) Use uppercase.
5) Create a mind map on plain paper and eliminate the editing process.
6) Leave room for additional themes.

In practice, the learning process in the classroom using mind maps as described above, the teacher usually uses colorful markers to further clarify and reinforce the points to be conveyed, with more advanced technology, the preparation of mind mapping related to dimensional geometry material three can be made using computer programs and the learning process to make it more interesting can be presented using interactive multimedia.

Learning Using Multimedia.

Etymologically, multimedia comes from the word multi (Latin) which means many, various, and medium (Latin) which means something that is used to convey or carry something. Meanwhile, according to Wikipedia, Multimedia is the use of computers to present and combine text, sound, images, animation and video with tools and connections so that users can navigate, interact, create and communicate.

The development of multimedia technology has promised great potential in the way a person learns, obtains information, adapts information and so on. Multimedia also provides opportunities for educators to develop learning techniques so as to produce maximum results and the learning process becomes more interesting and fun.

Computer-based learning programs in which there is a harmonious blend of visual (image), audio (sound) and text (writing) are called learning multimedia. When users get the flexibility to control, then this is called interactive multimedia. Visuals or images can be actual images such as photos of real objects and films/videos. Visuals can also be in the form of animations, graphics, charts and other illustrations. While audio is sound. Sounds can be people's voices, animal sounds, wind sounds, water sounds, thunder sounds and other natural sounds.

Both visual and sound function to clarify and reinforce the description of the material, so that the description of the learning material becomes easier to understand, easier, easier to remember and more interesting for students. While the text is in the form of writing whose function is to further clarify and reinforce the description of the

material presented through visuals and sound. In addition to clarifying and reinforcing the text, it also serves to help students' memory in remembering learning materials, both currently and what they have learned.

Three-dimensional geometry material which if taught conventionally is difficult for both teachers and students, by being displayed in the form of interactive multimedia will certainly be more interesting for both the teacher who will deliver the material, and for students who will receive the material.

Research Methodology

To find out the level of needs of students, related to the development of interactive multimedia-based learning media on three-dimensional geometry material, it is carried out through a survey method to respondents who are set as samples in the form of giving questionnaires.

There are two types of respondents, namely teachers (high school mathematics teachers under the guidance of Bintang Pelajar) totaling 28 teachers who teach mathematics for the Bogor, Jakarta, and Bekasi areas. SMA/MA students (MA students at Darul Muttaqien Islamic Boarding School, Parung Bogor) totaling 101 students. Each teacher is given 5 questions and 9 questions for students.

Research Result

The data generated in this study is in the form of quantitative data, based on the data obtained it will be described whether the development of interactive multimedia-based learning media on three-dimensional geometry material is needed and proceed to the next stage in the development process.

Questionnaire Survey Results for Teachers

From the same 5 questions posed to each teacher, the following data were obtained.

Table 2. Questions 1 and 2 of the Questionnaire

1. Pernahkah Bapak/Ibu mengajar materi Dimensi Tiga ?	
Pernah	92, 85%
Belum Pernah	7, 14%
2. Apakah Bapak/Ibu guru memiliki kesulitan untuk mengajarkan materi geometri dimensi tiga ke siswa ?	
Ya	89, 29%
Tidak	10, 71%

Table 2 shows that 92.85% of teachers have taught three-dimensional geometry and 89.29% stated that they have difficulty in teaching three-dimensional geometry.

Table 3. Question 3 of the Questionnaire

3. Jika merasa sulit, apakah penyebab dari kesulitan tersebut?	
Siswa Tidak memahami materi yang disampaikan	22, 50%
Siswa sulit membayangkan tanpa alat peraga	33, 93%
Media pembelajaranya hanya menggunakan whiteboard dan spidol	25, 36%
Siswa merasa sulit dalam perhitungan matematikanya	18, 21%

Table 3 shows that the difficulty in the learning process of three-dimensional geometry is more due to the difficulty of students in imagining without teaching aids and learning that only uses learning media in the form of whiteboards and markers which are 33.93% and 25.36% respectively compared to those without. Understanding the material presented (22.50%) and difficulties in the calculation process (18.21%) this shows that in managing the learning process of three-dimensional geometry requires tools to eliminate these difficulties.

Table 4. Questions 4 - 5 of the Questionnaire

4. Media ajar apa saja yang telah Bapak/Ibu gunakan ketika mengajar materi Dimensi Tiga?	
Hanya whiteboard (papan tulis) dan spidol aja	92,86 %
Sudah menggunakan alat peraga	7,14 %
Menggunakan bantuan alat multimedia seperti laptop dan lainya.	0 %
5. Jika ada terdapat alat bantu pembelajaran yang dapat memvisualisasikan materi-materi dalam dimensi tiga dalam bentuk multimedia apakah hal dapat membantu Bapak/Ibu dalam mengajar materi geometri dimensi tiga.?	
Sangat membantu	75 %
Membantu	25 %
Kurang membantu	0 %
Tidak membantu	0 %

Table 4 shows the largest percentage of learning media used in the learning process for three-dimensional geometry material is a whiteboard (whiteboard) of 92.86%. Based on Table 4, it can also be seen that 100% of teachers (75% very helpful and 25% helpful) stated that the learning activity aids in the form of multimedia that can visualize three-dimensional geometry material can help the learning process for the material.

Questionnaire Survey Results for Students

From the same 9 questions that were posed to each student in the form of a questionnaire to 101 grade 12 students of SMA/MA students (MA students of Darul Muttaqien Islamic Boarding School, Parung Bogor), the following data were obtained.

Table 5. Questions 1-3 of the Questionnaire

1. Apakah anda pernah mempelajari materi geometri dimensi tiga di sekolah?	
Belum	2,97%
Sudah	97,03%
2. Bagaimana cara anda mempelajari materi geometri dimensi tiga?	
Diajarkan seseorang (guru, teman, kursus, dll)	65,77%
Melalui buku	27,52%
Belajar sendiri menggunakan media lain (internet, perangkat ajar, dll)	6,71%
3. Apakah Anda merasa kesulitan dalam mempelajari dan memahami Dimensi Tiga?	
Selalu (76 – 100%)	27,00%
Kadang-kadang (51 – 75%)	52,00%
Jarang (26 – 50%)	19,00%
Tidak pernah (0 – 25%)	2,00%

Table 5 shows that almost all students have studied three-dimensional geometry (97.03%), they learned it through teachers and books by 65.77% and 22.52%, respectively. However, there are 6.71% of students learn it

by using other media. Judging from the level of difficulty in learning the material, 79% stated that they sometimes and always encounter difficulties related to the material.

Table 6. Questions 4 - 6 of the Questionnaire

4. Apakah penyebab Anda sulit mempelajari dan materi Dimensi tiga?	
Sulit membayangkan	39,42%
Kurangnya latihan soal	38,69%
Pembahasan materi di buku kurang lengkap	10,22%
Merasa materi tersebut tidak menarik karena membosankan Lainnya, sebutkan bila ada.	11,68%
5. Perangkat ajar adalah alat bantu pembelajaran, biasanya berupa software berbasis multimedia yang di dalamnya terdapat unsur teks, gambar, video, suara, dan animasi, sehingga pelajar dapat berinteraksi dalam proses belajar. Apakah Anda sudah pernah menggunakan perangkat ajar sebelumnya?	
Pernah	65,35%
Belum	34,65%
6. Apabila ada perangkat ajar berbasis Multimedia mengenai. Dimensi Tiga apakah Anda tertarik belajar menggunakan perangkat ajar tersebut?	
Sangat tertarik	38,61%
Tertarik	37,62%
Kurang tertarik	14,85%
Tidak tertarik	8,91%

The biggest factor that makes the material difficult is that it is difficult to imagine three-dimensional geometry material by 39.42%, after that due to lack of practice questions by 38.69%. Knowledge of learning aids in the form of multimedia-based software from students is quite good where 63.35% of students have used it. If there is a multimedia-based teaching device related to this three-dimensional geometry material, 75.24% are interested in learning to use it (a combination of interested and very interested).

Table 7. Questions 7-9 of the Questionnaire

7. Menurut Anda, apakah efektif, belajar materi Dimensi Tiga melalui media perangkat ajar?	
Sangat efektif	17,00%
Efektif	48,00%
Kurang efektif	27,00%
Tidak efektif	8,00%
8. Apakah dengan adanya perangkat ajar tersebut, dapat memotivasi minat Anda dalam belajar?	
Sangat termotivasi	13,86%
Termotivasi	49,50%
Kurang termotivasi	30,69%
Tidak termotivasi	5,94%
9. Apakah dengan adanya perangkat ajar tersebut, dapat meningkatkan hasil dalam belajar khususnya buat materi Geometri Dimensi Tiga?	
Sangat meningktkan	14,85%
Meningkatkan	53,47%
Kurang meningkatkan	23,76%
Tidak meningktkan	7,92%

Table 7 shows that 65% of students stated that they were effective in learning three-dimensional geometry through teaching media (a combination of very effective and effective). As many as 63.37% of students view

that the use of teaching tools can motivate students' interest in learning (a combination of highly motivated and motivated). As many as 68.32% of students stated that the use of these teaching tools would improve student learning outcomes related to three-dimensional geometry.

Conclusions and Suggestions

Conclusion

Based on the results of the study, it can be seen that teachers and students both view that three-dimensional geometry is one of the most difficult materials in Mathematics, where based on the results of the questionnaire, 89.29% of teachers stated that they had difficulties in teaching the material and 79% of students stated that they sometimes and always encounter difficulties related to the material. The biggest difficulty that arises from teachers and students lies in the problem of visualizing three-dimensional geometric shapes. Teachers and students both agree that the creation of interactive multimedia-based learning media will help the problem of difficulties in teaching and learning three-dimensional geometry material.

Suggestion

This research can be further developed by making interactive multimedia-based learning media devices combined with mind mapping learning methods on three-dimensional geometry materials, trying these devices on students and related parties until finished products are produced that can be used in the learning process of dimensional geometry materials.

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