Mixed Reality Application as a Learning System of Motion Systems using Pyramid Hologram Technology.

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Abstract. The purpose of this study was to develop Biology learning media with Mixed Reality applications using Pyramid Holograms. This research is a qualitative descriptive study. The research was conducted in two stages, namely the problem identification stage and the development stage. The problem identification stage is done by questionnaire and student test results and the development stage by designing Mixed Reality media. The results of the study were in the form of motion system material media with Pyramid Hologram technology that can be used in the learning process.

1. Introduction
Learning in schools applies the pattern of technological integrity as a form of disruptive technology resulting from the industrial revolution 4.0. The function of learning technology is to facilitate the learning of biology, so as to minimize misunderstanding on students' articulation and visuals. Information technology can be applied to the curriculum in Indonesia, especially in the 2013 curriculum. The application of information technology has a significant effect on the science, technology, engineering and mathematics (STEM) approach [1].

The use of learning technology changes the conventional pattern of Teacher Center Learning (TCL), students only listen to the delivery of material by the teacher and are not delivered contextually such as visual reality or semi-real. Non-contextual learning can make students' mindset abstract without any visual proof or form of word articulation. Michael et al. [2] proved that students generally have difficulty in studying the anatomy of the human body such as visualizing anatomy of the body from 2 dimensions (2D) to 3 dimensions (3D).

The results of student responses show that the most difficult material for students in science material is the Motion System. This is supported by several studies showing that the material of the motion system including the material category is quite difficult. One of the material difficulties is thought to be caused by learning strategies that are less attractive [1], unable to visually explain the types of joints and muscles, and movements in animals [3], bone shape, and the relationship between bones and muscles [4].

Problems faced by students in the motion system material that is not being able to remember or visualize the components of the motion apparatus in humans or animals and plants so that technology is needed that can make 2D objects into 3D and audio visual in the delivery of the material presented. One such innovation technology is Mixed Reality using Pyramid Hologram. Mixed Reality is a
technology that combines the real world and virtual world into a space so as to form a mixed reality or Hologram [5]. Based on the problems that have been studied, Mixed Reality media design is carried out using Pyramid Hologram in explaining the subject matter of the learning system of science in junior high school especially grade VIII.

2. Methodology
The study consisted of two stages: the first stage was identifying problems and collecting data with a closed questionnaire to find out the material difficulties faced by students on Biology material and observations on learning technology, students' impressions of the learning media used. The data obtained came from four junior high schools in Pekanbaru based on national examination results using a median so that schools were selected at intervals of 70, 60, 50, 40 from each school.

The second stage is designing Mixed Reality media using Pyramid Hologram using Camtasia 8 software, Adobe Audition, and relevant video sources. The results of the second stage will be validated by the validator which includes content validation and construct validation. Content Validation consists of four Validators namely Pedagogists, Materials, Media and Curriculum. Whereas the Construction Validation consists of 3 validators, namely Science Teachers who are selected based on length of teaching and level of education and an assessment team from the supervisor of Education Office in Pekanbaru.

Validation data will be analyzed using the Lawshe formula [6] to determine the suitability of the media. A review on Mixed Reality uses Pyramid Hologram, which is the graphic picture or video displayed and the suitability of the picture from a Biological scientific perspective.

3. Results and Discussion
Student responses to the questionnaire answers found that the difficult learning material is motion system material (Figure 1.) The students' impression of the learning media used by the teacher before, the media cannot explain the material contextually (60%), the media is less dynamic (65%), the media is less communicative and not interactive with students (55%) so understanding of the material using these media is still low.

Based on respondents' responses to the distributed questionnaire, there was still a lack of use of technology in learning. Respondent data based on simulation is obtained

![Figure 1. Difficulty of Class VIII Materials](image)

Based on Figure 1, we know that the most difficult material in the Motion System with 19% acquisition, and followed by the Digestive System 18% and the Respiratory System 12%. While the material Motion and Force get 0%. Students revealed that the motion system material is difficult because the memorization method is more focused than visual learning. In addition, the material displayed in the form of 1-dimensional images so that students only remember images in the form of 1D to 2D and motion organs are difficult to see when using abstract objects such as the human body.
3.1. Design of Mixed Reality use Pyramid Hologram
Design of media is carried out by following the framework in Figure 2 below.

![Figure 2. Design of Mixed Reality Media](image)

3.2. Result of Content Validation and Construct Validation
Media that have been developed, then assessed by the Content Validator and the Construction Validator to see the visual feasibility that has been made and their needs can be seen in Figure 3-6 below.

![Figure 3. Skeletal System](image)

![Figure 4. Muscular System](image)
In Figure 3-6 is Mixed Reality using Pyramid Hologram so that the image looks 3D and can be seen at an angle of 360°. In terms of biological biography, it can be seen that the video scheme is structured and does not cause abstract in the picture.

The validator considered that the video coloring was very good, namely black so that the image display was more clearly seen in the form of a hologram. Erbina [7] revealed that black is very suitable to be combined with other colors so that the appearance of the media is very attractive. The addition of pictures or videos can make it easier for students to express ideas at once at the same time will be easy to understand [8]. Picture of hologram video if observed in the study room can be seen in the following Figure 7.

**Figure 5. Animal Motion**

**Figure 6. Plant Motion**

**Figure 7. Mixed Reality by using Pyramid Hologram**
Figure 7 shows that the frame of the human body can be seen from 4 points of view or 360°. In addition, the video is also equipped with audio visual so the teacher does not need to explain the hologram video that is being run. The results of the validator assessment consisting of content validation and construct validation can be seen in Tables 1 and 2 below.

Table 1. Content Validation Assessment

| Aspect       | KD 3.1 Motion System | Average | Category      |
|--------------|----------------------|---------|---------------|
| Display      | 3,5                  |         |               |
| Program      | 3,6                  |         | Very Appropriate |
| Learning     | 3,6                  |         |               |
| Curriculum   | 3,5                  |         |               |

Table 2. Construct Validation Assessment

| Aspect                        | Score each Criteria | Average | Category   |
|-------------------------------|---------------------|---------|------------|
| Substance of material         | 4,8                 |         | Very Good  |
| Learning Design               | 5,0                 | 4,8     | Very Good  |
| Display of Visual Communication| 4,7                 |         |            |
| Utilization of Software       | 4,8                 |         |            |

Based on Table 1 shows that the results of content validation with an average of 3.6 categories are "Very Appropriate", while in Table 2 the construct validation obtained 4.8 categories of "Very Good". From the CVR test results the Lawshe formula shows that Mixed Reality media is very suitable to be applied in schools.

Mixed Reality media using Pyramid Hologram can be applied in schools and be interesting for students. 3D holographic animation media is a media of early learning that attracts and interests students [9,10,11,12,13]. The use of holographic media is also very good for improving teacher quality, 68% of respondents from several teachers choose the importance of Mixed Reality 3D models and holograms for future learning media [14;15]. The purpose of Mixed Reality media is to teach teachers to be able to make their own forms.

The results of media simulations conducted at school show that this media is quite communicative, and can explain abstract material to be more concrete, so as to increase student motivation in the learning process. The potential use of Mixed Reality media using Pyramid Hologram is that it can form new environments such as physical and virtual objects integrated at different levels [16], can be simulated and immersive in teaching practices [17], can visualize information, long distance collaboration, between humans, machines, design and education tools and training [18].

4. Conclusion

Based on the results of the study it can be concluded that Mixed Reality media using Pyramid Hologram can overcome the learning difficulties in the material of the motion system, because this media has advantages in explaining material, dynamic, communicative and interactive so that it is easy for students to understand.

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