Design of Massive Online Simulation (MOS) On Concept Archimedes' Principle

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Abstract. In learning physics, Archimedes' law is a physics material that is quite difficult and requires a deep understanding of concepts based on study files from several schools in Banten. As many as 96.4% of students need online simulation media using computers or androids to help study Archimedes Law material. The Massive Online Simulation (MOS) design is divided into six parts, namely the dashboard, home, materials, videos, simulations and quizzes. This study aims to design a media in the form of Massive Online Simulation (MOS) on Archimedes' legal material. The method used is ADDIE (Analysis, Design, Development, Implementation and Evaluation). Research and development of the ADDIE model is carried out only up to the Design stage. This research can produce an attractive Massive Online Simulation (MOS) design that can be accessed anytime and anywhere.

1. Introduction
Digital information and communication skills of learners have increased rapidly and are considered important skills in the 21st century, which refers to several aspects related to knowledge, beliefs, attitudes, and values regarding information and communication technology (ICT) [1]. The development of science and technology that is increasing rapidly in the field of information and communication technology has an influence in various fields including the field of education. Advances in Information Technology have encouraged many changes, including in the field of education, one of which is the emergence of multimedia as a learning medium. Various kinds of diverse technological advances can increase the interaction between teachers and students [2]. Learning media that are currently developing and are often used by teachers and students during the covid-19 pandemic, such as edupage, google meet, schoology, moodle and so on are examples of Massive Online [3]. Massive Online is a distance learning platform, generally contains free courses on a topic, and is characterized by a very high number of registrations [4]. There is a study that states that MOOCS media can increase academic self-efficacy, teaching attendance, and perceived benefits have a significant direct effect on learning engagement but there is no learning mechanism [5]. Based on the results of observations in schools that have been carried out 72% of students learn by using laptops / computers and telephone. As many as 85.5% of students like simulation media when applied in the learning process. However, about 88% of students have difficulty in understanding Archimedes' Law material. As many as 96.4% of students actually need online simulation media using a computer or android to help study Archimedes' Law material. In overcoming this, an online simulation media is needed that is attractive and easy to access anywhere and anytime to be able to assist students in understanding Archimedes' Law material.
Massive Online Simulation shows that academic, teaching attendance, and perceived usefulness have a significant direct effect on learning engagement [6]. In physics learning, Archimedes’ law is one of the physics materials that are quite difficult and requires an in-depth understanding of the concept because it is difficult to observe directly or invisible or unobservable, and students experience serious confusion and difficulties [7]. In addition, current teachers are required to change the direct learning system into online learning (distance) due to the spread of Covid-19. The development of various physical phenomena of visualization media and has not been observed, until now, is mostly done for the sake of learning physics, but the developed simulation does not have a learning mechanism, cannot display various objects in the simulation, is less user friendly, and is only in the form of videos, and cannot be said virtual simulation media. The novelty in this research is to develop a Massive Online design which contains Archimedes law simulation material that can facilitate students in learning physics, so that students can use MOS as a fun physical learning resource anywhere and anytime. As well as the novelties in this research is to develop a design based on the shortcomings of the media availability analysis and MOOCS shown in the results and discussion. Therefore, referring to the findings and results of the research above, it is deemed necessary to develop an MOS design, namely a media development design to obtain a product in the form of a complete virtual simulation with the use of simulation mechanisms, materials, videos, simulations, quizzes and user friendly.

2. Method
The research method used is ADDIE (Analysis, Design, Development, Implementation and Evaluation). Research on the development of the ADDIE model was carried out only at the design stage, because the purpose of this study was to design media in the form of Massive Online Simulation (MOS) on interesting and accessible Archimedes law materials anywhere and anytime, with 80 high school students as research subjects in several schools in the province. Banten, Indonesia. The research flow for the development of Massive Online Simulation (MOS) is shown in Figure 1.

![Figure 1. Massive Online Simulation (MOS) Development Research Flow](image-url)
3. Result and Discussion

3.1. Media availability analysis

Virtual simulation has advantages in attracting the attention of students. Simulations can help students understand the meaning of scientific knowledge, concepts and facts for students. Virtual simulations contribute to teachers and students' professional development, and provide an understanding of science in science teaching [8]. Virtual simulations give students the opportunity to collaborate with learning and are able to strengthen knowledge about interprofessional competencies [9]. Virtual simulation has advantages in attracting the attention of students [10]. Virtual simulations can contribute to the teaching and learning process by giving students the opportunity to learn by doing, providing interesting and fun activities to encourage students to discover, and ensuring active classroom interaction through discussion in the learning process [11]. The following is a platform analysis of the availability of simulation media on Archimedes' legal material, shown in Table 2 which has been developed by previous researchers and has been published.

Table 1. Analysis of Platform Availability of Virtual Simulation Media on Archimedes’ Legal Materials

| Virtual Simulation Media has been Developed | Source | Information |
|--------------------------------------------|--------|-------------|
| ![Simulation 1](https://phe.t.colorado.edu/sims/density-and-buoyancy/buoyancy_in.html) | <https://phe.t.colorado.edu/sims/density-and-buoyancy/buoyancy_in.html> | This Archimedes law simulation can display various kinds of objects, but cannot display learning mechanisms and the data is only a description of physical phenomena. |
| ![Simulation 2](https://iwan2study.org/lookangejs/02_newtonmechanics-6press ure/ejss_model_archimedes/archimedes_Simulation.xhtml) | <https://iwan2study.org/lookangejs/02_newtonmechanics-6press ure/ejss_model_archimedes/archimedes_Simulation.xhtml> | This Archimedes law simulation runs very slowly and cannot display various kinds of objects such as iron or aluminum. |
| ![Simulation 3](https://amrita.olabs.edu.in/?sub=1&brch=1&s im=72&cnt=131) | <https://amrita.olabs.edu.in/?sub=1&brch=1&sim=72&cnt=131> | This Archimedes law simulation cannot display various kinds of objects to determine floating, floating and sinking objects. However, there are conclusions after doing the simulation. |
| Virtual Simulation Media has been Developed | Source | Information |
|---------------------------------------------|--------|-------------|
| ![Image](https://www.vascak.cz/data/android/physicsatschool/template.php?s=mech_archimedes&l=en) | https://www.vascak.cz/data/android/physicsatschool/template.php?s=mech_archimedes&l=en | This Archimedes law simulation can be easily operated, but does not display physical phenomena |
| ![Image](https://www.golabz.eu/lab/verification-of-archimedes-principle) | https://www.golabz.eu/lab/verification-of-archimedes-principle | Archimedes' law simulation provides a variety of objects but is not user friendly |
| ![Image](https://www.golabz.eu/lab/splash-virtual-buoyancy-laboratory) | https://www.golabz.eu/lab/splash-virtual-buoyancy-laboratory | This simulation can display data, but has not been able to manipulate models and expand learning |
| ![Image](https://vlab.belajar.kemdikbud.go.id/Experiments/hukumanrchimedes/#/) | https://vlab.belajar.kemdikbud.go.id/Experiments/hukumanrchimedes/#/ | This Archimedes simulation is almost similar to phet, but the objects provided are more varied, the data are only limited to a description of physical phenomena. |
| ![Image](https://ww.physics-chemistry-interactive-flash-animation.com/mechanics_forces_gravitation_energy_interactive/buoyancy_) | ww.physics-chemistry-interactive-flash-animation.com/mechanics_forces_gravitation_energy_interactive/buoyancy_ | This Archimedes simulation has not been able to manipulate the model and expand learning |
Virtual Simulation Media has been Developed

| Source | Information |
|--------|-------------|
| https://www.edumedia-sciences.com/en/media/365-archimedes-principle | This Archimedes simulation has not been able to manipulate the model and expand learning. |
| https://www.ck12.org/physics/archimedes-law/ | This platform is quite complete like the Moodle platform, but when it is opened, one of the simulations is only a video. |

Based on Table 1, information is obtained that some of the simulation media in Archimedes’ legal material still have shortcomings, namely, there is no learning mechanism, cannot display various kinds of objects in the simulation, is less user friendly, and is only in the form of video, and cannot be said to be virtual simulation media because Therefore, a media development design is needed to get a product in the form of a virtual simulation complete with a simulation use mechanism, a sequence of material on Archimedes’ law material and user friendly.

Massive Online Simulation (MOS) is an adoption of the word MOOCs. Massive Online Simulation (MOS) is learning that is carried out online which has the nature of open learning, free of charge or free, with online media as the channel, referring to students who are given objects in the form of virtual representations of real objects or commonly called simulations, occurring through the website. And courses, structured around a set of learning objectives within a defined field of study. The following is an analysis of the Massive Online Simulation (MOS) availability platform shown in Table 2 which has been developed by previous researchers and has been published.

Table 2. Analysis of Massive Online Simulation (MOS) Availability Platforms

| Massive Online Simulation that has been developed | Source | Information |
|--------------------------------------------------|--------|-------------|
| https://www.my-mooc.com/en/ | This MOOCS has a good design and complete courses, but does not show the use of MOOCS. |
| Massive Online Simulation that has been developed | Source | Information |
|-------------------------------------------------|--------|-------------|
| ![Massive Online Simulation](image1.png)       | https://www.coursera.org/courses?query=mooc | This MOOCS features several accessible, but paid courses. |
| ![Massive Online Simulation](image2.png)       | https://www.classcentral.com/help/moocs | This MOOCS displays the use of MOOCS and learning mechanisms, but does not display interesting images or features. |
| ![Massive Online Simulation](image3.png)       | https://www.mooc-list.com | This MOOCS is one of the providers of free courses, but there is a free limitation in use for only 30 days. |
| ![Massive Online Simulation](image4.png)       | https://www.edx.org/search | This course service provider is very complete and has an attractive design. |
| ![Massive Online Simulation](image5.png)       | https://www.futurelearn.com/courses/collections/get-into-university | This MOOCS features a very attractive design and appearance, but there are no mechanics or tutorials for using media. |
| ![Massive Online Simulation](image6.png)       | https://www.udemy.com | This MOOCS features multiple learnings and has a unique design. |
Massive Online Simulation that has been developed | Source | Information |
---|---|---|
[Image](https://global.xfyun.cn/products/ise) | https://global.xfyun.cn/products/ise | This MOOCS has a free account feature, so it can make it easier for students to have an account. |
[Image](https://www.saylor.com) | https://www.saylor.com | The design used is attractive and good, but the features used are few. |

Based on Table 2, information is obtained that some MOOCS media still have shortcomings, namely they do not display the use of MOOCS, are paid, do not display interesting pictures or features, there is no learning mechanism, therefore, a MOOCS development design that displays the use of media, is free (free), displays interesting pictures or features, there is a learning mechanism and by adding simulations in the massive online to get a product in the form of Massive Online Simulation (MOS). The advantages of this study are that the MOS design developed can display the use of media, it is free, displays interesting images or features, there is a learning mechanism by adding online simulations to get products in the form of Massive Online Simulation (MOS), user friendly and media designed to be attractive and interesting, and can be accessed anywhere and anytime.

3.2. MOS development

Massive Online Simulation (MOS) is learning that is carried out online which has the nature of open learning, free of charge, with online media as the channel, referring to students who are given objects in the form of virtual representations of real objects or commonly called simulations, occurring via the web, and courses, structured around a set of learning objectives within a defined field of study. This media were developed using the iSpring Suite platform. In addition, the media are also made interactive, Massive Online has several components, namely home, dashboard, materials, videos, simulations accompanied by calculation data, and quizzes. The Massive Online Simulation (MOS) design developed in this study is as follows.

![Figure 2. MOS display at home](image-url)
Based on Figure 2, this screen appears when students have successfully logged in to Massive Online Simulation (MOS). This display is the home screen for Massive Online Simulation (MOS).

There are several main menus on the home screen, namely the home menu, materials, videos, simulations, and quizzes, as well as a menu of learning mechanisms and instructions for using media.

1. **Home**, the main screen when logged in to each account. And there is a menu of learning mechanisms and instructions for using media so that students are guided in using massive online simulation.
2. **Material**, on the material menu, of course, there is Archimedes' law material.
3. **Video**, on the interesting video menu there is a video of the application of Archimedes' law in life which can be witnessed in real and up close.
4. **Simulation**, in the simulation menu, there is a simulation of Archimedes' law with several kinds of objects.
5. **Quiz**, on the quiz menu there are 2 quizzes to find out ICT literacy in students when using massive online simulation of Archimedes legal materials.

![Figure 3. MOS Display on Material](image1)

![Figure 4. MOS Display in Simulation](image2)

Based on Figures 3 and 4, the display of material and simulation in Massive Online Simulation (MOS). On the material display, there are several main menus, namely the home menu, materials,
videos, simulations and quizzes and there is a "read material" button to go to the Archimedes law sequence display. In the simulation display there are several components and calculation data, namely material, mass, volume, density and volume change and data for calculating Archimedes force, gravity, submerged volume and floating volume are provided. The material in the simulation display can be selected which consists of several types of objects, namely bricks, floating objects and Styrofoam in accordance with Archimedes' law concepts, namely floating, floating, and sinking. When students select an object on the material or click on a brick material. The simulation screen will display a simulation of bricks submerged in water and the calculated data.

4. Conclusion

Students are interested and like simulation media when applied in the learning process. From the research it was stated that students experienced serious confusion and difficulties in Archimedes' law material. So a Massive Online Simulation (MOS) design was made for Archimedes' legal materials, by analyzing the availability of media on Archimedes' legal materials and analyzing the availability of MOS. Based on the analysis of the availability of media on Archimedes' legal material and massive online, it is necessary to design media to get a product in the form of a virtual simulation complete with learning mechanisms, simulations, materials, videos and quizzes on Archimedes' legal materials. Display images or features that are attractive, free, and can be accessed anywhere and anytime to get a product in the form of Massive Online Simulation (MOS) which will later be developed in the form of Massive Online Simulation which will be applied in a learning process.

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