Design of Massive Online Simulation (MOS) on kinetic theory of gases

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Abstract. The purpose of this study was to design a Massive Online Simulation (MOS) to describe the behavior of gas particles to make it easier for students to understand the microscopic kinetic theory of gases. This research is a type of development research (Research and Development) with the ADDIE model consisting of analysis (analysis), design (design), development (develop), implementation (implement) and evaluation (evaluate). But, in this study, researchers only use the initial stage is the stage of analysis and design. The result of this research is the design of Massive Online Simulation (MOS) learning media on a gas kinetic theory which discusses monatomic, diatomic and polyatomic sub-materials, in which there is a main display menu, start menu, material menu, simulation menu and quiz menu that can be used. Students for learning the kinetic theory of gases.

1. Introduction
At the current level of digitization software and technology are playing an increasing role in almost all areas of society and every aspect of life [1]. Advances in communication technology also indirectly change the social order of society in their social interactions. This phenomenon provides many opportunities for humans as potential beings to actualize their potential. However, its actualization of course requires tools as a condition to build a logical line of thought [2]. In physics learning that is studied in SMA Class XI there is material on the kinetic theory of gases, this material is material that is abstract. The kinetic theory of gases is the concept that gases consist of atoms that move randomly continuously. Even if we are able to carry out a class experiment using a pressure gauge and a syringe, the results of this experiment do little to explain the kinetic theory of gases [3]. Basically, the concepts of gas pressure and gas kinetic energy are microscopic concepts and cannot be observed directly. It also relates to Newton's laws of motion; in terms of microscopic aspects, namely speed, collision, gas pressure, the principle of equipartition of energy [4]. In grade 8 students and prospective science teachers showed that eighth grade students used examples from everyday life when talking about gases, teachers tended to emphasize the properties of gases in their explanations [5]. It is recommended to overcome this conceptual understanding with an interactive teaching model and supplemented with some multi-visualization-based teaching materials because the kinetic theory of gases is a microscopic concept [4]. Therefore, teachers are required to innovate in order to make learning interesting and students are actively involved in it. In the teaching and learning process, there needs to be a two-way relationship between students and teachers. It is intended that there is good cooperation during the teaching and learning process [6]. Based on the results of a preliminary study...
conducted in several senior high schools (SMA) in the Banten area using google forms which aims to determine the level of understanding possessed by students, it can be seen in table 1.1.

Table 1. Results of Students' Level Understanding

| Score       | Criteria       | Many participants Many participants Educate | Percentage amount Percentage amount learners |
|-------------|----------------|--------------------------------------------|---------------------------------------------|
| 80 < X ≤ 100| Very High      | 8                                          | 10%                                         |
| 60 < X ≤ 80 | High           | 6                                          | 7%                                          |
| 40 < X ≤ 60 | Medium         | 10                                         | 12%                                         |
| 20 < X ≤ 40 | Low            | 30                                         | 36%                                         |
| 0 < X ≤ 20  | Very Low       | 28                                         | 34%                                         |
| Total       |                | 82                                         | 100%                                        |

Based on table 1.1, the students' test results have a very low level of understanding, with a percentage of 34%. Meanwhile, students who have a very high level of understanding are only 10%. Students who have low criteria are 36%. Based on the preliminary study, it was concluded that the level of understanding, skills possessed by most of the students was still in the very low category. A preliminary study was also carried out by distributing a needs analysis questionnaire through the google form which had been carried out in several high schools in Banten. A total of 82 students contributed in filling out the questionnaire. Based on the results of the analysis of student needs, 92.7% of teachers have used various learning media. The physics learning media that are often used by teachers are shown in Figure 1.

Figure 1. Media used by teachers

In the picture the percentage of learning media used by students given by the teacher, the most widely used learning media by teachers is using power point with a percentage of 42.7%, while learning videos are 32.9% teaching aids 3.7% learning animation 15.9%, 2.4% file and other media used by teachers to students as much as 1.2%. Based on the results of the questionnaire that has been
distributed to students, it is known that the teacher has provided learning media to students with various kinds of media, but as many as 41.5% of students stated that they were not focused and did not understand the learning of gas kinetic theory at the time of learning, and 47.6% of students feel bored while learning. The results of the analysis of teacher needs were also carried out by distributing questionnaires via a google form. A total of 24 teachers from several high schools in Banten have filled out the questionnaire. From the results of the questionnaires that have been distributed, it is known that as many as 79.2% of students still do not have a good level of understanding of the kinetic theory of gases, as many as 45.8% of the learning media that teachers use have not been able to provide a complete picture of the movement of gas particles in space. Closed. So that 100% of teachers stated that they needed new learning media that could make students more active, creative and interactive in learning, and 100% of teachers stated that they agreed that it was necessary to develop a Kinetic Gas Theory learning medium using Massive Online Simulation (MOS). One of the current trending online learning media that is widely used by students and teachers is the Massive Open Online Course or often known by the abbreviation MOOC. Massive Online is an online learning media that can meet global learning needs with the main advantage of providing free education and virtual learning [7]. In addition, Massive Online learning media have another advantage, namely it can make education more accessible, because it tends to be interesting for students, the courses are easily accessible by anyone around the world with an internet connection [8]. This finding sheds new light on the influence of MOOC which shows that in terms of exploring students' knowledge, teachers also have a strong tendency to be able to see MOOC participation as a way to make participation able to explore knowledge on their own [9]. Simulation learning media, according to [10] has proven to be a useful tool for teaching and learning physics. With the open learning resources contained in MOOCs, accessed easily and flexibly, parents and teachers will have the opportunity to gain broader knowledge [2]. In previous research on the developed media, it was concluded that most of the teachers interviewed had explained that there were several challenges in producing Massive Open Online Course (MOOC) files. One teacher revealed that his lectures on campus had not worked out in a format, and he was motivated by the opportunity to learn new aspects of teaching. Experience with Massive Open Online Course (MOOC) projects will allow the possibility to use new teaching materials and activities on campus [11]. Learning physics will be more interesting if there is a simulation. Based on the problems described above, the authors are interested in conducting development research to design, simulation learning media on the kinetic theory of gas material called Massive Online Simulation (MOS) Design on Gas Kinetic Theory.

In an interesting learning process, you should use learning media that can make it easier for students to understand difficult material. Research [3] entitled Discovering the gas laws and understanding the kinetic theory of gases with an iPad app. This study aims to visualize the behavior of particles and to relate the behavior of gas properties such as pressure and temperature using the iPad application. The results showed that the iPad application called Atoms in Motion can demonstrate Boyle's Law and Gay Lussac's Law, to explain data to students about the kinetic theory of gases, namely the relationship between motion between particles and the nature of pressure and temperature. Research [4] entitled Analyzing Students' Level of Understanding on Kinetic Theory of Gases. This study aims to analyze the level of students' understanding of the kinetic theory of gases. The results showed that in the ideal gas law, 33% of the students had fully understood it. However, 14% of them have many misconceptions about the sub-material pressure and kinetic equipartition energy of gases. It is recommended to overcome this conceptual understanding with an interactive teaching model and supplemented with some multi-visualization-based teaching materials because the kinetic theory of gases is a microscopic concept. Research [12] entitled Designing MOOCS with Virtual Microscopic Simulation (VMS) for increasing students' levels of understanding. This study aims to determine the effect of MOOCS with Virtual Microscopic Simulation (VMS) on students' level of understanding. The results showed that students fully understood 76.67%, partially understood 15.56%, and misunderstood 5.56%, and did not understand at 2.22% and the lowest level of understanding was at the 0% level, namely students did not answer. It was concluded that the average level of understanding...
experienced a significant increase with learning through MOOCS with VMS. Research conducted by Carolyn Penstein Rosé & Oliver Ferschke [13] with the research title Technology Support for Discussion Based Learning: From Computer Supported Collaborative Learning for the Future of Massive Open Online Courses aims to determine the effect of Massive Open Online Courses (MOOCs) through a learning approach problem-based, team project-based learning, and collaborative reflection. This research method applies a problem-based learning approach, team project-based learning, and collaborative reflection. The results show that Massive Open Online Courses (MOOCs) for scale-based learning can improve problem-based learning, team project-based learning, and facilitate collaborative reflection on students. The researcher concludes that the use of Massive Open Online Courses (MOOCs) can increase collaborative reflection on students. MOOCS (Massive Open Online Courses) the current trend in online learning experiences significant changes towards a student-centered approach with the aim of being a new challenge for autonomous and independent learning.

Research conducted by Filippo Sciarrone and Marco Temper in [14] with the research title K-Open Answer: a simulation environment to analyze the dynamics of massive open online courses in smart cities, aims to provide a teacher platform with an environment capable of simulating MOOC (RQ1) to give the teacher some didactic insight about the classroom to set the right teaching strategy in real MOOC (RQ 2). This research method applies a method for modeling users that involve cross-analysis of student representations in the system, based on dependencies, and information flows between teachers and students. The results showed that the use of MOOC assisted by K-Open Answer for simulated learning for teachers could improve the quality of automatic assessment provided by the system. The researcher concludes that the use of simulation-based MOOC can improve the quality of automated assessments.

2. Method

Type Research This is a research development with models ADDIE (Analysis, Design, Development, Implementation, and Evaluation). The procedure of research that is used in the study is referring to the model of R & D that is the model of ADDIE because the steps are used more systematically and clearly. The stages that must be taken in the development model [15] consist of five stages, namely: analysis (analysis), design (design), development (development), implementation (implementation), and evaluation (evaluation). However, this study performed only at the design stage (design). The stages of the ADDIE model can be seen in Figure 2.

![ADDIE Model](image_url)

The initial step is to analyze the needs of the media teacher and participating students about the device learning online, students on the material difficulties the kinetic theory of gases and media required for online learning. The needs analysis was carried out by distributing questionnaires to several high school physics teachers and distributing questionnaires to several high school students in Banten Province. Data obtained from the teacher and participant students through a questionnaire that
was distributed through a google form. Furthermore, learning media Massive Online Simulation (MOS) in design to facilitate teachers convey instructional materials that are abstract and microscopic as well as help students to understand the material the kinetic theory of gases.

3. Result and Discussion

The result of the design of this form of media learning Massive Online Simulation (MOS) which contains the main page to log in and then after their login menu basic competence (KD) and the objectives, content learning, simulation and q is in it. Phase manufacture medium of learning is divided into two parts the first stage of preparation and that the second stage of the manufacture of media design that use methods ADDIE which consists of five stages, namely: analysis, design, development, implementation and evaluation. However, in this study only arrived at the design stage. This analysis stage was carried out by researchers to collect the data needed in making Massive Online Simulation (MOS). At the stage of analyzing a few things such as problems / solutions that experienced by the students during the teaching and learning activities (KBM), the availability of resources to learn at school, information regarding the material subjects, and the theory that needed to put into Massive Online Simulation (MOS). Stage design of the study this is done the design of the initial applications based on the results of the analysis that has been done, such as determining the contents of the content Massive Online Simulation (MOS) which in accordance with the matter in the eyes of subjects kinetic theory of gases, making the layout of the initial application, determine the content of Massive Online Simulation (MOS), make a description of each part, makes the contents of the content that consists of menu basic competence (KD) and the objectives, content learning, simulation and quiz. Design early application Massive Online Simulation (MOS) can be on view in the figure below this:

![Figure 3. Main View](image)

The main screen is the initial screen that appears when the user opens the Massive Online Simulation media. On this main display screen, there is a login for students who already have an account, and a list column for students who don't have an account.

![Figure 4. MOS Start Menu](image)

The start menu is a menu to enter Massive Online Simulation. On this start menu there is a start button
for users to enter Massive Online Simulation media. Button of sound to enable or disable sound. I am a media maker info, and book pictures are for reference used.

**Figure 5. Home Menu**

The Home Menu displays program menus, including: Basic Competencies, Objectives, Materials, Simulations and Quizzes.

**Figure 6. KD Menu and Destinations**

Menu displays to view basic competencies and objectives. The box can be clicked and go directly to the section you want to see.

**Figure 7. Material Menu**

Display menu to select the material you want to learn.

**Figure 8. Monatomic Matter**
Monatomic material that can be studied by students.

Figure 9. Diatomic Material

The material in atomizers that can be studied by students.

Figure 10. Polyatomic Material

Polyatomic material that can be studied by students.

Figure 11. Simulation

Simulation displays that will display monatomic, diatomic and polyatomic simulations.

Figure 12. Quiz Start Display Menu
Menu display to start the quiz.

![Figure 13. Quiz Display Menu](image)

The menu display is for displaying the quiz, while the arrow is showing the remaining time in working on the questions. Next is used to continue the quiz when the quiz is finished. Based on the results of the Massive Online Simulation learning media design, the researchers hope that this media can be used by teachers and students to easily study the kinetic theory of gases in monatomic, diatomic and polyatomic sub-materials.

4. Conclusion

Massive Online Simulation online learning media on gas kinetic theory material can make it easier for students and teachers in the online teaching and learning process or distance learning. The result of this study is the design of Massive Online Simulation (MOS) learning media on a gas kinetic theory which discusses monatomic, diatomic and polyatomic sub-materials, which includes the main display menu, start menu, material menu, simulation menu and quiz menu that can be used. Students for learning the kinetic theory of gases. So that in this journal a Massive Online Simulation (MOS) learning media design has been produced on the kinetic theory of gases that can assist teachers in conveying the material of the kinetic theory of gases and is expected to make it easier for students to understand the material of the kinetic theory of gases.

Reference

[1] J. Nouri, L. Zhang, L. Mannila, and E. Norén. Educ. Inq., vol. 11, no. 1, pp. 1–17, 2020, doi: 10.1080/20004508.2019.1627844.

[2] S. S. Dewi, S. Suherman, F. C. Wirbo, D. R. Darman, A. P. A. Rino, and I. A. Darmawan. J. Panelist. Pengemb. Pendidik. Fis., vol. 6, no. 1, pp. 17–24, 2020, doi: 10.21009/1.06103.

[3] G. B. Davies. Phys. Educ., vol. 52, no. 4, 2017, doi: 10.1088/1361-6552/aa6d9f.

[4] S. N. Kane, A. Mishra, and A. K. Dutta. J. Phys. Conf. Ser., vol. 755, no. 1, 2016, doi: 10.1088/1742-6596/755/1/011001.

[5] M. Çalik and A. Ayas. J. Res. SCI. Teach., vol. 42, no. 6, pp. 638–667, 2005, doi: 10.1002/tea.20076.

[6] W. Katrina, H. J. Damanik, F. Parhusip, D. Hartama, A. P. Windarto, and A. Want. J. Phys. Conf. Ser., vol. 1255, no. 1, 2019, doi: 10.1088/1742-6596/1255/1/012005.

[7] Y. Li, J. Sun, and M. Y. Sun. Kuram ve Uygulamada Eğitim Bilim., vol. 18, no. 6, pp. 3442–3448, 2018, doi: 10.12738/estp.2018.6.251.

[8] K. F. Hew. Br. J. Educ. Technol., vol. 47, no. 2, pp. 320–341, 2016, doi: 10.1111/bjet.12235.

[9] S. Ardavani, “How MOOCs Can Develop Teacher Cognition: The Case of in-service English Language Teachers,” Eur. J. Open, Distance E-Learning, vol. 22, no. 2, pp. 56–71, 2020, doi: 10.2478/eurodl-2019-0010.

[10] S. Y. Lye, L. K. Wee, Y. C. Kwek, S. Abbas, and L. Y. Tay. Educ. Technol. Soc., vol. 17, no. 3, pp. 121–137, 2014.

[11] K. Alsaadat. European Journal of Open Education and E-learning Studies pp. 46–53, 2019, doi:
10.5281/zenodo.3706329.

[12] F. C. Wibowo and B. H. Iswanto, *J. Phys. Conf. Ser.*, vol. 1402, no. 6, 2019, doi: 10.1088/1742-6596/1402/6/066094.

[13] C. P. Rosé and O. Ferschke, *Int. J. Artif. Intell. Educ.*, vol. 26, no. 2, pp. 660–678, 2016, doi: 10.1007/s40593-016-0107-y.

[14] F. Sciarrone and M. Temperini, *Soft Comput.*, vol. 24, no. 15, pp. 11121–11134, 2020, doi: 10.1007/s00500-020-04696-z.

[15] B. A. Jones, “Instructional Design in a Business English Context,” no. 1, pp. 683–696, 2014, [Online]. Available: http://www.umich.edu/~ed626/define.html%0Ahttp://www.brentjones.com/presentations/2008/id_business_english_handout.pdf.