Impact of the *EduPlasa* interactive media on reducing misconceptions of static fluid in high school students

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**Abstract.** Many efforts have been made to reduce misconceptions in physics learning, including traditional learning methods (without interactive media) or with modern learning (using interactive media). Most interactive media used are based on calculations or graphics. Usually students experience difficulties when interpreting the data shown in the media. To solve this problem, *EduPlasa* interactive media is based on images, contexts and final conclusions are displayed by *EduPlasa* media. The study used a quantitative approach, virtual experimental methods and data collection using the three tier diagnostic tests. The target population of all high school students in the city of Banda Aceh, but with a variety of considerations taken a sample of randomly 28 students of SMA 7 Banda Aceh. Data analysis used descriptive statistics to get a percentage reduction in student misconceptions on the concept of static fluid. The calculation results show that there was a reduction in misconceptions of 60.34% in other words a reduction in the misconception of the static fluid concept was very significant after the *EduPlasa* interactive media was applied. Inference from research results, teachers are encouraged to use image-based interactive media to reduce misconceptions in students.

1. **Introduction**

One step that is used to help students overcome the misunderstanding of interpreting a concept and identifying understanding of the concept is to find the form of the problem, find the cause, and determine the appropriate and appropriate remediation method to be applied [1]. Misconception remediation activities have been carried out by several researchers and have been successfully applied in reducing misconceptions and increasing student understanding, including refutation text [2-5], teaching aids [6], lego media [7], card media [8, 9], practical demonstrations [10], interactive demonstration models [11], comic teaching materials [12], and mind mapping [13].

Other media that are often used for remediation of misconceptions include audio, visual and audiovisual media. Audio media includes interactive media charged with cognitive conflict [14] and conceptual change [15,16]. Visual media includes Microsoft Power Point [17], flash animation media [18-23], image media [24], practicum media [25], demonstration media [26], Physic Education Technology (PhET) simulation [27-33], flash simulation media [34], computer simulation media [35-38], media lectora inspire [39,31], virtual laboratories [40,41]. Audio visual media include interactive...
guided discovery multimedia [42], multimedia chemo lysis [43], macromedia flash [44], Fotonovela media [45], pictorial riddle media [46], edu-chem-interactive media [47], Volta Chem media [48], audio visual media [49-51], LaInApp [52], ISpring pro [53].

Based on the number of media used to remedy misconceptions, interactive media is one of the right choices because interactive media can bring about two-way communication between the user and the media and the appearance of the illustrations looks more real. Besides that, all EduPlasa media are able to transform mathematical and scientific concepts into interactive, clear, and contextual forms of animation and interactive simulation so that they are easily understood by students [54]. PesonaEdu software is a tool that supports the occurrence of the accommodation process towards conceptual change through three of the four conditions put forward by Posner, namely (i) beautiful, clear, and contextual animated and interactive simulations can make students understand the intelligible concept (intelligible) (ii) animations and simulations that are displayed in accordance with the theory of physics according to experts so that the conceptions that are formed are plausible, and (iii) software Enchantment Edu displays animations and simulations that show the application of a concept so students feel that the concept is useful (fruitful) [55].

Previous research stated that the Pesona Edu software similar to EduPlasa plays an important role in helping students convince themselves of the new conception through descriptions of each animation with the explanation given by the teacher. It is seen that the average percentage decrease in misconception is 33% [56]. Based on the above explanation, the percentage decrease in misconceptions using EduPlasa media will not be much different from the Enchantment of Edu software with the same physical material namely fluid so that differences can be seen between the two in terms of effective in overcoming misconception. Submission of interactive material is proven to help the learning process [57]. Therefore, the purpose of this study is to determine the effectiveness of EduPlasa software to reduce misconceptions in learning physics, especially in the concept of static fluids.

2. Methods
2.1. Research approach
The type of research used in this study is an experiment with a quantitative approach. The research design used was a pretest-posttest control group design. In this design there are two classes, namely the experimental class and the control class. The population in this study were all students at Banda Aceh 7 High School consisting of 5 XI MIPA classes. The selection of samples in this study used a non-random method, namely Purposive Sampling. From the scattered population samples were selected, namely class XI MIPA 5 was chosen as the control class and class XI MIPA 4 as the experimental class.

2.2. Data collection
Data collection techniques in this study were diagnostic tests in the form of pretest and posttest, questionnaire method, and documentation. The test instrument was re-tested the question by calculating the value of validity, reliability, level of difficulty, and differentiation by using Anates, while non-test instruments in the form of questionnaires were validated by experts and calculated statistical tests using SPSS 22.

| Table 1. The confidence level scale in answering questions is based on the CRI technique |
|---------------------------------|--------------------------------------------------------------------------------------|
| Index  | Explanation                                                                                     |
| 0      | Total guess the answer / just guess (If answering the question, 100% guessed)                     |
| 1      | Almost guess (if in answering questions, the percentage of guessing elements is between 75 - 99%) |
| 2      | Not sure (If in answering the question, the percentage of guessing elements is 50–74%)           |
| 3      | Sure (If in answering questions, the percentage of guessing elements is between 25-49%)           |
| 4      | Almost Certain (If in answering the question, the percentage of guessing elements is 0 -         |
5 Certain/very confident with no doubt (If in answering the question there is no element of guessing)

Sources: [58]

Misconception diagnostic tests are used to identify misconceptions that occur in students regarding static fluid material that is performed on students before and after the learning process. The principles of the Certainty of Response Index (CRI) technique are still applied. The CRI technique is characterized by a scale of confidence level in answering questions, namely the scale of 0-5, with the translation as shown in table 1 [58].

The Certainty of Response Index technique was then developed by [59] to identify misconceptions tailored to the characteristics of Indonesian students. Criteria for the possibility of student answers in answering multiple choice questions for open reasons through a three-tier diagnostic test and using the CRI index are shown in table 2.

| Answers | Reason   | CRI Index | Description                      |
|---------|----------|-----------|----------------------------------|
| Wrong   | Wrong    | < 2.5     | Lack of Knowledge (LK)           |
| Wrong   | Right    | < 2.5     | Lack of Knowledge (LK)           |
| Wrong   | Wrong    | > 2.5     | Misconception (Mis)              |
| Wrong   | Right    | > 2.5     | Misconception (Mis)              |
| Right   | Wrong    | < 2.5     | Lucky Guess (LG)                 |
| Right   | Right    | < 2.5     | Understanding of concepts, but not confidence (NC) with the answer choice |
| Right   | Wrong    | > 2.5     | Misconception (Mis)              |
| Right   | Right    | > 2.5     | Knowledge of Correct Concepts (KCC) |

Source: [59]

2.3. Data analysis

Based on the results of each student's data based on the table above, a combination of multiple choice answers, right or wrong reasons, and based on the high and low CRI values, diagnostic data are grouped into five groups, namely groups of students who understand the concept correctly (KCC), groups of students understand material but not self-confidence (NC), groups of students who have misconceptions (eg), groups of students who understand partial concepts (LG), and groups of students who do not understand the concept at all (LK). This data was analyzed descriptively through the analysis technique of the percentage of table data based on the CRI criteria category. The pretest and posttest value data that have been obtained were analyzed based on quantitative statistics after normality and homogeneity tests were carried out on existing data, while the increase in students' cognitive learning outcomes was determined through normalized gain calculations. Data on decreasing misconceptions can be calculated from the acquisition of misconceptions before and after using interactive media. The technique of analyzing the feasibility of learning media is done using qualitative descriptive analysis techniques. The collected data is processed by adding up, then compared with the expected amount and obtained by the percentage [60]. After percentage presentation, the next step is to describe and draw conclusions on each indicator from the media expert's assessment, content and evaluation and student responses.

3. Result and Discussion

This study aims to determine how much the impact of EduPlasa's media in remediating misconceptions of static fluid material in students. EduPlasa media has been validated by validators with media expert ratings of 81.5% and 85% content, student responses to media are 86.68% and student worksheet and lesson plan are 75%. The trial results show the high positive response from users (students) this is
shown in Figure 1. This shows that students are taught with the help of EduPlasa media can improve understanding of concepts or reduce misconceptions close to 60%.

![Figure 1. Percentage of student responses to EduPlasa media](image)

The trial results also show a significant difference between the control class and the experimental class as shown in Figure 2. The percentage diagram of the average reduction in misconceptions in the initial and final tests for the experimental and control classes is shown in Figure 2. The results of previous relevant studies indicate that the use of interactive multimedia effectively reduces the number of students who experience misconceptions and can increase students' interest in learning [56].

![Figure 2. The average value of the student's pretest and posttest](image)

Based on the diagram above in figure 2, the average value of the pretest of the experimental class was 29 and the control class was 21, while the average posttest value of the experimental class was 92 and the control class was 55.2. From the results of the pretest and posttest, it can be concluded that the form of misconception that occurs in students is the greater the density of a liquid, the smaller the lifting force that occurs on the object; the greater the density of a liquid, the object dipped in liquid will be heavier; the smaller the volume of the object being immersed, the greater the buoyancy force that occurs in the object; students consider Archimedes's style to be influenced by the density of objects; buoyancy force is only influenced by the mass of the object and the volume of liquid, not the density of the liquid; heavy objects will surely sink; the bigger the shape of the object, the object will sink; students consider the sinking of an object due to the weight of an object; students assume the mass of objects determines floating events, drifts and sinks of objects; the viscosity of liquid does not affect the rate of matter, the rise and fall of a liquid is only influenced by absorption, and others.

![Figure 3. Percentage diagram of students' CRI pretest and posttest criteria](image)
This is in accordance with the opinions of previous researchers, he found several student misconceptions in understanding static fluid material, namely the understanding of the amount of pressure determined by the area of the vessel, the volume and mass of the substance, pressure proportional to time, the object will sink easily [61]. The results of the percentage of CRI criteria experienced by students when the pretest and posttest are shown in figure 3.

Based on the diagram above shows the level of understanding and confidence of students. At pretest, students who understood the concept (KCC) 9.5%, students understood the concept but were not sure (NC) 0%, students who understood the concept of part (LG) 0%, students who did not understand the concept (LK) 0%, and students whose misconceptions (M) are 90.5%. At posttest, students who understood the concept (KCC) 81.83%, students who understood the concept but were not sure (NC) 2.17%, students who understood the concept of part (LG) 1%, students who misconceptions (M) 9%, and students who don't understand the concept at all (LK) 6%.

**Table 3. Correlation of posttest values and misconceptions of the control class**

|       | X                      | Y                      |
|-------|------------------------|------------------------|
| Pearson Correlation | 1 | -.587** |
| Sig. (2-tailed) |  | .003 |
| N | 24 | 24 |

The results of the present study indicate that there is a relationship between the posttest scores and student misconceptions can be seen in tables 3 and 4. The results obtained in this study are not much different from previous studies using the Lectora Inspire and PhET media simulation on dynamic electrical material, where the results of the experimental class pretest of 20% of students did not know the concept (LK), 14% of students knew the concept (KCC), 6% of students guess (LG), 58% of students whose misconceptions (M), 2% of students know the concept but are not sure (NC). While the posttest results from the same study showed 5% of students did not know the concept (LK), 63% of students knew the concept (KCC), 11% of students guessed (LG), 20% of students had misconceptions (M), 1% of students knew the concept but not sure (NC). Thus in previous studies using Lectora Inspire there was a reduction in misconceptions of around 38% compared to the control class that did not receive the funding [31].

**Table 4. Correlation of posttest values and misconceptions of experimental classes**

|       | X                      | Y                      |
|-------|------------------------|------------------------|
| Pearson Correlation | 1 | -.992** |
| Sig. (2-tailed) |  | .000 |
| N | 24 | 24 |

Another researcher, Azzarkasyi, has also attempted to reduce miconseption by using PhET media simulation on the concept of dynamic electricity [27]. The results of the study showed that the pretest results of 25.95% of students did not know the concept (LK), 20.79% of students knew the concept (KCC), 0.68% of students guessed (LG), 40.49% students were contaminated with misconceptions (M), 1% of students know the concept but are not sure (NC). The posttest results from the Azzarkasyi study showed that 11.64% of students misconceptions (M) and 50% of students knew the concept (KCC), in other words there was a reduction in misconceptions by 39%. Based on the results of the
present study and the two results of previous studies, there were significant differences between the results using the media lectora inspire, PhET simulation, and EduPlasa media.

The results of testing the correlation using SPSS 24 indicate a correlation. This can be seen from $r_{\text{count}} > r_{\text{table}}$, that is $0.587 > 0.4044$ with $r$ correlation obtained medium in the control class and $r_{\text{count}} > r_{\text{table}}$ which is $0.992 > 0.4044$ with $r$ correlation obtained very strongly in the experimental class as seen in the correlation table and its interpretation shown in table 5.

Table 5. Correlation index and interpretation

| Value “r” product moment ($r_{xy}$) | Interpretation          |
|-----------------------------------|--------------------------|
| 0.00 – 0.20                       | Correlation is very weak |
| 0.20 – 0.40                       | Weak correlation         |
| 0.40 – 0.70                       | Medium correlation       |
| 0.70 – 0.90                       | Strong correlation       |
| 0.90 – 1.00                       | Correlation is very strong|

Sources: [62]

Calculation of normalized gain to find out the improvement of students’ cognitive learning outcomes in the experimental and control classes is presented in Figure 4.

Figure 4. The normalized gain value diagram

4. Conclusion
Based on data analysis, it was found that the application of EduPlasa media could decrease the percentage of students who experienced misconceptions in significant static fluid material. The difference in the average percentage decrease in the number of students who experienced misconceptions in static fluid material after being given remediation with EduPlasa interactive multimedia occurred significantly between the control and experimental groups. With normalized gain values the experimental class is 0.88 in the high category and the control class is 0.447 in the medium category. Interactive media can be said to be effective in overcoming student misconceptions because the percentage of students who experience misconceptions in the experimental class is lower than the control class and the increase in student learning outcomes in the experimental class is higher than the control class.

5. References
[1] Suparno, Paul 2013 Miskonsepsi dan perubahan konsep dalam pendidikan fisika (Jakarta: Grasindo)
[2] Doug L, Robert W D and Neil Y 2016 J. Learning and Instruction 44 74
[3] Irene A N D, Thalia M, Argyro F and Christos I 2016 J. Learning and Instruction 41 60
[4] Lucia M, Roberta B, Sara D R, Sara S, Robert W D and Gale M S 2017 J. Contemporary Educational Psychology 49 275
[5] Amalia M D, Jennifer Z and David N R 2018 J. Contemporary Educational Psychology 54 1
[6] Krista R M, Gale M S, Reinhard P, Philip H W, Gregory T, Kelsey M L and Brendan M
2018 J. Contemporary Educational Psychology 55 155
[7] Katinka B, Jasmine K, Martin V B, Paulvan D B and Panayiota K 2019 J. Contemporary Educational Psychology 56 67
[8] Kelsey K W, Andalusia M, Haley A V and Panayiota K 2019 J. Learning and Individual Differences 69 108
[9] Rifa’i M, Edy T and Syukran M 2018 Jurnal Pendidikan dan Pembelajaran 8 12
[10] Ulhamy A 2016 Jurnal Pendidikan dan Pembelajaran 6 1
[11] Esra K and Pinar K 2010 J.Procedia Social Behavioral Sciences 2 3111
[12] Maria K and Anthi G 2017 J.Computer and Education 109 122
[13] Ali G A and Balim G 2018 Jurnal Pendidikan dan Pembelajaran 8 12
[14] Ioannidou A I, Stephanos P and Panagiotis T 2010 J.Interacting with Computers 18 683
[15] Zulfa I, Woro S and Mukhayaratin 2016 Jurnal Inovasi Pendidikan Fisika 8 23
[16] Dalacosta K, Kamariotaki M P, Palyvosa J A and Spyrellisa N 2009 J.Computer and Education 52 741
[17] Konstadina D, Maria P K and Evagelia A P 2015 J.Procedia Social Behavioral Sciences 15 3272
[18] Rezan K 2015 J.Procedia Social Behavioral Sciences 46 2036
[19] Ertug E, Ali G B and Didem I 2009 J.Procedia Social Behavioral Sciences 1 2274
[20] Guliz A and Ali G B 2009 J.Procedia Social Behavioral Sciences 1 2258
[21] Chin S F and Norhayati M 2010 J.Procedia Social Behavioral Sciences 7 240
[22] Filiz A B Acar S F and Gulay K 2014 J.Procedia Social Behavioral Sciences 152 602
[23] Mahbub M Z, Kirana T and Poedjia stoeti 2016 Jurnal Pendidikan IPA Indonesia 5 247
[24] Raj K M, Kavi Kr, Khedo T and Venkata P 2018 J.Computer and Education 117 102
[25] Gurbuz H, Mustafa K, Mehmet El, Ali A and Sakip K 2010 J.Procedia Social and Behavioral Sciences 2 3043
[26] Sakip K, Ceren C and Hulya Kodan 2011 J.Procedia Computer Science 3 1341
[27] Limia A M, Abdel R, Mohammad A and Chin H L 2013 J.Procedia Social Behavioral Sciences 103 1319
[28] Yee C L, Viviana, Low L M, Chong S T and Jina N Y 2013 J.Procedia Social Behavioral Sciences 103 1088
[29] Sevda M 2014 J.Procedia Social Behavioral Sciences 98 1077
[30] Vetta V, Tony C, Garry H and Gaalen E 2011 J.Teaching and Teacher Education 27 1179
[31] Bayu R H and Subuh I H 2014 Jurnal Pendidikan Teknik Elektro 3 15
[32] Setiawan B 2015 Jurnal Pendidikan IPA Indonesia 4 97
[33] Akhils I and Dewi N R 2014 Jurnal Pendidikan IPA Indonesia 3 8
[34] Tessa B, Alexander S and Emma A 2018 J.Computers & Education 126 105
[35] Lilia H, Nor A B and Subahan T M 2010 J.Procedia Social Behavioral Sciences 2 2868
[36] Tabitha G M 2014 International Journal of Educational Development 39 100
[37] Mute’ah, Jackson S and Sukib 2016 Jurnal Pijar MIPA Unram 11 81
[38] Turhan C, Erdem U and Orhan G 2012 J.Procedia Social and Behavioral Sciences 47 1780
[39] Azzarkasyi M 2015 Jurnal Pendidikan Sains Indonesia 3 107
[40] Irsyaf E P, Adlim and A Halim 2016 Jurnal Pendidikan Sains Indonesia 4 13
[41] Ersen C and Remziye E 2009 J.Procedia Social and Behavioral Sciences 1 2470
[42] Apriliani S S 2016 Jurnal Pendidikan dan Pembelajaran 5 17
[43] Bakirci H, Arzu K B and Alper S 2011 J.Procedia Social and Behavioral Sciences 15 1462
[44] Handan M G, Oktay G and Meral H 2011 J.Procedia Social and Behavioral Sciences 15 1130
[45] Ramazan G and Osman B 2012 J.Computers & Education 58 931
[46] Lestaria 2016 Jurnal Pendidikan dan Pembelajaran 6 25
Acknowledgments

Thank you for all those involved in writing this article, those who have helped validate the media in the form of questionnaires as well as media usage guidelines and others. Media and animation experts who have been willing to validate the EduPlaza program, we thank you. We also thank the physics education lecturers who have given input and thoughts. Special thanks were conveyed to Prof. Dr. Djufri, M.Sc as Dean of the Teaching and Education Faculty and Drs. Agus Wahyuni, M.Pd as chair of the physics education department who supported the implementation of this study.