Needs Analysis of Air Quality Detection Tool in Project Based Learning

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Abstract. Riau is an area that tends to experience the effects of air pollution due to smoke haze and dust in the dry season, causes the need for early understanding for students in schools. For this reason, it is necessary to have an experiment media specifically designed for learning science physics on environmental pollution and global warming in secondary schools. Therefore, the purpose of the research is to analyze the need for an air quality detection experiment that can be used in project-based learning. This research uses the method of ADDIE model (Analysis, Design, Development, Implementation, Evaluation) which focuses on the analysis phase of the need for designing experiment media tools. The instrument of research collecting data was through interviews with teachers and giving questionnaires to junior high school students. The results of the research indicate that an experiment media tools that is easy to use, easy to carry, has instructions and is able to measure air quality digitally is needed. Based on the analysis of the aspects of the needs through interviews with teachers and questionnaire to students, basically teacher and students need an experiment tools media for detection of air quality in project-based learning in junior high schools.

1. Introduction

Learning media in the teaching-learning perspective is a means of transmitting or sending messages to achieve learning objectives effectively [1]. Media can be used to give instructions or explain a concept. Media is absolutely necessary in learning, because it functions as a trigger for ideas and makes it easier to understand a material. In addition, learning media enables increased communication that can accelerate and maximize learning outcomes [2,3]. Science as knowledge that facilitates students to study natural phenomena requires tools as learning media. Learning media are really needed especially if the material taught is abstract and difficult to be captured by the senses, such as the concept of electricity, the solar system, waves, particles and gas.

Learning media and technology are two things that work together. Technology and learning have a reciprocal relationship with each other [4]. The development of technology can improve the quality of learning if used appropriately and conversely the development of better learning, can improve science and technology. Designing digital learning activities and technology tools that can be applied flexibly is the key for integrated learning of current information technology [5]. Learning with technology must not only be interactive but must also support participation, teamwork, and interaction with digital tools [6]. One of application technological development in learning is to present technology-based
experiment tools in learning. One model that is suitable for learning environments by utilizing technology is through the application of project-based learning models.

Project Based Learning (PjBL) allows students to be actively involved in analyzing and solving a problem to find possible solutions to the problem. The given project usually presents problems about facts or phenomena related to the proposed learning material [7]. PjBL can be applied to learning in the classroom and outside the classroom [8]. PjBL allows students to take a role in the learning environment, take responsibility for their own learning, develop creativity, and learn to understand and compile information [9]. PjBL requires students to work on projects with an interdisciplinary approach to science, collaboratively, openly while student learning instructions and activities are guided in books or teaching materials that are arranged systematically [10]. PjBL is one of the learning models that provides real experience and opportunities to be directly involved in solving a real problem, for example the problem of alternative energy, air pollution, and global warming.

Environmental pollution and global warming material is part of science material for high schools. This material appears in the school curriculum in Indonesia as the impact of climate change and pollution is getting worse, especially in Riau which is always hit by fire disasters during the dry season. The impact of air pollution that tends to be difficult to control [11]. Learning about the causes and effects of global warming increases the ability to adapt and mitigate climate change [12]. Adaptation and mitigation of climate change requires knowledge, skills and behavioral changes obtained through education [13]. Through this change, students are expected to become agents of change in their environment [14]. The development of caring for the environment is one of the reasons why this material is available in the 2013 curriculum in Indonesia. Implementation of learning on this material requires good preparation so that learning objectives on this material are achieved. Preparations in question include the preparation of media and learning models. According to Asfuriyah and Nuswowati [15], the delivery of global warming material requires a media that is able to integrate the concepts of environmental pollution and global warming well. The choice of media must be a particular concern, because good media in addition to delivering information also serves to arouse students' motivation in learning.

The problem that exists in environmental learning such as environmental pollution and global warming is that learning on this material is still mostly done conventionally with simple media such as pictures. Some educators apply certain learning models, but minimal learning media. As a result, the learning that is carried out seems monotonous and feels boring to students. In addition, conventional learning and without media causes learning goals not to be achieved effectively and efficiently. Even though the key to the success of effective and efficient learning is the teacher can create an atmosphere that attracts the attention of students and students learn more than conventional learning [16]. Referring to these problems, it is necessary to do an analysis of needs related to the right media to be designed that can be used in learning by using several methods that are integrated in the project-based learning model. Therefore, the purpose of this study is to analyze the need for an air quality detection tool used in learning in schools through the application of project-based learning.

2. Methodology

This research is a development research using ADDIE model through 5 phase, namely the Analysis, Design, Development, Implementation and evaluation Evaluation [17]. The research focuses on the needs analysis phase to describe the user needs phase for the design of air quality testing tools media. The research subjects were students of class VIII SMP 25 Pekanbaru Indonesia, in 2019. The instrument of data collection was through interviews with 2 physics teachers and a questionnaire sheet for 37 students. The questionnaire sheet consists of 2 aspects, namely: aspect 1 about the level of learning difficulties in physics science, methods and types of media used in learning with 4 criteria; aspect 2 related to experiment media tools and models in learning environmental pollution and global warming with 9 criteria. Analysis of interview data is presented descriptively related to learning physics, media, methods and models as needed. While the results of student questionnaire data analysis, expressed in percentages displayed in graphical form for aspect 1 and in the form of tables.
for aspect 2. Criteria for conclusions are determined based on the level of dominance of the results of interviews and questionnaires from respondents. The air quality testing tools media was stated as needed if the majority of respondents' data analysis results agreed and if the majority did not agree it was not necessary.

3. Results and Discussion

The results of the analysis of students' response data for aspect 1 with 4 criteria namely the level of difficulty in learning physics, the frequency of method use, the frequency of media use and the appropriateness of media use in learning environmental pollution and global warming are shown in Figure 1. Figure 1 shows the relationship graph of respondent responses to the criteria for aspect 1, where each criterion has 4 choices of statements.

Criterion 1 is related to impressions in learning physics including subjects with choices: very difficult, difficult, easy, and very easy. Respondents gave the majority response (81%) stated physics as a difficult subject, even 14% stated very difficult. Very few states that say easy is 5%, while statements are very easy 0%. This shows that even though a new curriculum has been implemented, there is still a need for additional solutions to overcome the learning difficulties of students.

Criterion 2 relates to methods often used in learning physical science with choices: lecture, discussion, experiment, and other methods. Respondents gave the largest percentage of responses to the discussion method 70% followed by the experiment method 46%, while the smallest was the lecture method 11% and the other method 24%. The choice of method should be good enough, but this data is not in accordance with reality, which in criterion 1 is still dominant to say that physics is difficult. This means that the discussion method has not been carried out optimally, as well as the experiment method which is not yet optimal, because there is not enough available experiment media.

Criterion 3 concerns the types of media that are often used in learning physics with choices: image media, video, experiment tools, and other media. The response of the dominant statement based on Figure 1 was 59% of the experiment media, followed by 51% of the image media. While the responses of respondents who are few namely 19% of other media, even 0% video media. This shows that although the experiment tools media are dominant, they are not yet optimal, including image media which should be transferred to better media such as video media. Furthermore, for criterion 4 of Figure 1, which is the type of media that is most suitable in learning environmental pollution and global warming materials with choices: image media, video media, experiment media, and other media. The most appropriate responses obtained by respondents were 70% image media, 30% for video media and

![Figure 1](image-url). Graphic results of students' responses about learning science in physics, methods and media.

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experiment tools media, while other media were only 0.5%. This data shows that the most dominant type of media used in learning is image media. This situation is of course due to the lack of use of media such as video and experiment tools media. So that these results become the basis for the need for an experiment tool media that can display the facts in the environment.

**Table 1.** The results of the students' agreement on the needs of the experiment tools media.

| No | Statement Items                                                                 | Student Responses (%) |
|----|---------------------------------------------------------------------------------|-----------------------|
| 1  | It is important and interesting if in learning to use experiment tools media that can determine the occurrence of pollution in the air environment | 89.2                  |
| 2  | Support the creation and development of learning media that can display digital numbers related to the level of pollution of the air environment | 83.8                  |
| 3  | Learning media can display indicators/indicators such as the color of lights that indicate the state of air quality in the environment | 94.6                  |
| 4  | Learning media that are made can detect types of gases harmful to human life such as CO, CO₂, and dust particles that indicate the state of environmental pollution (air) | 94.6                  |
| 5  | Learning media are made easy to use, easy to carry, and the size is appropriate as a learning media | 97.3                  |
| 6  | Media that is created has guidelines or guidelines for how to use it             | 91.9                  |
| 7  | Media created can help understand air pollution and the impact of pollution on global warming significantly. | 81.8                  |
| 8  | Media tools that are made to detect air quality, should be used in learning by implementing appropriate learning strategies or models | 86.5                  |
| 9  | The use of media tools made should apply a learning model based on the project, because it can directly know the air quality in a particular environment and can report the results | 94.6                  |

Average response 90.5

The results of the analysis through interviews to physics science teachers for aspect one were obtained for the criteria 1 respondent 100% stated the use of media is not always important, but depends on the subject. Even though every physics science subject should be very important to use media assistance in helping students understand the subject. Based on the criteria 2 respondents stated 100% often use three methods namely: lectures, discussions and experiment methods. This fact shows that the lecture method is still dominant, while the discussion and experiment methods, although chosen, are in fact not optimal because the lecture method is still dominant. Furthermore, from the criteria 3 media images 100%, 50% video media, meaning that there is no media available for experiment tools in learning environmental pollution and global warming. Furthermore, from the criterion of 4 respondents 100% stated that the use of image and video media is the most appropriate in learning environmental pollution and global warming. This is a factor in the difficulty of learning physics for students. Teachers still tend to think that only the best image and video media. Even
though it should be able to provide an experiment tools media that is able to train cognitive abilities, psychomotor, and environmental care attitudes through the results of direct observations using an air quality experiment tools based on real data. The use of experiment tools media can certainly change the views of students who consider physics difficult, into enjoyable learning.

The results of the analysis of aspect 2, namely aspects of the needs of students containing 9 criteria are shown in Table 1. Statement of student agreement regarding the need for experiment media for project-based learning on environmental pollution and global warming subjects, the lowest results obtained 81.8%, namely statements related to media created can help to understand the material significantly, while the highest 97.3% related to learning media that are made easy to use and easy to carry, as well as the appropriate size. Overall, an average approval of 90.5% was obtained. These results indicate a high percentage of the student's agreement stage to the need for an experiment tools for measuring air quality. This is triggered by frequent air pollution in the form of dust and smoke by motorized vehicles in cities, industries or companies that use fossil fuel oil and coal as well as dust and smoke caused during land fires in the dry season which have a negative impact on humans in Riau and its surroundings [18, 19, 20, 21].

The results of the analysis through interviews with science teachers of physics science, it is known that teachers generally feel the lack of media in the form of experiment tools especially for learning environmental pollution and global warming subjects, thus agreeing on the importance of experiment tools to make students are more interested in learning so they can easily understand them, supporting making appropriate experiment tools media, the media can show the level of water quality in the form of light colors and digital numbers, can detect gases that cause pollution, the media is easy to use and carry, and has easy to understand usage guidelines. In addition, the teacher also agreed to produce experiment tools capable of facilitating the understanding of the material, and fulfilling learning that applies the project based learning model. Each statement related to teacher approval was scored 100%. This shows how important the water quality detection experiment tools are to be realized so that they can be used in project-based learning. Air quality test experiment tools as needed, can be designed using an arduino microcontroller which is equipped with various air quality sensors and other supporting tools and materials.

The air quality detector as a media that supports project based learning on environmental pollution and global warming materials is a media that can be used to create a more meaningful learning atmosphere. Environmental learning will be more successful when it focuses on local aspects, real, sustainable, especially if it can be handled by individual behavior [22]. The use of air quality detectors allows students to take direct measurements of the surrounding air quality. This will provide a different learning atmosphere and be able to increase the motivation of students because students are directly involved. The implementation of learning like this indirectly fosters a caring attitude towards the students.

4. Conclusion
Based on the results of an analysis of the need for air quality experiment tools in project-based learning, it was concluded that the majority of teachers and learners agreed on the need to design the air quality test experiment tools that could detect how much the level of air pollution occurred in the environment. The tool is designed to be easy to use, easy to carry, has instructions for use, has air quality indicators and provides measurement results digitally.

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References

[1] Naz A A and Akbar R A 2011 Use of Media for Effective Instruction its Importance: Some Consideration Journal of Elementary Education 18(1-2) 35-40

[2] Upadhyay M 2017 The Utility of Media in Education Journal of Content, Community & Communication 5 32-37.

[3] Taufiq M, Dewi N R and Widiyatmoko A 2014 Pengembangan media pembelajaran IPA terpadu berkarakter peduli lingkungan tema “konservasi” berpendekatan science-edutainment Jurnal Pendidikan IPA Indonesia 3(2) 140-145

[4] Yanti M N, Ihsan and Subaer 2017 Development of Interactive Learning Media on Kinetic Gas Theory at SMAN 2 Takalar Journal of Physics: Conf. Series 812 012029 doi:10.1088/1742-6596/812/1/012029

[5] Lin M H, Huang C C and Liu K S 2017 A Study of the Effects of Digital Learning on Learning Motivation and Learning Outcome EURASIA Journal of Mathematics Science and Technology Education 13(7) 3553-3564

[6] Siemieniecka, Dorota, Wioletta K, Kamila M and Malgorzata S 2017 The Potential of Interactive Media and Their Relevance in the Education Process: International Journal of Psycho-Educational Sciences 6(3) 1-10

[7] Amamou, Sonia and Cheliniti B L 2018 Tutorial In Project Based Learning Procedia Computer Science 126 176-185

[8] Efstratia D 2014 Experimental Education Trought Project Based Learning Procedia-Social and Behavioral Sciences 152 1256-1260

[9] Ergul N, Remziye and Kargin E K 2014 The Effect of Project Based Learning On Student’s Science Success Procedia – Social and Behavioral Sciences 136 537-541

[10] Chu, Samuel K W, Yin Z, Katherine C, Chi K C, Celina W Y L, Ellen Z and Wilfred L 2017 The Effectiveness of Wikis for Project-Based Learning in Different Disciplines in Higher Education Internet and Higher Education 33 49-60

[11] Vita Y I 2016 Peran dinas kota pekanbaru dalam menanggulangi dampak kabut asap kebakaran hutan di kota Pekanbaru Kutubkhanah: Jurnal Penelitian sosial keagamaan 19(1) Januari-Juni

[12] UNITAR 2013 Integrating Climate Change in Education at Primary and Secondary Level Malawi

[13] Anderson A 2010 Combating climate change through quality education. Washington DC Brookings Global Economy and Development

[14] Falaye F V and Okwilagwe E A 2016 Assessing the Senior School Students’ Knowledge, Attitude and Practices Related to Climate Change Implications for Curriculum Review and Teacher Preparation JISTE 20(1) 43-53

[15] Asfuriyah S and Nuswowati M 2015 Pengembangan Majalah Sains Berbasis Contextual Learning Pada Tema Pemanasan Global Untuk Meningkatkan Minat Belajar Siswa Unnes Science Education 41 739-746

[16] Pradono S, Maria S A and Jurike M 2013 A Method for Interactive Learning International Journal of Communication and Information Technology (CommIT) 7(2) 46-48

[17] Darryl L S 2014 Design models and learning theories for adults American Society for Training & Development (ASTD) Pages 181-199

[18] Doni W C, Hendro E and Ufira I 2017 Analisis dampak bencana kabut asap kebakaran hutan dan lahan terhadap pdrb sektor transportasi Angkutan udara di provinsi riau Tahun 2005 – 2014 JOM Fekon 4(1) 1149-1163

[19] Awaluddin 2016 Public health complaints due to haze Forest and land fires in the city of Pekanbaru Riau Journal Endurance 1(1) 37-46

[20] Fathuddin Y and Muhammad A 2017 Pekanbaru City Air Pollutant Data Clustering Using the K-Means Clustering Method Jurnal CoreIT 3(2) 76-81
[21] Sri F R, Oktaviana S, Elsie and Wahyu 2014 Analyze the growth rate of CO2 emissions in Pekanbaru city by using powersim *Jurnal Photon* 4(2) 59-66

[22] Anderson A 2012 Climate change education for mitigation and adaptation *Journal of Education for Sustainable Development* 6(2) 191-206