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PISCES**Proceeding of Integrative Science Education Seminar**Journal homepage : <https://prosiding.iainponorogo.ac.id/index.php/pisces>**Article****Integrated Science in Teaching Aids-based Learning Media with Water Pollution Models in Virtual City Construction**Fadila Nur Azyza ^{1*}, Kharisma Ika Nur'aini ², Maheta Purwaning Astuti³, Rahmi Faradisya Ekapti⁴¹²³⁴Institut Agama Islam Negeri Ponorogo, Indonesia*Corresponding Address: fadilnurazyza.19@gmail.com**Article Info**

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ABSTRACT

Water pollution on the subject matter pollutions are already very much inherent in everyday life, but do not know in detail and in depth the process of its occurrence and only know the basic theories of such contamination. The background of this problem requires strategies to enable students to learn more in depth of the material, namely by developing a safety device with a model of water pollution. This research is research by integrating between biology and physics, through the phases of ideas, design, testing and product development. At the phase of ideas innovation is obtained from the background of the problem and its solution. In the design phase, the product was produced in the form of a sewer with a model of water pollution in urban areas, where the water contamination was generated as a result of man-made activity. The components of water pollution are produced from factory waste, buildings, oil spills. While the testing and development phase is carried out through the integration of physics that applies the concept of filtration, i.e. contaminated water becomes clear water back due to the presence of a simple filtration device, the development of this device is analyzed after the identification of the success of the test process.

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INTRODUCTION

The field of education continues to grow, and education reform initiatives are growing rapidly, therefore, integrated learning is needed. The use of learning media as an integrated tool in the learning process can help students understand different concepts and improve their learning outcomes. (Khasanah, 2018). Integrated learning tools can help students develop, refine, and transform ideas into concrete forms (Mulyati, 2017). Integrative learning tools can help students in developing the practical skills needed to face education and technology in the future.

Learning media have a significant role to play in improving student understanding, especially in complex scientific concepts, through interesting presentations (Delita et al., 2022). This makes it easier for students to understand the learning material visually, especially in the IPA subjects. IPA Subjects are often considered challenging for students, because many teachers provide the material only through lecture methods, resulting in students getting bored and having difficulty in understanding the material delivered. Minimum personal experience and student involvement in the learning process can also cause material to be difficult to understand because IPA subjects are abstract (Suyono dkk., 2009). In this case, an innovative learning medium is needed that combines conceptual knowledge with the skills to create or reconstruct visual images of an abstract nature. This skill is essential for students to distinguish between mental representation and actual representation through physical molecular models (Kuit & Osman, 2021).

The natural science subjects consist of a large amount of material, which is divided into three categories: biology, physics, and chemistry. Each of these subjects has its own distinctive characteristics that distinguish them from each other. When submitted separately, students will only have a limited understanding of concepts and will have difficulty in connecting information from various materials that have been studied in everyday life (Muda, 2013). This requires an integrated learning application involving more than one subject to understand not just one subject. According to Fogarty (1991), the most complex of curriculum models are the sequenced, shared, webbed, threaded, and integrated models. Of these, the model that combines several materials is the Integrated model (Drake & Burns, 2004).

In order to effective learning processes, relevant learning models and innovative learning means are required. During the learning process, it is important to use innovative learning methods to ensure that learning proceeds pleasantly and learning goals can be achieved successfully. However, the problem faced in the learning of IPA subjects is the lack of innovative tools. The tools used in the learning process are mostly outdated and tend to be boring, resulting in less interactive and boring learning processes. There needs to be an innovative interactive teaching tool such as the Water Pollution Modeling Tool on Virtual City Construction. The water pollution tool is a tool that can stimulate the mind, emotions, skills, attention, and willpower of students so as to streamline the learning process in students. In addition, it gives students the opportunity to engage actively in every learning process, thus creating an interactive learning experience (Loban et al., 2021).

However, the compatibility of the instruments of instruction with the materials taught should also be noted. Taking into account the consistency between the materials taught and the tools used, will provide a clear representation of the material to be delivered, thereby stimulating critical thinking of the students about the material. Research conducted by Jarvinen (2007) shows that children aged 11-14 have a thinking ability that produces unique ideas, which can be stimulated by educators through interactive learning processes using appropriate learning models and media. The goal of the author is to improve students' understanding of IPA learning materials by integrating between materials so that learning works effectively.

METHODS

The method used in developing this innovation is to modify 2D techniques into 3D. The 3D development model consists of three stages: (1) Definition, (2) Design, and (3) Development (Setiawati, 2017). During the definition phase includes the process of definition or analysis. It begins by identifying the problems and conditions necessary for the development of innovative learning media. The definition stage begins with the analysis of the first and final findings. This phase of analysis covers the identification and determination of fundamental problems faced by students in IPA learning that require solutions through the development of learning media strategies. At this stage the author identifies and defines the learning innovations that will be created to solve the problems faced by students in IPA learning. The first phase begins with analysing the contents of the KD (Basic Competence) on biological material namely environmental pollution and aligning it with relevant physics and chemistry topics to create an integrated learning medium. This phase is done to identify the interrelationship of the material to be delivered during the learning process. The second stage

involves sketching and preparing the tools and materials needed to make these shields. The equipment needed was glue, scissors, cutters, clamps, hammer, while the materials needed to make urban reconstruction included 2 wooden boards, 7 nails, paint, plastic coatings, grass and synthetic trees, water pumps, water tubes, bottles, and water container boxes. The materials used for filtration included fine sand, coconut straps, shrubs, coals, sponges, and cotton. Stage three of making a shield with the following steps:

1. Prepare the necessary tools and materials.
2. Make replica sketches of river, urban, and factory on wooden boards.
3. Cut a sketch on a wooden board with a scissor and unite the pieces of the sketch with a shot glue to make replicas of rivers, cities, factories, and highways.
4. Apply paint on each replica according to sketch figure
5. Set the filtering layer in sequence on the water container starting from fine material, coconut straps, cherries, coal, sponges, and cotton.
6. Wrap the wooden board with a plastic layer.
7. Install the water hose on the wood board and connect the hose with the water pump and water containers that have been equipped with filtration.
8. Set up all replicas of rivers, urban, factory, road, synthetic trees and grass on the timber board.

At the learning media stage of the IPA lecturer and teacher of IPA SMP through the validation test instrument which includes several evaluation components including the conformity component of the test item as many as 3 tests, the accessory component as much as 3 test items, the ease of use component such as 1 test item, as well as the clarity components of one test item so that the total test of 8 items resulted in an innovative learning device using the innovation of a safe tool that can be used for learning. At the development stage, the authors evaluate the validity of the product by seeking input from learning media experts, lecturers and IPA teachers. Using the instrument as an assessment guideline consisting of 8 assessment criteria, a box of suggestions & criticisms, and a statement of conclusion. The data collected is subsequently processed using the average rating method for each validator with the following calculation: The validation test results are calculated using the Average Rating per Validator formula.

Average Rating per Validator:

$$Final\ Score = \frac{\sum Score\ Obtained}{\sum Item\ Score}$$

Final Value of Validation Test :

$$Final\ Value\ of\ Validation\ Test = \frac{\sum validator\ final\ value}{\sum validator\ final\ value\ item}$$

Score Interval (Lailiyah, 2010)

Table 1. Interval Score and Eligibility Criteria for Learning Media

Score Interval	Information
7,25 – x – 7,75	Very good
2,15 – x – 4,25	Good
1,45 – x – 1,85	Not enough
1,00 – x – 1,15	Very less

RESULTS AND DISCUSSION

Research with water pollution models on the construction of virtual cities through the research process carried out using 3D development paradigms (define, design, and develop).

1. Early and recent analysis at the early stage of analysis,

The problem identified was that the IPA material was divided into three categories: biology, physics, and chemistry, each of which had its own characteristics. This leads to a lengthy process of delivery of IPA learning because the material is presented according to its categories. Besides, the material used by teachers in teaching is less attractive, most of the instruments are outdated and boring. As a result of this problem, learning media innovations have emerged that integrate different categories of material to shorten learning time. Therefore, IMPIPA was created as a teaching tool to demonstrate water pollution in urban development virtually.

2. Analysis of material concepts

The analysis was carried out to ensure the concept - concepts that can be delivered using the IMPIPA tool. The concept was formed based on the material experienced by students in everyday life, with the target students of 8th grade. The material is adapted to the Curriculum Merdeka established by the government, within the scope of the material which can be presented by using the ImpIPA tool, among others: a. Environmental pollution process b. Causes of water contamination c. Consequences of water pollution d. Methods for reducing water pollution The integrated material analysis of the Impypa tool includes : a. Mixing of liquid substances b. Filtration (separation of liquid substance) c. Property analysis - fluid properties

3. Specification Learning purpose

Based on the concept of material analysis it is known that the specification of the learning objectives of materials delivered through the learning media is as follows: students can understand the process of occurrence of environmental contamination, students can identify the factors caused by the impact of water, as well as the nature of fluid contamination.

Design phase

In the design phase, the initial process is with the creation of a design or early design of the development of a learning device, which is divided into several stages. The first phase begins with analyzing the content of the basic competence (KD) of biology that is environmental pollution and aligning it with relevant topics in the fields of physics and chemistry to create an integrated learning medium. This step is done to map the correlation between the material to be taught during the learning process. The second phase involves sketching and preparing the tools and materials needed to make this demonstration tool. The necessary equipment includes hot glue, scissors, cutting machines, cranes, hammer, while the materials needed to make urban reconstruction include 2 wooden boards, 7 nails, paint, plastic coatings, grass and synthetic trees, water pumps, water tubes, bottles, and water containers. The materials used for filtering include fine sand, coconut straps, shrubs, coals, sponges, and cotton. The third phase of the toolmaking process consists of the following steps:

- a. Preparing the necessary tools and materials.
- b. Creating sketches of replicas of rivers, urban areas, and factories on wooden boards.
- c. Cutting a sketch on a wooden board with a scissor and uniting the pieces of the sketch using hot glue to make replica of river areas, urban regions, factories, and highways.
- d. Applying paint on each replica according to the drawing.
- e. Apply a plastic coating layer on the wooden board
- f. Install a water hose on the wood board and connect the hose to the water pump and water container that has been equipped with a filter.

- g. Assembling all the replicas of rivers, cities, factories, roads, synthetic trees, and grass on wooden boards.
- i. Testing learning tools.



Figure 1. Media Innovation Learning Tools on Urban Environmental Pollution (IMPIPA)

IMPIPA Innovation Tool for Integrated Learning Media

IMPIPA is an innovative IPA learning media tool developed by integrating environmental pollution material with the concepts of physics and chemistry. Integration is a curriculum paradigm that connects many subjects by connecting environmental pollution loads to physical separation loads and chemical properties analysis. By using IMPIPA safety tools during the learning process, students can directly see environmental pollution and listen to the teacher's material explanations interactively. To provide an effective learning experience, students are directly involved in the learning process through the use of IMPIPA safety tools. Research findings conducted by English education and pedagogy experts show that the learning experience of students greatly affects their understanding of a subject. It's known that students learning outcomes of 10% reading, 20% listening, 30% observing, 50% watching, 60% speaking, and 90% speaking and doing (Juwairaiyah, 2013).

Based on the results of the research, it can be concluded that IMPIPA teaching tools can shape the learning experience of students through observation, hearing, and demonstration of such teaching instruments.

Development Phase (Evaluation and Development)

At the development stage, a validation test was carried out against the innovation of environmental pollution prevention tools by 4 people learning media experts including 3 lecturers of IAIN Ponorogo and 1 teacher of IPA SMP/MTs. From the results of the validation test instrument used in the evaluation of innovation, this tool consists of several evaluation components, including the conformity component, the component of completeness, the convenience component and the clear component.

Table 2. IMPIPA Validation Test Results

Validator	Score Obtained	Item Score	Final Score	Category
Science Lecturer 1	34	15	2,26	Good
Science Lecturer 2	31	15	2,06	Good
Science Lecturer 3	36	15	2,4	Good
Science Teacher 1	39	15	2,6	Good

Based on Table 2 shows that the validation test results carried out by IPA lecturers and teachers with an average final result of 7.37 are in the very good category of environmental pollution prevention tool innovation. With the conformity and material completeness components showing a good level of presentation. The ease and clarity components of the validation assessment indicate an excellent level of presentation. There are comments and

suggestions from the validator on the design of environmental pollution protection tools. This overall pollution protection tool is good but it needs improvements to the filtration tool (technology) to be more attractive in the product or appearance so that it becomes part of the main product due to environmental contamination material and it needs to be the addition of guidelines how to use the protection tool to make it easier for the people who use it. The author's response to the criticism of the results of the validation by the lecturers and teachers of the IPA is to improve the work using the given criticism, continuously strive to enhance the quality of the work, do not give up and will take criticism as part of the process of learning and self-development. The results of the criticism stating that the filtration made is still conventional, does not show or produce a sophisticated and attractive filtration tool based on development or innovation on the existing technology is a valid thing to cover the shortcomings of the innovation made, besides realizing that a less sophisticated and less attractive filter tool can affect the quality and attractiveness of such a tool. Therefore, the author will pay attention to such criticism and strive to improve quality and appeal of the filter tool made. Find out how to create more sophisticated and exciting filtering tools to meet user needs. In addition, the author also acknowledges that the less flexible part of the filter displayed tends to be less practical resulting in the need for a great deal of effort to operate it. In addition, the author also realizes that in the manufacture of the filter device is also considered less effective because in the operation against contaminated water pollution material, the results obtained water can't be clear, so still a little polluted. Therefore, the criticisms submitted by the validator, the author quite acknowledges the way of realizing that it needs to be corrected and developed again.

CONCLUSION

The study focuses on the integration of learning media based on water pollution models on virtual urban construction. The aim of this study is to enhance students' understanding of air pollutants through integrating biology and physics, by generating ideas, planning, developing, and producing a product. The study also investigates the role of the media in visualizing learning concepts, in the eyes of the IPA Lesson. The study highlights the need to utilize innovative learning tools that can apply conceptual knowledge and creativity to create visually attractive structures. This approach helps students in understanding the relationship between mental representation and actual representation through physical models.

The research focuses on the development of innovative learning media with the paradigm of 3D modeling. The model consists of three steps: definition, design, and development. The definition includes the identification of the needs and conditions necessary for developing an innovative learning medium. Design involves the process of making structures and providing the materials necessary for making learning media. Design involve the process to create and assemble a variety of components and materials for use in learning media, the materials used include wood, plastic, and plastics, as well as materials for learning media making. Validation involves a product verification process using input from learning media, teachers, and experts. This study uses standard tests to assess the validity of the product.

IMPIPA's teaching tools facilitate this integration, and its capabilities include assessment of environmental pollutants as well as their correlation with physical substance content and analysis of chemical properties. According to research carried out by experts in education and pedagogy, the IMPIPA teaching tool creates an extremely effective learning experience with an 80% comprehension rate.

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