FINAL PROJECT PROPOSAL
COURSE: VISUAL PROGRAMMING.

Wastemath: Mathematics Educational Mobile Game for Estimation and Measurement of Nonstandard Units with STEM-based Environmental Care Approach

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1. **Background**

    Basic mathematics education plays an important role in shaping children's skills from an early age. However, in Indonesia, it is still a challenge, especially because many primary school students do not understand basic mathematical concepts (Wiryana & Alim, 2023). This lack of understanding can hinder the development of critical thinking skills needed to solve problems in everyday life. One of the basic concepts that needs special attention is the measurement of length, mass, and capacity using non-standard units, although this material is part of the Merdeka Curriculum implemented in primary schools.

    In addition, awareness of environmental issues, such as waste management and its impact on climate change, needs to be instilled in primary school students (Victoria Olasoji, Ukamaka Felicity, & Onoh, nd). Innovative, interactive, and relevant education with the concept of sustainability is essential to create a generation that cares about the environment. By integrating STEM (Science, Technology, Engineering, and Mathematics) education and the Sustainable Development Goals (SDGs), especially SDG 4: Quality Education and SDG 13: Addressing Climate Change (Suryani, Kun, & Haryanto, 2023). That way, children will be equipped with a deep understanding to practice good waste management to become environmentally responsible citizens.'

    The application of interactive learning media, such as Unity-based game development, is able to provide a fun and educational learning experience (Austin Widjaja, Jefferson, Ferdinand Binsar Siahaan, & Chow, nd). This media not only improves the understanding of basic mathematical concepts but also forms better environmental awareness through an understanding of waste management and its impact on climate change (Lestari, Nurapriani, & Kusumaningrum, 2024). With a relevant and innovative approach, this learning media has great potential to be used by educators and families in supporting STEM-based and sustainable education.

2. **Media Description**

   1.1. Media Ideas

   Wastemath (Mathematics and Waste Processing) is a game-based learning application designed to improve primary school students' basic math skills, especially in the results of estimating and measuring length, mass, and capacity using non-standard units. This application provides an interactive, fun, and relevant learning experience, while instilling values of environmental concern. Through this approach, students not only learn math skills, but they can also understand the importance of preserving the environment through various learning contexts.

   1.2. Media Objectives

   This application is designed as a practical, effective, and engaging solution to help students develop basic math skills, while supporting the development of STEM (Science, Technology, Engineering and Mathematics)-based learning media in Indonesia. In addition, this application is also made by combining math learning with environmental awareness. Wastemath is a simple first step but has the potential to have a big impact in preparing a smart and resilient generation to face the challenges of the world.

   1.3. Media Targets

   Wastemath is a media aimed at primary school students, namely students who are in regular and international schools. Where in regular schools students can study mathematics and English.

1.4. Benefits of Media

By combining basic mathematical concepts and environmental awareness, Wastemath offers a variety of benefits that support the cognitive, emotional, and social development of primary school students. Here are the benefits obtained from using this learning media:

1. Improve basic understanding of mathematics in the concepts of estimation and measurement, as well as understanding the importance of environmental awareness.

2. Creating a fun learning experience and supporting diverse learning styles, through game-based learning.

3. Developing students' critical thinking skills so that they become accustomed to solving problems and making decisions based on these problems.

4. Supporting STEM (Science, Technology, Engineering, and Mathematics) based education that helps students understand concepts holistically.

5. Forming students' characters with global insight, through the integration of sustainability values, Wastemath instills awareness of environmental issues for a more caring generation.

6. Encourage collaboration between teachers and students in supporting the learning process at school and at home.

1.5. Media Relevance

Wastemath is a media that is relevant to the needs of education in Indonesia and environmental awareness. In addition, this application is also designed to instill environmental awareness, support transformative education and is relevant to global challenges and sustainability goals.

3. Media Concept

3.1 Media Diagram

The gameplay of the installed Wastemath game is as follows.
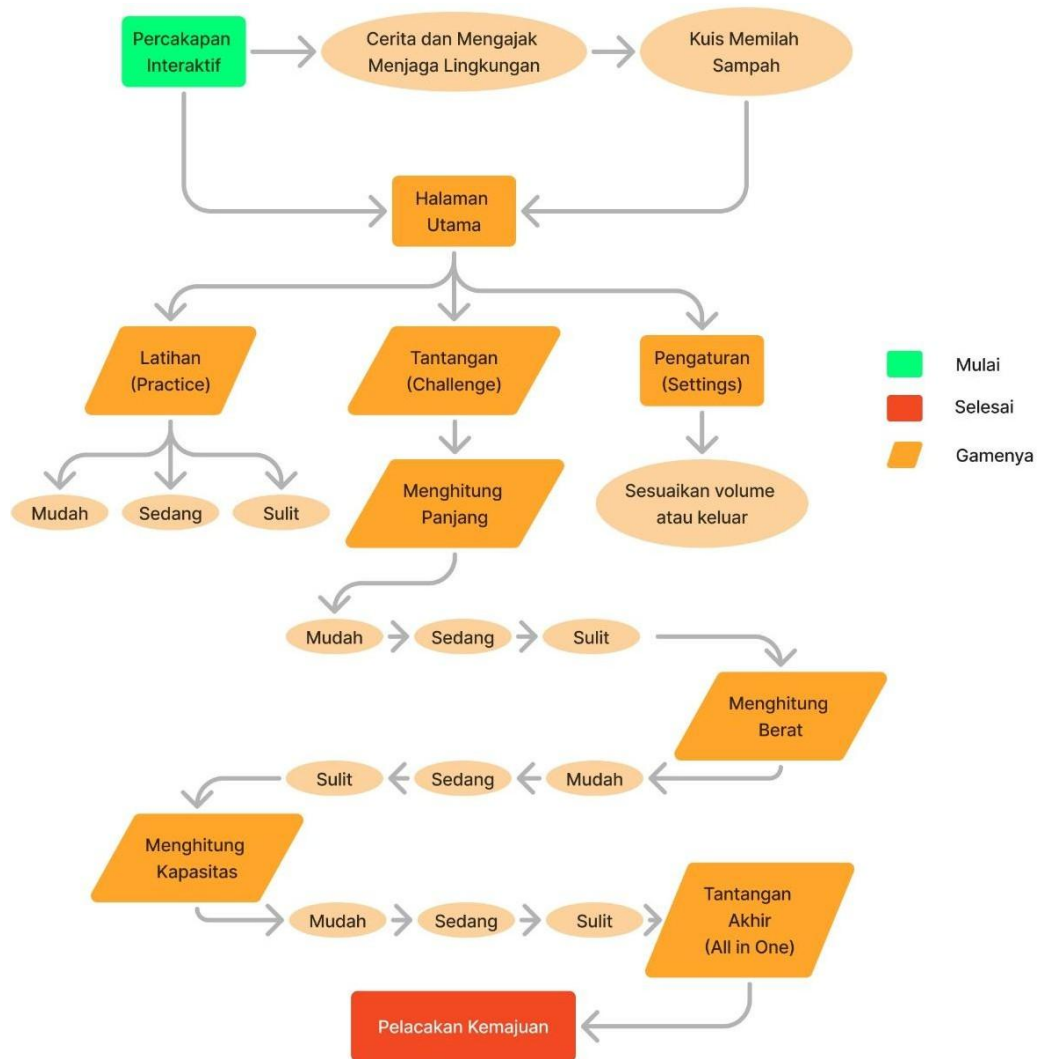
3.2. Key Features of Media

   a. **Interactive Conversation**

   This conversation discusses ways to sort and recognize waste that can be naturally decomposed (organic) and that which cannot be decomposed (non-organic), which is equipped with questions as a means to encourage students to care more about the environment.

b. Practice Mode

This feature allows students to practice their math skills before playing in challenge mode. There are three difficulty levels, easy, medium, and hard, which provide various challenges according to the player's skill level.

c. Challenge Mode

This feature provides students with the opportunity to test their knowledge and skills in non-standard units of measurement through several challenging quizzes. The challenge mode is divided into various categories, such as length, mass, and capacity. This provides a more comprehensive and in-depth learning experience regarding various types of measurements.

d. Progress Tracking

This application provides a progress tracking feature through a summary of scores for each game. This feature helps students monitor their progress in learning and identify areas that need improvement, so they can focus more on aspects that need to be improved.

e. Overall Challenge (All in One Mode)

This feature allows students to play all categories of the challenge mode in one session. This feature provides a comprehensive review of the lessons learned in practice mode and also the various categories in challenge mode. This way, students can strengthen their understanding thoroughly in one practice session.

f. Clear and User-Friendly Interface

Wastemath has a simple and user-friendly interface, which makes for a fun and engaging learning experience. It also includes a text-to-speech feature, which allows students to hear questions and instructions read aloud. This feature is especially useful for students who prefer to study with audio guidance, making it easier for them to understand the problems without having to read the text.

3.3. Initial Media Sketch

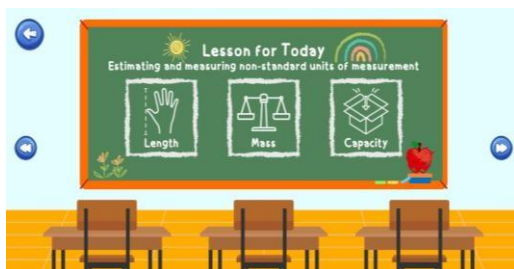*Figure 1. Waste sorting quiz*

Picture 2. Main page

Figure 3. Challenge page
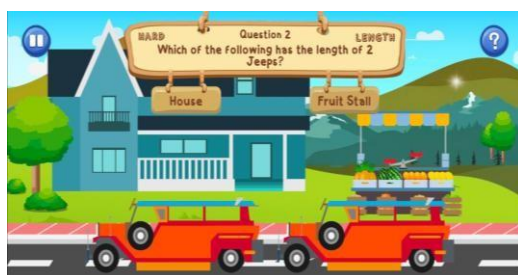

Picture 4. Level of difficulty of exercise

Figure 5. Example questions

Picture 6. Score results

4. Technology Innovations Used

In developing Wastemath game learning media, we use three main platforms, namely Unity 2021, Figma and C#.

1. **Unity 2021**

   Unity was chosen because of its flexible and reliable ability to create interactive games with attractive visuals. This platform is used to create game animations and integrate with programming. In addition, Unity is used in implementing development results on Android devices, so that this game is easily accessible to users.

2. **Figma**

   Figma is used to design clear and easy-to-use user interface (UI) designs, especially for primary school students. By using Figma, the design process is more structured and efficient, so that the layout and visual elements can be designed optimally to support learning (Viktor & Rydgren, 2023).

3. **C# Programming Language**

   In building game logic, optimally organizing user interactions, and compiling mathematical functions, we use C#. This programming language is integrated with Unity to create interactive and responsive games. This combination of technologies produces innovative and effective digital learning media in improving students' understanding of basic mathematical concepts (Ilić, Mikić, Gligorijević, & Zlatkovic, 2023).

5. Sustainability and Transformation

5.1. Impact on Education

   Wastemath is a STEM-based digital learning media designed to have a major impact on the world of education in Indonesia. By using digital technology, this application not only educates students in terms of academic knowledge, but also builds broader social awareness, making education more relevant and applicable to real-world challenges. Wastemath also supports the achievement of Goals

Sustainable Development Goals (SDGs), especially in Quality Education (SDG 4) and Climate Action (SDG 13), and enriching the technology-based education system in Indonesia. This allows students to engage in a more meaningful, relevant, and sustainable learning process.

5.2. Twenty First Century Transformation

Wastemath is a digital learning media that supports major changes in education in the 21st century by utilizing technology to create learning that is more inclusive and relevant to future challenges. In this era, education is not only focused on mastering knowledge, but also on developing the skills needed to adapt to global changes that are taking place so rapidly. By using the STEM (Science, Technology, Engineering, and Mathematics) approach, this application is expected to encourage students to be able to think critically, solve problems, and develop creativity in facing complex challenges (Vankúš, 2021).

On the other hand, this application also teaches sustainability values by connecting math lessons to global issues such as environmental management, which are very relevant to the needs of today's world. Through this approach, this application helps prepare students to become future leaders who have broad insights, are able to think holistically, and are ready to face global challenges.

In addition, the 21st century transformation also demands an understanding of English as one of the essential skills in international communication. Therefore, Wastemath is designed to integrate English elements into the learning process, so that primary school students can begin to understand basic English concepts in an interesting and contextual way. This approach ensures that children not only master mathematics and sustainability issues, but are also able to understand and use English as an essential communication tool in the current era and the future.

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