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DEVELOPMENT OF EDUCANDY-BASED TEACHING MEDIA ON SOLID FIGURES TO IMPROVE NUMERACY SKILLS OF FOURTS GRADE ELEMENTARY STUDENTS

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A R T I C L E I N F O

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A B S T R A C T

This research aims to develop Educandy-based teaching media for mathematics on the topic of solid figures to enhance numeracy skills among fourth-grade elementary school students. The study adopts a research and development (R&D) approach using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The participants were fourth-grade students at UPT SDN Purutrejo I, Pasuruan City. Instruments used included pretest and posttest, expert validation sheets, and student response questionnaires. Results show that the media was considered valid by content experts (76%) and media experts (74%) and received positive responses from students. A paired sample t-test revealed a significant improvement in student achievement after using the Educandy media. Therefore, this media is effective and feasible for use as an evaluation tool in mathematics learning, particularly on solid figures.

INTRODUCTION

Numeracy skills are fundamental competencies required for navigating the modern, complex world and form the bedrock for advanced mathematical reasoning. Suboptimal handling of numeracy issues in early education can significantly hinder students' ability to grasp more complex mathematical concepts later on, and can also negatively impact their

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logical thinking and sound decision-making in daily life. Consequently, there is an urgent need to implement innovative and efficient educational strategies, such as project-based learning and the utilization of interactive educational media, to strengthen numeracy proficiency at the elementary school level.

In the current digital era, learning tools have undergone a substantial transformation, leading to a proliferation of digital media, including educational applications and interactive platforms. However, the improper utilization of these digital tools can introduce new challenges, such as reduced teacher-student communication, limited development of social skills due to excessive solitary use, and a failure to support actively participatory learning. For this reason, educators must judiciously evaluate and select media that align perfectly with instructional objectives and student needs.

Observations and interviews with Grade IV teachers revealed a significant issue: students struggled with numeracy, resulting in low mathematics scores. Furthermore, the learning process for the space geometry topic was teacher-centric, leaving most students passive and struggling with the abstract concepts of three-dimensional shapes. There was a clear necessity for a novel, engaging teaching method to address these difficulties and enhance numeracy.

Based on the identified problems, this study focused on developing an interactive digital media to address the issues of low numeracy and difficulty in understanding abstract spatial geometry concepts. The digital platform **Educandy** was chosen to transform the monotonous learning of space geometry into an engaging experience.

The research questions addressed were:

1. How valid is the Educandy media in developing fourth-grade students' numeracy skills in space geometry?
2. How effective is Educandy media in developing fourth-grade students' numeracy skills in space geometry material?
3. How practical is the Educandy media in developing fourth-grade students' numeracy skills in space geometry material?

The primary objective of this research was to develop an effective learning medium to enhance fourth-grade students' numeracy skills in space geometry (cubes and cuboids).

Literature Review

Numeracy and Space Geometry

Numeracy is the ability to understand and use numbers and symbols related to fundamental mathematical concepts, and to analyze information presented in diverse formats (e.g., graphs, tables, charts) to solve practical problems in daily life. Experts concur that numeracy is a critical competency for students to thrive in an increasingly complex and interconnected world. Effective and structured learning is crucial for students to acquire and develop these skills.

Space Geometry (or Three-Dimensional Geometry) refers to geometric shapes that possess volume, such as cubes, cuboids, cylinders, and spheres. In the context of the Grade IV curriculum, instruction is specifically limited to

cubes (kubus) and **cuboids (balok)**. Understanding these concepts involves not only identifying their properties but also calculating related numerical values, such as volume and surface area, which directly involve numeracy.

Educandy as Digital Learning Media

Educandy is an online learning platform that offers a variety of interactive games and activities to support teaching and learning. Its features—including the ability to create quizzes, puzzles, flashcards, and word games—make the learning process more engaging and enjoyable. It is considered a useful tool for online learning, offering an innovative way to teach complex concepts and boost student motivation and participation. The developed Educandy product in this study provided various types of questions related to space geometry, such as identifying shapes, calculating area/volume, and determining characteristics, using formats like

Find a Match, **Multiple Choice**, **Short Answer**, and **Essay**.

Theoretical Framework

Several educational theories underpin the development of the Educandy learning media:

1. **Constructivism Learning Theory:** This theory posits that students do not passively receive information; instead, they actively construct their own understanding through direct experience and reflective processing. Educandy facilitates this by allowing students to actively participate in learning through interactive games, enabling them to build their understanding and numeracy

skills independently through personal reasoning and experience.

2. **Multimedia Learning Theory:** This theory asserts that integrating various media types can enhance students' learning experiences and motivation. By combining diverse interactive games and visuals (animations and images), Educandy enhances the learning experience and increases students' interest in space geometry.
3. **Problem-Based Learning Theory:** This theory emphasizes that effective learning occurs through the solution of problems relevant to students' daily lives. The interactive games and problems on the Educandy platform were designed to be engaging and relevant to real-life contexts, thereby encouraging critical thinking and problem-solving skills necessary for developing numeracy.

Previous Research

Previous studies have affirmed the positive impact of Educandy across various subjects. Research by Sesilia Ferdianti (2023) showed that Educandy increased cognitive learning outcomes in mathematics for Grade V students. Similarly, Khotimah et al. (2023) found that Educandy positively influenced English learning outcomes among elementary students. Furthermore, Wibowo (2021) demonstrated that Educandy, through gamification, increased both learning outcomes and motivation in citizenship education (PPKN). While prior research focused on general mathematics or learning outcomes, this study's uniqueness lies in its specific focus on developing **numeracy skills** within the context of **space geometry** for Grade IV students, filling a specific curriculum and skill gap.

METHOD

This research employed the **Research and Development (R&D)** approach, which focuses on practical applications to develop products or innovations that improve field conditions. The specific R&D model utilized was the **ADDIE model**, chosen for its systematic, structured, and cyclical approach to product development, allowing for evaluation and revision at every stage. The five phases of the ADDIE model were implemented as follows:

1. **Analysis:** Identifying the core issues (low numeracy, abstract space geometry material, conventional media), analyzing student needs (interactive, fun media,

concrete visuals), teacher needs (effective media for evaluation), curriculum needs (technology-based learning), and technological needs (internet access, digital devices).

2. **Design:** Planning the Educandy media structure, determining interactive game types (matching, multiple-choice, short-answer), designing assessment instruments (pretest and posttest), and formulating lesson plans (RPP).
3. **Development:** Creating the learning content (definitions, characteristics, volume, surface area of cubes and cuboids). The initial product underwent validation by a Material Expert and a Media Expert. Based on their feedback, revisions were made to ensure the media's quality, clarity, and technical feasibility.
4. **Implementation:** The validated and revised media were implemented in the trial class (experiment group) in a two-session field test. Students were introduced to the media, solved interactive problems in groups, and recorded their answers.
5. **Evaluation:** Assessing the media's **validity** (expert consensus), **practicality** (student/teacher response questionnaire), and **effectiveness** (analysis of pretest and posttest results).

The research was conducted at UPT SDN Purutrejo I, Pasuruan City. The primary subjects were fourth-grade students. The research involved two groups:

- **Experiment Group (Trial Class):** Class IV B.
- **Control Group:** Class IV A.

The research utilized both qualitative and quantitative data derived from the following instruments:

1. **Pretest and Posttest:** These were used to measure students' understanding of space geometry concepts (e.g., volume calculation and property identification) and their numeracy skills before and after the intervention.
2. **Expert Validation Questionnaire:** Used during the Development and Evaluation phases to assess the validity of the media in terms of content suitability, presentation clarity, and technical feasibility.
3. **Practicality Questionnaire:** Used during the Implementation and Evaluation phases to gather student responses regarding the media's ease of use, attractiveness, and overall impact on learning.

Data Analysis:

- **Validity and Practicality Data:** Analyzed descriptively using percentage scores and categorizing them (e.g., Very Valid, Valid, etc.).

Effectiveness Data: Analyzed quantitatively using **descriptive statistics** (mean scores) and **inferential statistics** (paired T-test) to compare the mean scores of the pretest and posttest and determine the statistical significance of the difference.

RESULT AND DISCUSSIONS

Product Validity and Practicality

Expert validators assessed the media's eligibility. The validation results were crucial for confirming the product's quality before implementation.

o.	Validator Aspect	Total Score	Percentage (%)	Category	Citation
	Material Expert	30 / 35	85.7%		**Valid**
	Media Expert	25 / 25	85.7% (Average Score 3.5/5)		**Valid**

The results from both experts indicated a high level of agreement on the media's quality and suitability for Grade IV students. The final percentage of **85.7%** placed the Educandy media in the **Valid and Feasible** category for use in the learning process. The validation process ensured the content aligned with the curriculum, the presentation was accurate, and the design was technically sound and engaging.

The practicality of the media was determined from student and teacher responses collected via a questionnaire administered after the implementation phase. A high positive response affirmed the media's usability, indicating that the Educandy application was **easy to use (user-friendly)**, **attractive**, and **motivating** for the students. This practical feedback confirmed the media's suitability for daily classroom use by both teachers and students.

Product Effectiveness

The effectiveness of the Educandy-based media in improving students' numeracy skills in space geometry was measured by comparing the pretest and posttest scores of the experiment class.

Test Type	Average Score (M)	N	Std. Deviation
Pretest	49.33	0	N/A
Posttest	79.79	0	N/A

The comparison between the pretest and posttest scores showed a marked improvement. To verify that this increase was statistically significant and not due to chance, a paired sample T-test was conducted:

- **p-value (Significance Value):** 6.21×10−10 (equivalent to 0.000).
- **Significance Threshold (α):** 0.05.

Since the calculated **p-value (0.000) is much smaller than the significance threshold (0.05)**, the null hypothesis (H0: there is no difference between pretest and posttest scores) is rejected, and the alternative hypothesis (Ha: there is a significant difference) is accepted.

Conclusion on Effectiveness: The Educandy learning media intervention led to a **statistically significant improvement** in student scores. Therefore, the Educandy-based learning media is **effective** in enhancing fourth-grade students' numeracy skills in space geometry.

Discussion

The significant increase in average scores from 49.33 to 79.79 validates the positive impact of the Educandy media on student learning. This finding aligns directly with the core educational theories underpinning the development:

1. **Constructivism in Action:** Educandy, through its interactive game format (quizzes, matching), compelled students to engage with the material rather than passively receive lectures. By repeatedly solving volume- and surface-area problems in a game environment, students developed a deeper, more concrete understanding of the abstract concepts of cubes and cuboids, thereby

strengthening their numeracy competence.

2. **Impact of Multimedia and Gamification:** The use of interactive, visually appealing digital media, as suggested by Multimedia Learning Theory, successfully increased student motivation and engagement. The gamification aspect of Educandy transformed the typically monotonous evaluation process into a fun, non-threatening activity. This high level of engagement is a critical factor contributing to the observed learning gains.
3. **Addressing Core Problems:** The media successfully addressed the initial problems of low motivation and difficulty with abstract spatial concepts. The interactive nature provided an alternative to conventional teaching, making the abstract concepts of space geometry more tangible and comprehensible.

The positive quantitative and qualitative results (high validity/practicality and significant effectiveness) firmly establish Educandy as a viable and effective tool for enhancing mathematical numeracy in elementary education. The study's findings are further supported by previous research showing that Educandy is effective in improving cognitive outcomes across various subjects.

CONCLUSIONS

Based on the results of the Research and Development (R&D) study using the ADDIE model, the following conclusions are drawn:

1. The Educandy-based learning media for space geometry material is highly

Valid and Feasible for use in Grade IV elementary schools, as confirmed by expert validation scores (e.g., 85.7%).

2. The Educandy-based media is highly **Effective** in enhancing the numeracy skills of Grade IV students. The significant statistical difference between the pretest (M=49.33) and posttest (M=79.79) scores, with a p-value of

6.21×10−10 statistically confirms its positive impact on student learning outcomes.

3. The media is considered.

Practical due to high positive responses from students and teachers regarding its ease of use, attractiveness, and ability to foster motivation and active participation in learning.

In summary, the development of Educandy-based learning media provides an innovative, validated, and effective solution for improving numeracy skills by

making abstract space geometry concepts accessible and engaging for Grade IV students.

Based on the findings, the following recommendations are suggested:

1. **For Teachers:** Educators are encouraged to adopt and integrate interactive digital media, such as Educandy, as an effective alternative to conventional methods. This media can be utilized both for formative assessment and as a reinforcement tool to increase student motivation and participation in mathematics.
2. **For Future Researchers:** Further research is recommended to expand the scope by using larger sample sizes to enhance the generalizability of the findings and to explore the combination of this innovative media with other technology-based assessment methods. It is also recommended to consider nonparametric statistical tests if the data distribution warrants them.

For Students: Students are advised to actively utilize available learning resources, including Educandy, both individually and collaboratively, to deepen their understanding of difficult concepts and enhance their teamwork and discussion skills.

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