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Development of STEAM-Based Mathematics Bulletin as a Learning Media to Improve Creativity and Understanding of Fractions in Grade V Students at a Public Elementary School in Jakarta

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ABSTRACT
Low student engagement and difficulties in understanding mathematical concepts, particularly fractions, remain major challenges in elementary education. This study aims to develop a STEAM-based Mathematics bulletin as an innovative learning medium to improve fifth-grade students' creativity and conceptual understanding of fractions. The study employed the 4D development model (Define, Design, Develop, Disseminate) and was conducted at a public elementary school in Jakarta. The Define stage involved curriculum analysis, classroom observation, and literature review. The Design stage focused on developing content and visual layouts integrating Science, Technology, Engineering, Arts, and Mathematics elements. The Develop stage included expert validation and limited trials with students to evaluate the validity, practicality, and effectiveness of the bulletin. The Disseminate stage was carried out by presenting the product to teachers to obtain feedback. Data analysis consisted of expert validation scores, student questionnaires, pretest–posttest comparisons, and paired sample t-tests. The results showed that the bulletin was feasible with an average validation score of 81%. The student questionnaire demonstrated high reliability (Cronbach's alpha = 0.8877). The pretest–posttest results indicated a significant increase in students' scores from 47.22 to 81.11 ($p < 0.05$). In addition, the bulletin enhanced student creativity through engineering projects, art activities, science experiments, and reflection tasks. This study is significant as it provides empirical evidence that STEAM-based printed learning media effectively enhance creativity and conceptual understanding in elementary mathematics learning. Therefore, the STEAM-based Mathematics bulletin is valid, practical, and effective and can serve as a reference model for developing innovative STEAM-based learning media in elementary schools.

ABSTRAK
Rendahnya keterlibatan siswa dan kesulitan dalam memahami konsep matematika, khususnya pecahan, masih menjadi tantangan utama dalam pembelajaran di sekolah dasar. Penelitian ini bertujuan untuk mengembangkan buletin Matematika berbasis STEAM sebagai media pembelajaran inovatif untuk meningkatkan kreativitas dan pemahaman konseptual pecahan pada siswa kelas V sekolah dasar. Penelitian ini menggunakan model pengembangan 4D (Define, Design, Develop, Disseminate) dan dilaksanakan di sebuah sekolah dasar negeri di Jakarta. Tahap Define meliputi analisis kurikulum, observasi kelas, dan kajian literatur. Tahap Design difokuskan pada perancangan konten dan visual yang mengintegrasikan unsur Science, Technology, Engineering, Arts, dan Mathematics. Tahap Develop melibatkan validasi ahli media serta uji coba terbatas kepada siswa untuk menilai validitas, kepraktisan, dan efektivitas media. Tahap Disseminate dilakukan melalui penyampaian produk kepada guru untuk memperoleh masukan. Analisis data meliputi skor validasi ahli, angket kepuasan siswa, perbandingan pretest–posttest, serta uji paired sample t-test. Hasil penelitian menunjukkan bahwa buletin berada pada kategori layak dengan skor validasi rata-rata 81%. Angket siswa menunjukkan tingkat reliabilitas yang tinggi (Cronbach's alpha = 0,8877). Hasil pretest–posttest menunjukkan peningkatan skor yang signifikan dari 47,22 menjadi 81,11 ($p < 0,05$). Selain itu, buletin mampu mendorong kreativitas siswa melalui proyek rekayasa, kegiatan seni, eksperimen sains, dan refleksi. Penelitian ini signifikan karena memberikan bukti empiris bahwa media cetak berbasis STEAM efektif dalam meningkatkan kreativitas dan pemahaman konsep matematika siswa sekolah dasar. Dengan demikian, buletin Matematika berbasis STEAM dinyatakan valid, praktis, dan efektif serta dapat dijadikan sebagai model pengembangan media pembelajaran inovatif di sekolah dasar.

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INTRODUCTION

Education is an effort to develop students' abilities so that they possess noble character and greater independence. In this millennial era, the world has entered the Industrial Revolution 4.0, where technology plays a major role in changing human lifestyles, including in the field of education. The digital era opens up various conveniences and opportunities, especially for students in accessing information quickly and widely. However, behind these opportunities also lie increasingly complex challenges, such as the low level of active student participation and the declining interest in certain subjects such as Mathematics. Although digital media are increasingly used in education, printed learning materials remain effective, particularly for elementary students. Studies show that reading from printed texts supports deeper comprehension and reduces cognitive distraction compared to screen-based reading (Delgado et al., 2021). To address these challenges, the STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning approach has emerged as an innovative and integrated solution. This approach encourages students to develop interdisciplinary thinking and stimulates creativity through real-world projects that combine aspects of science, technology, engineering, arts, and mathematics. Siregar et al. (2020) stated that STEAM-based learning is effective in improving mathematical literacy and problem-solving skills in everyday life contexts. This study is aligned with the Merdeka Curriculum, which emphasizes student-centered, contextual, and project-based learning to foster higher-order thinking skills and creativity (Kemendikbudristek, 2022). Various studies related to the implementation of technology in education have been widely conducted in recent years. In the study of Science, Technology, Engineering, Art, and Mathematics (STEAM), along with mathematics education, in the past few years, active and innovative methods have acknowledged the increasing dedication in determining the proper development of students' capacities (Jeong & Gomez, 2024). Individual student characteristics have been shown to influence the way they interact with technology in the learning process (Ahmed & Opoku, 2020). The STEAM approach has been proven to improve students' cognitive and affective abilities (Chen et al., 2020). Fatima and Nawaz (2021) found that integrating elements of art and technology into mathematics learning can increase student engagement and help them understand abstract concepts. Digital and print learning media, such as bulletins, are also considered effective in presenting material visually and contextually, thus making it easier for students to understand complex materials such as fractions (Wang et al., 2019).

The study conducted by Muzakkir et al. (2024) on the development of the Q-STEAM module also showed that the integration of the STEAM approach in instructional media development can simultaneously enhance mathematical concept comprehension and build students' character. A STEAM-based module designed by considering local context, character values, and engineering design principles has been proven to have high validity and is effective in facilitating project-based mathematics learning. Meanwhile, Pasichnyk et al. (2022), through content analysis of classical mathematics journals, showed that learning media such as bulletins or magazines hold significant historical and pedagogical value in delivering material narratively and contextually. Nevertheless, several studies indicate that many students still struggle to understand mathematical concepts due to the lack of engaging and relevant learning media (Yeh et al., 2023).

Previous studies have generally focused on the use of digital platforms in general or the implementation of STEAM in science and project-based learning, but few have examined the integration of the STEAM approach into mathematics learning media in the form of bulletins. Furthermore, very few studies have developed STEAM-based bulletins to improve both the understanding of fraction concepts and the creativity of elementary school students. Therefore, it is important to conduct this research by combining the STEAM approach and bulletins as an innovative learning strategy. This study aims to develop STEAM-based Mathematics bulletins and examine their effect on enhancing creativity and conceptual understanding of fractions among fifth-grade elementary school students. The research formulates the problem: *"How can a STEAM-based Mathematics bulletin be developed as a learning medium for fractions?"*

This study has theoretical benefits in enriching the body of knowledge on the integration of the STEAM approach in the development of mathematics learning media, particularly bulletins as innovative print media to improve creativity and conceptual understanding of fractions. Practically, for teachers, this research provides an alternative learning medium that is engaging and contextual; for students, it helps in understanding fractions creatively and enjoyably; for schools, it supports STEAM-based learning and numeracy literacy; and for other researchers, it serves as a reference for developing similar learning media.

a) Mathematics Bulletin

Print media such as mathematics bulletins have a long history as effective and insightful learning tools. Pasichnyk et al. (2022) highlighted that since the 19th century, science and mathematics bulletins have played a role as media for knowledge dissemination and as sources of inspiration that shaped the culture of learning and

scientific thinking. Mathematics bulletins provide structured narratives that combine text, visuals, and contextual problems, making abstract concepts such as fractions more accessible. However, their effectiveness depends on careful instructional design and teacher facilitation (Pasichnyk et al., 2022). In the modern context, bulletins developed thematically and interdisciplinarily can provide more engaging and contextual learning narratives, thereby bridging abstract concepts such as fractions into visual and applicable forms. Bulletins as mathematics learning media also enable the presentation of structured narrative content, using a combination of text, images, and illustrations that support concept comprehension and retention. In addition, their flexible format allows teachers to adjust the content according to students' characteristics and needs.

b) Learning Media

Good learning media not only delivers content but also facilitates students' cognitive processes in building understanding and skills. Saddhono et al. (2020) emphasized that innovative STEAM-based learning is highly needed in the context of primary education in Indonesia because it can train students' thinking skills, innovation, and creativity in an integrated manner. STEAM-based media have also been proven to integrate thematic approaches and address affective and psychomotor domains through structured, real-life activities.

The study by Muzakkir et al. (2024) showed that media designed using the STEAM approach with context-based project principles (such as the Q-STEAM module) demonstrated high validity and has the potential to improve students' mathematical understanding. Such media encourages students' active participation in exploration, design, and presentation of solutions to real-world problems, while simultaneously fostering character values such as responsibility and collaboration.

c) Creativity and Understanding of Fraction Concepts

One of the topics that often becomes a challenge in elementary school mathematics learning is fractions. Difficulties in understanding fractions are widely reported in elementary mathematics education. Studies have shown that students often struggle to connect fraction concepts with real-life contexts, particularly in comparison and representation tasks (Barus et al., 2024). International assessments such as PISA also indicate persistent challenges in students' mathematical literacy, highlighting the need for more contextual and visual learning approaches. Understanding fraction concepts requires strong visualization and logical connection skills. However, many students face difficulties in linking fractions with their real-life experiences. Siregar et al. (2020) noted that the low level of Indonesian students' mathematical literacy in PISA and TIMSS results indicates the need for more contextual and creative learning innovations. The STEAM approach allows students to build understanding through hands-on experiences and creative project-based activities.

In addition to conceptual understanding, creativity is an important component of mathematics learning that is often overlooked. Learning that combines elements of art and technology has been proven to stimulate students' creativity in representing and solving mathematical problems innovatively (Fatima & Nawaz, 2021; Yeh et al., 2023). The Q-STEAM study also emphasized that project activities with an interdisciplinary approach are highly effective in fostering creativity, as well as building deep understanding of mathematical concepts.

d) STEAM-Based Learning

STEAM-based learning integrates Science, Technology, Engineering, Arts, and Mathematics to promote interdisciplinary thinking, creativity, and problem-solving skills. This approach emphasizes hands-on, project-based, and creative learning experiences that enable students to connect abstract mathematical concepts with real-life situations. Empirical studies published in high-impact international journals indicate that STEAM-based instruction is particularly effective in mathematics learning, as it supports conceptual understanding, student engagement, and creative problem solving through contextual and artistic representations (Li et al., 2020)

METHODS

This study was conducted at a public elementary school in Jakarta, with the research subjects consisting of fifth-grade A students in Mathematics. The subjects were selected purposively based on the school's openness to innovation in learning media. This research employed a research and development (R&D) approach aimed at producing a STEAM-based Mathematics bulletin that is valid, practical, and effective in improving students' creativity and understanding of fraction concepts.

The development process adopted the 4D model proposed by Thiagarajan, Semmel, and Semmel (1974), which consists of four stages: Define, Design, Develop, and Disseminate. However, the implementation of this study

was limited to the Define, Design, and Develop stages, with dissemination conducted only on a limited scale. The focus of the research was on identifying learning needs, designing and developing the learning media, and evaluating its validity, practicality, and initial effectiveness. The Disseminate stage was not carried out extensively, as the study emphasized initial product development and feasibility testing rather than large-scale implementation.

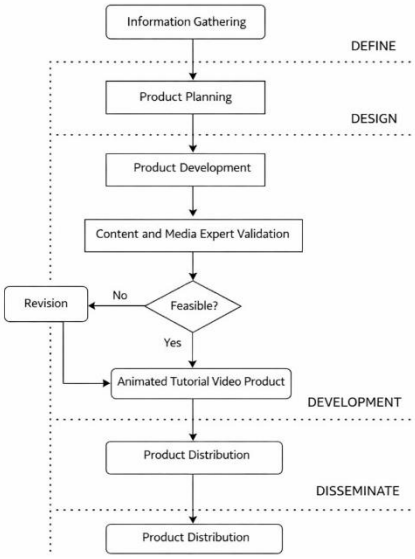

Figure 1.Four-D Development Mode

The first stage is Define, which aims to identify and formulate the learning needs in the field. Activities at this stage included curriculum analysis and relevant learning outcomes, particularly fraction material in the Merdeka Curriculum phase C. In addition, classroom observations were conducted to identify students' difficulties and the need for appropriate learning media. A literature review was also carried out to examine the effectiveness of the STEAM approach and the potential of bulletins as learning media in Mathematics.

The Define stage aimed to identify and formulate learning needs through curriculum analysis of the Merdeka Curriculum (Phase C), classroom observations to identify students' difficulties in understanding fraction concepts, and a literature review on the STEAM approach and bulletin-based learning media.

The Design stage involved developing the structure, content, and visual layout of the bulletin by integrating narrative elements, material visualization, contextual problems, and STEAM-based project activities. At this stage, research instruments were also designed, including expert validation sheets, student practicality questionnaires, and tests to measure students' understanding of fraction concepts.

The Develop stage focused on expert validation and limited product trials. Validation was conducted by elementary mathematics learning media experts to assess content feasibility, visual design, and STEAM integration. The product was revised based on the validators' feedback. Subsequently, a limited trial was conducted with fifth-grade students to evaluate the practicality and effectiveness of the bulletin. The trial results were analyzed to examine improvements in students' conceptual understanding of fractions and creativity through project-based activities.

The Disseminate stage was conducted on a limited scale by presenting the developed bulletin to teachers at the trial location. This stage aimed to obtain practitioners' feedback regarding the usability, relevance, and potential application of the bulletin in classroom learning and served as a foundation for further development.

The research instruments consisted of expert validation sheets, student practicality questionnaires, fraction concept comprehension tests, and a creativity assessment rubric measuring originality, elaboration, and clarity of students' project work. Data analysis focused on three aspects: media validity based on expert assessment scores, media practicality based on student questionnaire responses using a Likert scale, and media effectiveness based on pre-test and post-test score improvements and students' creativity outcomes.

RESULTS AND DISCUSSIONS

The media developed in this study is an interactive bulletin specifically designed for fifth-grade elementary school students, carrying the theme *"Fractions in Real Life!"*. This bulletin integrates the STEAM approach (Science, Technology, Engineering, Arts, and Mathematics) in the delivery of fraction material, allowing students to learn through contextual, applicable, and enjoyable experiences. The bulletin is presented in a booklet format consisting of 12 full-color pages, with an attractive visual design and layout adapted to the cognitive characteristics of elementary school students.

Define (Definition)

The define stage is the initial step in the 4D development model, serving to comprehensively identify learning needs before the media is developed. In this study, the define stage was carried out through three main approaches: analysis of learning objectives in the Merdeka Curriculum, classroom observations and interviews, and supporting literature reviews. First, the researcher analyzed the Learning Outcomes (Capaian Pembelajaran/CP) of phase C in the Merdeka Curriculum, particularly in Mathematics for fifth-grade elementary school students. One of the main elements in this phase is the ability of students to understand and use various forms of fractions (proper, mixed, decimal, and percentage) in solving contextual everyday problems. The Merdeka Curriculum emphasizes active student involvement in the learning process as well as the integration of interdisciplinary knowledge to develop 21st-century competencies (Kemendikbudristek, 2022). This aligns with the principles of STEAM-based learning, which combines Science, Technology, Engineering, Arts, and Mathematics in the context of real-world projects.

Second, the researcher conducted classroom observations and interviews with a fifth-grade mathematics teacher at an elementary school in South Jakarta. The observations revealed that most students had difficulty understanding fraction concepts, especially in comparing values and relating them to real-life situations. The teacher also stated that the learning media used were still conventional and not entirely contextual or engaging for students. The teacher expressed the need for media that could bridge abstract concepts into more visual and applicable forms. Third, the researcher carried out a literature review related to the use of the STEAM approach in mathematics learning and the effectiveness of bulletins as learning media. Previous studies showed that the STEAM approach can enhance student engagement and foster creative mathematical understanding (Muzakkir et al., 2024). In addition, bulletins developed with narrative and visual structures have been proven to support concept retention and provide space for student expression (Pasichnyk et al., 2022).

Based on these three sources of information, it was determined that the development of a STEAM-based mathematics bulletin is an appropriate alternative medium to help students understand fraction concepts in a contextual and creative manner. This also aligns with the spirit of the Merdeka Curriculum, which encourages meaningful, student-centered, and project-based learning.

Design (Planning)

At this stage, the researcher developed the initial design of the STEAM-based Mathematics bulletin tailored to the characteristics and needs of fifth-grade students. The design process integrated the principles of the Merdeka Curriculum and the STEAM approach (Science, Technology, Engineering, Arts, Mathematics) into bulletin content that is contextual, applicable, and visually engaging.

a b c

Figure 2. Cover, Preface, and Learning Objectives of the STEAM Mathematics Bulletin

The initial step of the design process began with creating an attractive cover that reflects the spirit of collaboration and the enthusiasm of students in learning mathematics. The cover features illustrations of children holding learning tools along with STEAM symbols, emphasizing the integration of multiple disciplines. On the opening pages, a Preface was included to explain the background, objectives, and intended use of the bulletin. In addition, a Learning Objectives page was provided to outline the competencies expected to be achieved by students, such as understanding the concept of fractions in daily life through the STEAM approach.

a b c

Figure 3. Table of Contents, Visual Design, and Science Experiment

Next, the researcher developed a Table of Contents that systematically presents the structure of the material. The following page displays an attractive design featuring a photo of students conducting experiments, reinforcing the message that learning mathematics can be carried out actively and enjoyably. In the science and mathematics experiment section, students are encouraged to understand the concept of decimal fractions through simple practical activities, such as measuring liquids with a measuring cup or dividing ingredients. Measuring liquid activities support students' understanding of decimal fractions and proportional reasoning, while the Fraction City project helps students conceptualize fractions as part–whole relationships through engineering design tasks. This approach helps students grasp fractions in a concrete and applicable way.

a b c

Figure 4. Engineering Project, Art Project, and Mathematics Story

This bulletin is also equipped with a *Mini Project: Building a Fraction City* page, which serves as an example of applying engineering principles. Students are guided to design simple buildings using paper cutouts corresponding to specific fractions, allowing them to learn fraction concepts while engaging in creative activities. In addition, there is an *Art Corner: Fraction Collage* as an application of Art, where students create collages using various geometric shapes representing fractions. This activity helps foster creativity, precision, and the ability to visualize fractions. To further enrich the learning experience, a *Fraction Stories in Daily Life* page is also presented, featuring contextual narratives. This section aims to illustrate the application of fractions in everyday life, increase reading interest, and strengthen numerical literacy.

a b c

Figure 5. Quiz, Scientist Profile, and Reflection

In the quiz or mini-game section, students are invited to play by matching fractions in the form of images (drag and drop). This activity reinforces fraction concepts while enhancing student engagement through a gamification approach, representing the application of Technology. Furthermore, there is a *Scientist and Artist Profile* page which, in this edition, features Leonardo da Vinci. This page introduces an inspiring figure who combined science, art, and engineering, aligning with the spirit of STEAM. The final section presents a *Reflection Corner and Student Work*. Here, students are asked to reflect on the learning experiences they have undergone, while also showcasing their work such as collages or fraction models. This page is designed to foster a sense of pride, increase motivation, and strengthen self-reflection skills.

Develop (Development)

The STEAM Mathematics Bulletin that had been developed was then validated by two experts to obtain feasibility scores as well as suggestions for improvement of the media created. Media validation in this study was carried out by an experienced elementary school teacher who is competent in developing instructional media, Mrs. Nuril Aufa, S.Pd., who is also a teacher at a public elementary school in Jakarta with a background in Elementary School Teacher Education. The validation test process was conducted on June 18, 2025, during which the validator was provided with the Mathematics Bulletin document along with a validation questionnaire. The instrument consisted of 20 items covering four main aspects, namely visual attractiveness, media practicality, media readability, and media readiness.

Table 1. Media Expert Validation Test Results

Aspects of Expert Media Evaluation	Obtained Score	Expected Score	Achievement Percentage	Remarks
Visual Attractiveness	4,75	5,0	95%	Very Feasible
Media Practicality	4,0	5,0	80%	Feasible
Media Readability	4,0	5,0	80%	Feasible
Media Readiness	3,5	5,0	70%	Quite Feasible

Based on Table 1, the validation test by media experts on the STEAM-based Mathematics Bulletin showed that the media had a good level of feasibility with an average achievement percentage of 81%, categorized as *feasible*. The aspect of visual attractiveness obtained the highest score with 95% and was categorized as *very feasible*, followed by the aspects of media practicality and readability, each with 80% and categorized as *feasible*. Meanwhile, the aspect of media readiness achieved 70% and was classified as *fairly feasible*. These findings indicate that the media is

reasonably good for use, although improvements are still needed, particularly in terms of readiness for implementation.

The testing of the student satisfaction questionnaire for the STEAM-based Mathematics Bulletin was conducted on Wednesday, June 19, 2025, at a public elementary school in Jakarta. The instrument consisted of 10 items designed to measure the level of acceptance and satisfaction of students toward the bulletin-based learning media used in the fraction topic. The questionnaire was administered to 18 students who participated as the research sample**.** Item validity was analyzed using Pearson Product-Moment correlation, comparing the calculated r-values with the critical r-table value at $\alpha = 0.05$ (Guilford, 1956). The reliability of the instrument was then examined using Cronbach's alpha coefficient.

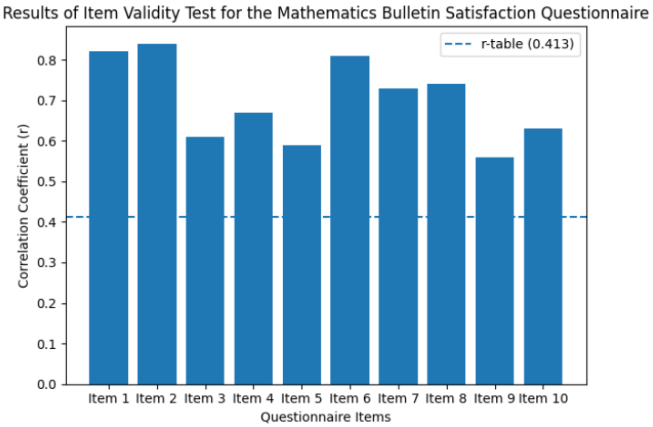

Figure 6. Graph of Student Questionnaire Results

Based on the validity test results, all items had correlation coefficient values (*r count*) higher than the *r table* value (0.413), which means that all questionnaire items were declared valid. The highest *r count* value was 0.84, while the lowest was 0.57. According to Guilford's interpretation, several items fell into the category of very high validity ($r > 0.80$), while the rest were in the high to moderate validity category. This indicates that all items in the questionnaire accurately measured the intended aspects.

In addition, the reliability calculation using Cronbach's alpha formula showed a value of $r = 0.8877$. This value falls into the high reliability category (0.70–0.89) according to Guilford. This means that the instrument had a very good level of consistency if it were to be used again for the same measurement. With validity and reliability having been confirmed, the satisfaction questionnaire for the STEAM Mathematics Bulletin was declared feasible to be used as a valid and reliable evaluation tool both in research and classroom practice.

After the questionnaire testing was completed, the next step was to conduct the media effectiveness test through pretest and posttest administration. Data analysis was carried out using several statistical tests, including normality test, homogeneity test, descriptive statistical analysis, and paired sample *t*-test.

Table 2. Kolmogorov-Smirnov Normality Test

Group	Number (N)	Mean	Standard Deviation	Maximum Difference	Z K-S Value	Sig. (2-tailed) Value
Pretest	18	47,22	23,72	0,211	-	0,352
Posttest	18	81,11	16,41	0,208	-	0,363

The pretest and posttest data were normally distributed because the significance value (Sig.) was greater than 0.05. This means that the data met the requirements to be analyzed using parametric statistics such as the *t*-test.

Table 3. Homogeneity of Variance Test (Levene's Test)

Statistik Levene	df1	df2	Sig.
2,692	1	34	0,110

The variance between the pretest and posttest data was homogeneous (not significantly different), as the significance value (Sig.) was greater than 0.05. This indicates that the data met the assumption of homogeneity, allowing the subsequent *t*-test analysis to be conducted under the assumption of equal variances.

Table 4. Descriptive Statistics

Group	N	Mean	Standard Deviation	Standard Error Mean
Pretest	18	47,22	23,72	5,59
Posttest	18	81,11	16,41	3,87

The average posttest score (81.11) was higher than the pretest score (47.22), indicating that there was an improvement in learning outcomes after the treatment using the STEAM-based Mathematics Bulletin.

Table 5. Paired Sample t-test

R calculated	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
12,031	17	0,00000000097	33,89	2,82

There was a highly significant difference between the pretest and posttest scores. The *p* value (Sig.) was far below 0.05, thus the null hypothesis was rejected. This means that the use of the STEAM-based Mathematics Bulletin had a significant effect on improving students' learning outcomes. There was a highly significant difference between the pretest and posttest scores. The *p* value (Sig.) was far below 0.05, thus the null hypothesis was rejected. This indicates that the use of the STEAM-based Mathematics Bulletin had a significant impact on enhancing students' learning outcomes.

Disseminate

After going through the expert validation stage and limited trials, the dissemination process of the STEAM-based Mathematics Bulletin was carried out on a limited scale. This dissemination was not conducted at a mass level, as the research focused on the initial development stage and on validating the feasibility and practicality of the product. The dissemination activity was conducted in the form of a presentation of the development results to teachers at the school where the trial was implemented. During this activity, the researcher presented the background, development process, validation results, and findings from the limited trials, including improvements in students' understanding of fraction concepts and creativity. The dissemination results indicated that teachers responded positively to the bulletin, particularly regarding its visual design, clarity of content, and integration of STEAM elements. Teachers also stated that the bulletin was easy to use, aligned with the Merdeka Curriculum, and applicable for classroom and project-based learning activities. Furthermore, teachers expressed interest in adopting the bulletin as an alternative learning medium for mathematics instruction and suggested its further development for other mathematics topics. These findings demonstrate that the STEAM-based Mathematics

Bulletin is not only feasible and practical but also has strong potential for broader implementation in elementary school mathematics learning.

CONCLUSIONS

Based on the results and discussion, it can be concluded that the STEAM-based Mathematics Bulletin developed in this study proved to be valid, practical, and effective for use in teaching fractions to fifth-grade elementary school students. Expert validation showed that the bulletin had a good level of feasibility, with an average validation score of 81%, categorized as feasible. The student satisfaction questionnaire also demonstrated very positive results, with high validity and reliability levels, indicating that the instrument was valid and reliable for measuring student acceptance of the media.

The use of the STEAM-based Mathematics Bulletin significantly improved students' understanding of fraction concepts, as evidenced by the difference between the average pretest score (47.22) and posttest score (81.11), as well as the *t*-test results showing a significant effect ($p < 0.05$). In addition to improving understanding, this medium also fostered student creativity through engineering projects (building a "Fraction City"), art projects (fraction collages), science experiments, as well as reflection and quiz activities. Thus, the STEAM-based Mathematics Bulletin can serve as an innovative learning medium that supports the implementation of the *Merdeka Curriculum*, promotes student interest in learning, and develops creativity and conceptual understanding in a comprehensive manner for elementary school students.

The findings of this study indicate that the integration of technology and interactive media in mathematics learning can effectively improve conceptual understanding and student engagement. These results emphasize the importance of implementing innovative, student-centered learning approaches in creating meaningful mathematics learning experiences. As a suggestion for further development, it is recommended that the scope of this newsletter be expanded to other mathematics topics and refined in the form of a website to reach more schools and students. Further research is also recommended to test the effectiveness of this newsletter in collaborative or interdisciplinary learning, as well as to explore its impact on students' critical thinking and problem-solving skills in the long term.

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