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DicMath application with songs: A solution for overcoming misconceptions in mathematics story problems in elementary schools

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ABSTRACT

Mathematical word problems are an essential part of elementary school learning. However, many students develop misconceptions when solving them, highlighting the need for innovative solutions to enhance their understanding. This study aims to develop and evaluate the feasibility and effectiveness of the DicMath (Dictionary of Mathematics) application, which incorporates songs as a learning medium to address misconceptions in mathematical word problems. The application uses the Problem-Based Learning (PBL) model for third-grade elementary school students. This research follows the Research and Development method using the ADDIE development model. Data analysis techniques include media feasibility tests, normality tests, t-tests, and N-Gain tests to assess the application's effectiveness. The findings indicate that the DicMath application, enhanced with song-based learning, was rated as 'highly feasible,' receiving a feasibility score of 92.6% from material experts and 95% from media experts. The N-Gain test results demonstrated a high effectiveness level on a small scale (0.7383) and a moderate effectiveness level on a large scale (0.6101). Therefore, the DicMath application with song integration is considered both feasible and effective in addressing students' misconceptions about mathematical word problems. This study contributes to developing interactive, technology-based learning tools that enhance students' understanding and support more effective elementary school learning.

Aplikasi DicMath berbantuan lagu: Solusi untuk mengatasi miskonsepsi dalam soal cerita matematika di sekolah dasar

Kata Kunci:

lagu pembelajaran, soal cerita matematika, miskonsepsi, pembelajaran berbasis masalah

ABSTRAK

Soal cerita matematika merupakan bagian penting dalam pembelajaran di sekolah dasar, namun banyak siswa mengalami miskonsepsi dalam menyelesaikannya, sehingga diperlukan solusi inovatif untuk meningkatkan pemahaman mereka. Penelitian ini bertujuan untuk mengembangkan, menguji kelayakan, dan mengevaluasi efektivitas Aplikasi DicMath (Dictionary of Mathematics) berbantuan lagu sebagai media pembelajaran untuk mengatasi miskonsepsi soal cerita matematika. Aplikasi ini diterapkan dalam pembelajaran menggunakan model Problem-Based Learning (PBL) pada siswa kelas III Sekolah Dasar. Penelitian ini menggunakan metode Research and Development dengan model pengembangan ADDIE. Teknik analisis data mencakup uji kelayakan media, uji normalitas, uji t, dan uji N-Gain untuk mengukur efektivitas aplikasi. Hasil penelitian menunjukkan bahwa Aplikasi DicMath berbantuan lagu memperoleh kategori

"sangat layak" dengan persentase kelayakan 92,6% dari ahli materi dan 95% dari ahli media. Hasil uji N-Gain pada skala kecil sebesar 0,7383 termasuk dalam kategori efektivitas tinggi, sedangkan pada skala besar sebesar 0,6101 termasuk dalam kategori efektivitas sedang. Dengan demikian, Aplikasi DicMath berbantuan lagu dinyatakan layak dan efektif dalam membantu mengatasi miskonsepsi siswa terhadap soal cerita matematika. Penelitian ini berimplikasi dalam menyediakan media pembelajaran berbasis teknologi yang interaktif untuk meningkatkan pemahaman siswa dan mendukung pembelajaran yang lebih efektif di sekolah dasar.

Contribution to the literature

This research contributes to:

- Providing song-assisted interactive learning applications can support the learning process of mathematics in elementary schools and make it more interesting and fun.
- Supporting technology-based learning following 21st-century learning.
- Providing innovative mathematics learning media that is more effective and efficient to overcome student misconceptions.

1. INTRODUCTION

Mathematics is one of the most crucial subjects for elementary school students. The elementary school serves as the foundation for learning mathematics. When students have a strong grasp of basic mathematical concepts, they can progress more effectively to higher levels of learning [1]. Every student is expected to master fundamental mathematical knowledge to develop a better understanding of real-life problem-solving [2]. Applying mathematical skills is important for fostering critical thinking, adaptability, and innovation, ultimately providing students with a comprehensive learning experience that enhances their 21st-century skills [3].

One of the key tools in mathematics instruction is learning media. Learning media makes teaching and learning more interactive and helps achieve optimal learning outcomes [4]. Mathematics learning, in particular, requires engaging and interactive media to maintain student interest [5]. Learning media should be designed with a student-centered approach to ensure effectiveness [6]. Additionally, learning media can be adapted to keep up with advancing technology, with digital technology-based media being the most suitable for today's generation [7].

However, learning challenges have been identified at SD Negeri (State Elementary School) 1 Sirongge, Pandanarum District, Banjarnegara Regency. Pre-research findings indicate that a key issue in teaching mathematics in the third grade is the limited use of learning media and a teacher-centered approach, where instruction relies primarily on textbooks. Although digital media is available, many elementary school teachers remain unmotivated or lack the skills to operate it, continuing to rely on conventional methods [8]. Educators play a crucial role in integrating technology into engaging learning media to enhance student participation [9]. Despite this, students still struggle to understand mathematical concepts, particularly when solving addition and subtraction word problems. Many experience misconceptions, such as difficulty distinguishing between problems and uncertainty about addition or subtraction. This challenge is further reflected in student performance data, which shows that 64% of the 28 third-grade students have not met the learning achievement criteria for addition and subtraction word problems.

The issue is concerning, as mastering addition and subtraction story problems is essential and is explicitly stated in the learning outcomes outlined by the Decree of the Head of the Education Standards, Curriculum, and Assessment Agency of the Ministry of Education, Culture, Research, and Technology (Number 033 of 2022): "Students can perform addition and subtraction operations of non-numerical numbers up to 1,000" [10].

Story problems are often challenging for students as they struggle to grasp the meaning of the given problem [11]. When solving mathematical story problems, students must connect their mathematical understanding with the ability to visualize the vocabulary used in the problem [12]. Misinterpreting math story problems can lead to misconceptions. However, misconceptions related to addition and subtraction story problems can be minimized by incorporating keywords within the problem, presented in the form of a mathematical word dictionary. Since problems of the same type typically follow a consistent language pattern, identifying these patterns can help students determine the type of story problem they are solving [13]. Thus, students with stronger reading comprehension skills who can detect keywords in story problems are better equipped to solve them [14].

The developed media is the DicMath application, Dictionary of Mathematics. This application provides a dictionary of keywords for solving addition and subtraction story problems involving integers. It also includes learning songs, video tutorials on problem-solving techniques, and evaluation questions. The DicMath application will be developed using Articulate Storyline, a tool for creating interactive learning media accessible on Android, iOS, and web platforms without requiring programming knowledge [15]. Articulate Storyline integrates various media into a single application, making it a valuable learning resource [16]. Its interactive features, such as navigation buttons, sound effects, and embedded questions, enhance student engagement and provide immediate feedback [17].

The DicMath application also incorporates learning songs, a cognitive tool to boost student interest, aid in long-term material retention, enhance aesthetic appreciation, and stimulate positive emotions [18]. Learning songs develops students' creativity and interpretation skills [19]. One effective strategy for creating an engaging learning experience is incorporating singing activities, which increase students' enthusiasm for learning [20]. These songs help students easily remember the keywords needed to solve addition and subtraction story problems involving integers.

The media will be implemented using the PBL model. PBL enhances students' problem-solving skills by encouraging them to acquire knowledge through active engagement with learning material [21]. This model fosters critical thinking, promotes active student participation, and encourages learners to gather information from multiple sources to apply in real-life situations [22]. By adopting the PBL approach, educators can tailor learning strategies to meet students' needs [23]. When applied to addition and subtraction material, students will be given story problems involving integers and use the provided media to solve them effectively.

Previous studies have shown that song-assisted learning media can positively impact learning. Using songs in learning applications can create effective, engaging, and enjoyable learning activities while improving student learning outcomes [24]. Furthermore, media that incorporate learning songs can enhance student-centered learning [25]. Additionally, the development of learning applications using song-assisted methods has proven effective, as evidenced by significant improvements in learning outcomes before and after using song-assisted learning media [26]. Moreover, song-assisted math learning media have been shown to enhance students' math learning outcomes [27].

However, despite various previous studies, no research has specifically explored the development of song-assisted math learning applications within the framework of the PBL model as a solution to misconceptions in math story problems involving the addition and subtraction of integers.

Therefore, this study aims to develop, assess the feasibility of, and evaluate the effectiveness of the DicMath application. This application integrates song-assisted learning with the PBL model to address misconceptions in story problems related to the addition and subtraction of numerical values among third-grade elementary school students. The findings of this study are expected to contribute to the development of effective and innovative technology-based learning media, helping teachers enhance students' conceptual understanding and improve their mathematical problem-solving skills.

2. METHOD

The research method employed in this study is the development research method, commonly known as Research and Development. Additionally, the ADDIE development model is applied. This model comprises five stages: analysis, design, development, implementation, and evaluation [28]. The ADDIE model was chosen because it offers a systematic, flexible, and evaluation-focused approach, ensuring creating a high-quality and effective learning product or application.

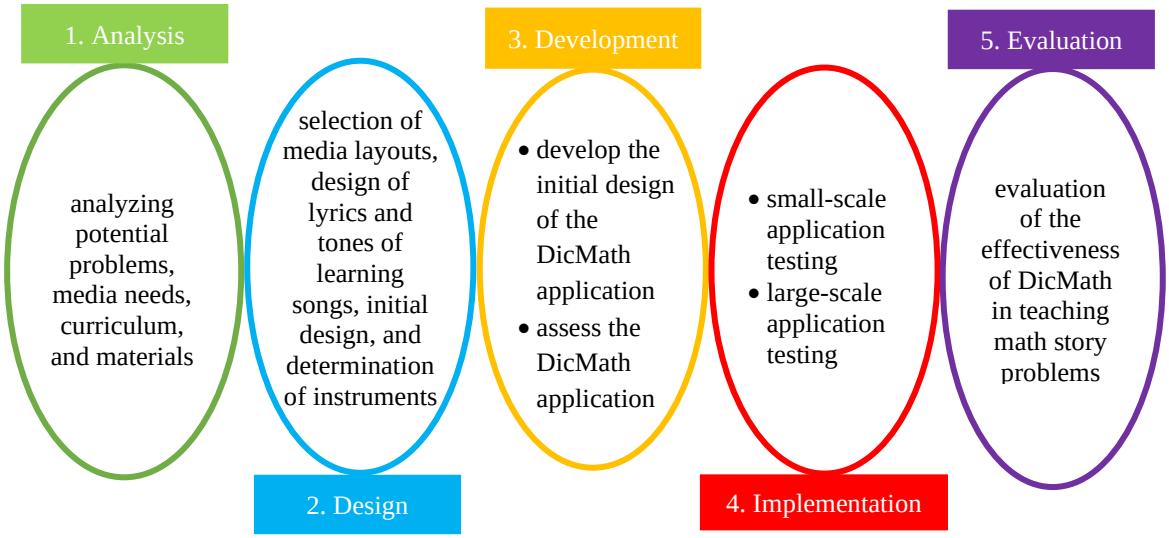


Figure 1. The Procedure of the ADDIE Model

The analysis examines potential problems, media needs, curriculum, and materials. Potential problems are analyzed through interviews, observations, questionnaires, and student performance data. Media needs analysis is carried out by collecting data through teacher and student needs questionnaires and literature studies related to the requirements for developing learning media. Curriculum analysis is conducted by reviewing the current curriculum, including the independent curriculum, learning outcomes, and learning objectives. Material analysis involves selecting the content to be used in learning media development.

In the design stage, products are created based on the analysis's findings. Key considerations include selecting media layouts, designing lyrics and melodies for learning songs, creating initial designs, and determining the necessary instruments. During the development stage, the initial design of the learning application is created, including

learning songs and instruments based on the previous stage. The developed media is then validated by media and material experts, who provide feedback for improvement. Revisions are made based on the criticism and suggestions experts provide to enhance the quality of the media.

In the implementation stage, the learning media, which has been designed and developed into a learning application, incorporates keywords for story problems and learning songs to help students retain information. After obtaining validation from media and material experts, the application is tested through pretests and posttests to assess its effectiveness in addressing students' misconceptions about addition and subtraction story problems. The trials are conducted on both small and large scales. Following the learning activities, teacher and student response questionnaires are distributed to assess the feasibility of the developed learning application. At the evaluation stage, an assessment is conducted based on the questionnaire data collected. The results are used to refine the learning media further. The research was conducted after receiving ethics approval.

This study's subjects were 28 third-grade students from SD Negeri 1 Sirongge, Banjarnegara Regency, during the 2024/2025 academic year. Six students participated in a small-scale trial, while 22 students participated in a large-scale trial. The research was conducted after obtaining consent from both parents and students. The object of this study is the DicMath application, which incorporates songs and was developed using the Articulate Storyline application. The study focuses on mathematics, specifically the arithmetic operations of addition and subtraction of small numbers, presented as story problems.

Data collection instruments used in this study included both test and non-test techniques. Non-test data collection involved observations and interviews to identify potential problems, teacher and student needs questionnaires for media needs analysis, expert validation questionnaires, and teacher and student response questionnaires to assess media feasibility. Test-based data collection was conducted using pretest and posttest questions to measure the effectiveness of the DicMath application in addressing students' misconceptions about addition and subtraction story problems. The application was implemented through the PBL model.

Instrument validation is conducted by developing pretest-posttest questions, which are validated by expert reviewers and tested for validity, reliability, difficulty level, and differentiation. The validation questionnaire sheet and responses from teachers and students are then analyzed using a Likert scale. The collected data is examined based on the frequency of responses for each chosen alternative, multiplied by 100%. The percentage results for material and media feasibility, as well as teacher and student responses, are categorized as follows: 76% - 85% is considered "feasible," 60% - 75% is considered "quite feasible," 55% - 59% is considered "less feasible." Percentages below 54% are categorized as "not feasible." [29]. Additionally, learning outcome data is analyzed based on pretest-posttest results to measure the effectiveness of the DicMath Application, which is assisted by songs in addressing students' misconceptions when solving integer addition and subtraction word problems. The analysis includes a normality test, a paired-sample t-test, and an N-Gain test. The paired-sample t-test is used to compare the mean difference between two paired samples under the assumption that the data follows a normal distribution. Meanwhile, the N-Gain test evaluates the improvement in students' learning outcomes before and after using the DicMath Application. The N-Gain score is categorized as follows: an N-Gain value of less than 0.3 indicates low improvement, a value between 0.3 and 0.7 represents moderate improvement, and a 0.7 or higher signifies high improvement [30].

3. RESULTS AND DISCUSSION

The results of the research on the development of song-assisted DicMath applications as a solution to misconceptions about addition and subtraction of integers are explained following the stages of research and development of the ADDIE model.

3.1 Analysis Stage

In analyzing potential problems, researchers conducted observations and interviews with third-grade teachers at SD Negeri 1 Sirongge. The results indicated that mathematics was the least favored subject among students, as they perceived it to be difficult and involved too many numbers. Mathematics also caused anxiety for some students, who feared making mistakes in their assignments due to the subject's complexity [31]. Several obstacles were identified in learning mathematics, including students' difficulties understanding mathematical concepts, inappropriate learning models, limited learning media, and minimal technology integration. In particular, students struggled with arithmetic operations presented in word problems. Many experienced misconceptions when distinguishing between addition and subtraction problems. Data on students' learning outcomes supported this in addition to subtraction word problems involving integers. Among the 28 third-grade students, 18 students (64%) fell into the category of needing guidance, with scores ranging from 0 to 64. Eight students (29%) were classified as sufficient, scoring between 65 and 76, while only two students (7%) were in the good category, scoring between 77 and 88.

Furthermore, researchers distributed questionnaires to class teachers and students based on the analysis of media needs. The results showed that 100% of respondents supported the development of the DicMath application, which incorporates songs tailored to learning objectives. Respondents agreed that the application should be designed attractively, featuring learning songs and video tutorials presented in straightforward and simple language. Additionally, 93% of respondents favored using bright color harmonization. All respondents (100%) also agreed that the DicMath application should include evaluation questions to enhance students' understanding of the material [32].

Furthermore, a curriculum analysis was conducted, revealing that the school implemented an independent curriculum. Regarding material analysis, researchers focused on word problems involving addition and subtraction of integers. The findings indicated that students frequently misunderstood such problems, particularly when distinguishing between addition and subtraction in smaller-number scenarios. Students perceived word problems as more challenging because they required a deeper level of comprehension to solve them effectively [12]. Addressing these misconceptions is essential to prevent them from hindering students' conceptual understanding of mathematics. This aligns with Bruner's constructivist learning theory [33], which suggests that students build new concepts based on prior knowledge.

3.2 Design Stage

The second stage was the Design stage, where the initial product design was created based on the analysis results, as shown in Table 1. The selection of story problem material for addition and subtraction of integers was taken from Chapter 1: Numbers up to 1,000, specifically Topic D: Addition of Numbers to 100 and Topic E: Subtraction of Numbers to 100 [34]. Therefore, the material development for the DicMath application was aligned with the teacher's book and student book from the independent curriculum for grade III Elementary School. This alignment ensures that the application content remains relevant and supportive of students' actual learning experiences in the classroom.

As illustrated in Figure 1, after compiling the initial product design, the researcher began preparing various words to be used as keywords in the addition and subtraction word dictionary. These keywords were then arranged into learning songs to make them easier for students to remember. Additionally, the researchers enhanced the application with video tutorials on problem-solving, evaluation questions, and general information. The design process was initiated using the Canva application before being further developed into an interactive learning application through Articulate Storyline 3. This development aimed to create a more engaging and accessible learning experience for students.

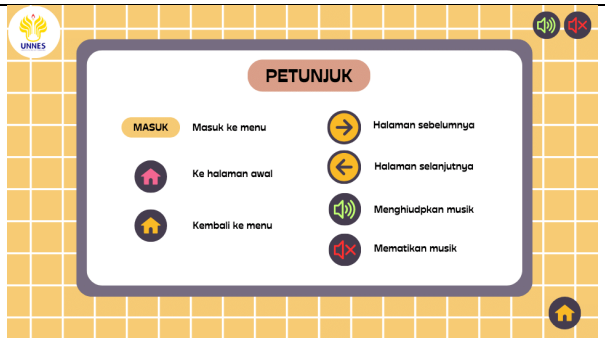
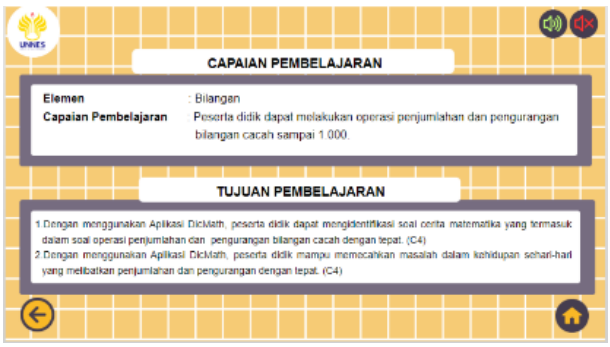
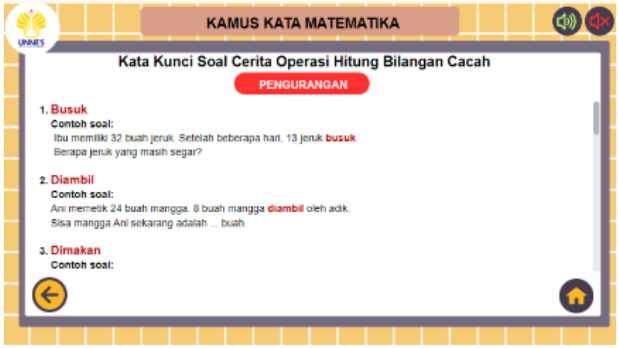
At the product design stage, the intended development was an interactive learning medium created using Articulate Storyline 3 in the form of the DicMath application, supported by educational songs. Learning media based on Articulate Storyline 3 aimed to produce an engaging and educational interface [16]. Furthermore, the developed learning media incorporated learning songs, aligning with humanistic learning theory and emphasizing self-recognition. Since elementary school students prefer cheerful and engaging learning activities, integrating songs into interactive learning applications was considered beneficial [35].

3.3 Development Stage

The third stage was Development. At this stage, the initial framework of the learning media was designed and developed. The song-assisted DicMath application included an application start page, a menu page, an instructions page, a learning outcomes & learning objectives page, a math dictionary page, a "Let's Sing" page, a video tutorial page, an evaluation questions page, and a general information page. All components were arranged systematically to support students' understanding of mathematical concepts. The use of songs and interactive features was expected to increase student engagement and motivation in learning.

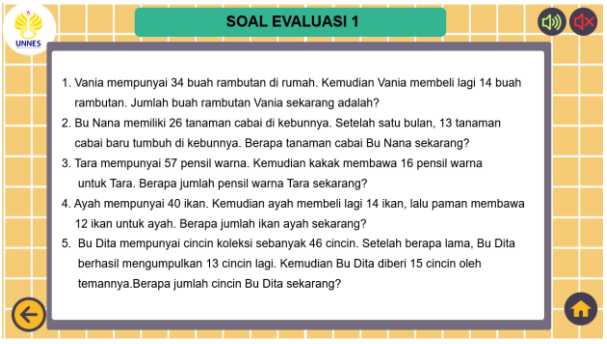
Table 1. The Display of the Song-Assisted DicMath Application

No	Display	Description
1		Home page display
2		Menu page

3		Instruction page
4		Outcomes and Objectives page
5		Mathematics dictionary page
		
6		Let's Sing page

7 

Tutorial video page

8 

Evaluation page

9 

General information page

Here are the lyrics of the learning song from the math story problem keywords:

Kata Kunci Soal Cerita Matematika

Mari mengingat kata kunci soal cerita penjumlahan
Datang, diberi, memasang, memasukkan
Membawa, membeli, dan juga membuka
Menanam, mengumpulkan, dan juga tumbuh
Setelah itu kita jumlahkan
Menanam, mengumpulkan, dan juga tumbuh
Setelah itu kita jumlahkan

Mari mengingat kata kunci soal cerita pengurangan
Busuk, diambil, dimakan, dan diminum
Dipinjam dan hilang, layu, juga mati
Pecah, putus, rusak, dan juga sobek
Setelah itu kita kurangkan
Pecah, putus, rusak, dan juga sobek
Setelah itu kita kurangkan
Setelah itu kita kurangkan

Translation:
Math Story Problem Keywords

Let's remember the keywords of addition story problems
Come, given, put, put in
Bring, buy, and open
Plant, collect, and grow
After that, we add them up
Plant, collect, and grow
Then we add them up

Let's remember the keywords of subtraction story problems
Rotten, taken, eaten, and drunk
Borrowed and lost, withered, and died
Broken, snapped, damaged, and torn.
After that, we subtract
Broken, snapped, damaged, and also torn
Then we subtract
Then we subtract

Figure 2. The Lyrics of the Learning Song

It was evident that the lyrics of the song contained various keywords. The learning song was created to help students remember diverse keywords more easily. As a result, students found it easier to solve addition and subtraction story problems by singing the learning song to analyze the keywords in the problems. Additionally, the learning song attracted students and increased their enthusiasm for learning, making learning activities more enjoyable. Learning songs was an innovative and engaging medium that prevented monotony, made students happier, improved their understanding of concepts, and enhanced their memory [36].

After the product was developed, it was then validated by material and media experts. This validation was conducted using a validation sheet containing various indicators to assess the feasibility of the developed learning media. Lecturers of mathematics courses in elementary school teacher education programs carried out material validation. In contrast, media validation was conducted by lecturers of learning media courses in the same programs. A summary of the assessment results for the feasibility of the material content component and the media presentation in the DicMath application is presented in Table 2.

Table 2. The Results of Expert Validation

No	Validator	Percentage	Criteria
1	Material Expert	92,6%	Highly Feasible
2	Media Expert	95%	Highly Feasible
	Average	93,8%	Highly Feasible

Table 2 shows that the assessment results from material and media experts indicated that the DicMath application met the criteria for being highly feasible. Therefore, developing the DicMath application was deemed suitable for third-grade elementary school students. However, there were still some suggestions and feedback from the material and media experts. The material experts suggested that in the presentation of the math word dictionary, the example section should include complete story problems rather

than just sentence fragments to provide clearer examples. Meanwhile, the media experts recommended adding reference sources in the general information section.

At this stage of development, the DicMath learning media, assisted by songs and evaluated by both material and media experts, was successfully created and met feasibility criteria. Interactive learning applications were considered effective in enhancing students' learning experiences, making the process more meaningful, and improving their understanding during learning activities [15]. This aligns with Ausubel's learning theory, which states that for students to gain new understanding, they must first develop an initial comprehension of the material. Consequently, students' engagement in learning activities directly influences their ability to grasp new concepts [37].

3.4 Implementation Stage

The fourth stage was implementation. After the product had been developed and had gone through the validation stage by material experts and media experts to test its feasibility, the next stage was testing the product in learning activities using the PBL model. This PBL model increased student learning motivation and improved problem-solving skills [38]. This study conducted a small-scale trial involving six students and a large-scale trial involving 22 students. In addition to assessing feasibility through media and material experts, the feasibility of the medium was also evaluated based on the results of teacher and student response questionnaires from both small-scale and large-scale trials. The activity was carried out with third-grade students of SD Negeri 1 Sirongge, and the overall results of the completed questionnaires can be seen in Table 3.

Table 3. The Teacher's and Students' Responses

Questionnaire	Percentage	Criteria
Homeroom Teacher	93%	Highly Feasible
Small-scale Trial	98%	Highly Feasible
Large-scale Trial	95%	Highly Feasible

Based on the data above, it was concluded that the DicMath application, with the help of songs, was highly feasible for reducing misconceptions in addition and subtraction story problems involving small numbers. The data obtained indicated that this song-assisted DicMath application aligned with the needs of both teachers and students in conducting technology-based learning activities.

Furthermore, the effectiveness of the DicMath application as a learning medium, supported by songs, in addressing students' misconceptions while solving addition and subtraction story problems was measured through a pretest-posttest approach. The instrument used in this trial was a written test using descriptive questions designed based on indicators for analyzing and solving addition and subtraction story problems. These questions aimed to help overcome misconceptions about such problems among third-grade elementary school students.

The data from the pretest-posttest results were further analyzed using a normality test to determine whether the data followed a normal distribution. The normality test was conducted based on the assumption that Ho would be accepted if the data were normally distributed and rejected if they were not. The significance level for the normality test was set at 5%, with the condition that if the value exceeded 5% (> 0.05), Ho was accepted, and if it was equal to or below 5% (≤ 0.05), Ho was rejected. Data analysis in this normality test employed the Shapiro-Wilk formula, as the sample size was less than 50 ($n < 50$). At this stage, the researcher processed the data using SPSS and obtained the values in Table 4. These results served as the basis for the subsequent hypothesis testing.

Table 4. The Normality Test Result

Components	Sig.	Description
Pretest of the small-scale trial	0,164	Normal
Posttest of the small-scale trial	0,320	Normal
Pretest of the large-scale trial	0,078	Normal
Posttest of the large-scale trial	0,072	Normal

The normality test results from the data showed that the significance value was greater than 5% (> 0.05), indicating that Ho was accepted, meaning the obtained data were normally distributed. Once the data were confirmed to be normally distributed, they became eligible for parametric hypothesis testing, specifically the paired sample t-test. The paired sample t-test was used to determine whether there was an improvement in students' ability to overcome misconceptions in addition and subtraction story problems involving numerical numbers before and after using the DicMath application, which was assisted by songs in the application of the PBL model. Since the normality test requirements were met, the hypothesis test was conducted using the paired sample t-test formula in SPSS, and the results can be seen in Table 5.

Table 5. The Result of the Hypothesis Test (*Paired Sample t-Test*)

Description	Mean	Sig. (2-tailed)
Small-scale trial	-33,7500	0,000
Large-scale trial	-25,00000	0,000

Table 5 shows that the significance value (sig. (2-tailed)) obtained in both small-scale and large-scale trials was 0.000. Since this value was less than 0.05 (0.000 < 0.05), it was assumed that the research hypothesis (Ha) was accepted, while the null hypothesis (Ho) was rejected. Therefore, it could be concluded that there was a significant difference in student's ability to overcome misconceptions in addition and subtraction story problems involving numerical numbers before and after using the DicMath application, which was assisted by songs within the PBL model.

In line with the test results, it was evident that the use of the DicMath application, supported by songs in the PBL model, improved students' understanding of addressing misconceptions in addition and subtraction story problems involving numerical numbers. Table 6 examines the effectiveness of the DicMath application assisted by songs.

Table 6. The Result of the N-Gain Test

Description	Mean
Small-scale trial	0,7383
Large-scale trial	0,6101

Table 6 illustrates that the N-Gain value in the small-scale trial was 0.7383, which meant it was ≥ 0.7, classifying it under the criteria for high effectiveness. Meanwhile, the N-Gain value in the large-scale trial was 0.6101, which fell within the range of 0.3 ≤ N-Gain < 0.7, categorizing it as moderately effective. Based on these results, it was concluded that using the DicMath application, supported by songs, was both recommended and effective in enhancing students' understanding and addressing misconceptions in addition and subtraction story problems involving small numbers. These findings affirm the application's potential for broader implementation in early grade mathematics learning.

During the implementation stage, it was found that the DicMath application, when combined with songs, met the criteria for effectiveness in grade 3 elementary school settings within the application of the PBL model. This PBL model helped students improve their understanding by engaging with problems provided by the teacher for them to solve

[39]. This finding aligns with Vygotsky's learning theory, which states that students develop new understanding when confronted with problems [40].

3.5 Evaluation Stage

The next stage was evaluation, during which all tests from experts, teachers, and students on the DicMath application, assisted by songs, were conducted, evaluated, and concluded. The results of the evaluation were used to improve the song-assisted DicMath application and enhance its effectiveness, ensuring that the application was suitable for use. Through learning activities using the DicMath application with song assistance, students appeared more enthusiastic and demonstrated a better understanding of the subject matter. Based on the questionnaire responses from teachers and students, the DicMath application, assisted by songs, had an attractive appearance, with clear images and illustrations, legible text, and easy-to-understand instructions. Additionally, it increased students' interest in learning, aligned with learning indicators, provided comprehensible evaluation questions, and used accessible language.

At the evaluation stage, findings indicated that the DicMath application, with the aid of songs, was feasible and effective for third-grade students as a solution to misconceptions in addition to subtraction story problems involving integers. Using song media in learning activities helped students understand and retain subject matter in the long term engagingly [41]. This aligns with humanistic learning theory, which emphasizes that learning activities should consider students' personalities. Elementary school students, in particular, tend to prefer enjoyable learning methods, such as singing [40]. Therefore, incorporating songs into learning not only addresses conceptual misunderstandings but also fosters a more student-centered and enjoyable educational experience.

The song-assisted DicMath application supported more meaningful student learning experiences, as its Articulate Storyline-based learning media facilitated interactive engagement between teachers and students [17]. As a result, students developed new concepts and understandings, allowing them to analyze problem types and approach story problems more effectively [41]. Furthermore, the DicMath application was developed with technological integration, fostering innovation in technology-based learning media. This advancement ensured that learning activities remained relevant and benefited from modern technological sophistication [42].

This research aligned with previous studies. Learning media development based on Articulate Storylines has been shown to improve students' conceptual understanding and mathematical learning outcomes [43]. Additionally, the DicMath application, supported by songs, served as a bridge for long-term material retention, as learning through songs increased student enjoyment and motivation [35]. The research was implemented using the PBL model, which significantly impacted students' cognitive abilities and critical thinking skills [44]. While previous studies had not specifically addressed solutions for overcoming misconceptions in mathematical story problems, this research successfully developed a song-assisted DicMath application incorporating keywords for math story problems within a PBL framework.

The implication of this research on the development of the DicMath application was its positive impact on education by promoting the use of technology-based learning media. This made learning activities more effective and practical to implement. However, this study had certain limitations, as it focused on only one class and covered only the addition and subtraction of integers. Therefore, its effectiveness for other materials or subjects had not yet been tested. Future researchers are encouraged to expand the application to include word dictionaries for story problems in other mathematical topics, making it easier for

students to analyze and solve problems. Additionally, further development of learning applications should aim to be more engaging and interactive, adapting to technological advancements.

4. CONCLUSION

Based on the research and discussion, it can be concluded that the development of the DicMath application, which incorporates songs as a solution to misconceptions about addition and subtraction in numerical story problems, consists of several key components. These include an instructions menu, learning achievements and objectives, a word dictionary containing keywords for solving addition and subtraction problems, learning songs to reinforce these keywords, evaluation questions, and general information. The feasibility of the song-assisted DicMath application was rated as highly feasible, receiving a feasibility score of 92.6% from material experts and 95% from media experts. This is further supported by a teacher response questionnaire score of 93%, a student response score of 98% in a small-scale trial, and 95% in a large-scale trial.

The N-gain test results indicate that the small-scale trial scored 0.7383, which falls within the high-effectiveness category. In contrast, the large-scale trial scored 0.6101, categorized as moderately effective. These findings demonstrate that the DicMath application, assisted by songs, effectively enhances students' understanding and addresses misconceptions when solving integer addition and subtraction story problems. The implications of this research suggest a positive impact on the advancement of education by integrating technology-based learning media. This approach makes learning more engaging, effective, and practical for implementation in educational settings.

AUTHOR CONTRIBUTION STATEMENT

IYA contributed as the primary researcher, designing the study, conducting research, processing data, and compiling articles. PYS provided guidance, direction, and suggestions throughout the research and article preparation.

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