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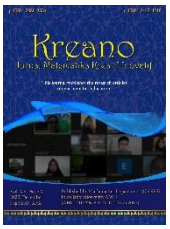

Digital Trigonometry Worksheets: Integrating Computational Thinking and Palembang Local Wisdom to Support Students' Numeracy Skill

Amrina Rosyada[1], Budi Mulyono[1*], and Hapizah[1]

[1]Sriwijaya University

Correspondence should be addressed to Budi Mulyono: budi_mulyono@fkip.unsri.ac.id

Abstract

Results from international assessments and previous studies indicate that students' numeracy skills remain low, particularly in understanding trigonometric ratios and applying them to real-life situations. Computational Thinking (CT) has the potential to support numeracy skills by enabling students to solve problems logically, systematically, and efficiently. This condition is attributed to limited learning innovation. In addition, the integration of Palembang local wisdom contexts can make learning more meaningful by connecting mathematical concepts to students' real-life experiences. This study aims to develop digital worksheet for trigonometry based on CT with Palembang local wisdom that is valid, practical, and effective in enhancing numeracy. Using design research method with development studies type, the stages consisted of preliminary research, development/prototyping, and assessment. The subjects were 34 tenth-grade students from one of the Madrasah Aliyah Negeri (MAN) in Palembang. Data were collected through validity and practicality questionnaires, as well as pretests and posttests. Results showed a validity score of 94% (very valid) and practicality of 92% (very practical). Moreover, the Wilcoxon Signed-Rank Test revealed a significant difference between students' pretest and posttest numeracy scores (Asymp. Sig. = 0.000 < 0.05), indicating that the worksheet effectively supports students' numeracy skills. Thus, the developed digital worksheets are valid, practical, and effective. Future research may test this on larger samples to verify consistency of results.

Keywords: Digital Worksheet; Trigonometry; Computational Thinking; Palembang Local Wisdom; Numeracy Skill

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Abstrak

Hasil asesmen internasional dan penelitian terdahulu menunjukkan bahwa kemampuan numerasi peserta didik masih rendah, terutama dalam memahami perbandingan trigonometri dan menerapkannya pada kehidupan nyata. Kondisi ini disebabkan oleh terbatasnya inovasi pembelajaran. Computational Thinking (CT) berpotensi mendukung kemampuan numerasi dengan membantu peserta didik menyelesaikan masalah secara logis, sistematis, dan efisien. Selain itu, integrasi konteks kearifan lokal Palembang dapat membuat pembelajaran lebih bermakna dengan menghubungkan konsep matematika pada pengalaman nyata peserta didik. Penelitian ini bertujuan mengembangkan LKPD digital trigonometri berbasis CT dengan konteks kearifan lokal Palembang yang valid, praktis, dan efektif dalam mendukung kemampuan numerasi. Penelitian ini menggunakan metode design research jenis development studies dengan tahapan preliminary research, development/prototyping, dan assessment. Subjek penelitian ini adalah 34 peserta didik kelas X di salah satu Madrasah Aliyah Negeri (MAN) di Palembang. Data dikumpulkan melalui angket validitas dan kepraktisan, serta pretest dan posttest. Hasil penelitian menunjukkan bahwa LKPD digital yang dikembangkan memperoleh skor validitas sebesar 94% (sangat valid) dan kepraktisan sebesar 92% (sangat praktis). Selain itu, hasil uji Wilcoxon Signed-Rank menunjukkan adanya perbedaan yang signifikan antara skor pretest dan posttest kemampuan numerasi peserta didik (Asymp. Sig. = 0,000 < 0,05), mengindikasikan bahwa LKPD tersebut efektif dalam mendukung kemampuan numerasi peserta didik. Dengan demikian, LKPD digital yang dikembangkan terbukti valid, praktis, dan efektif. Penelitian selanjutnya dapat mengkaji penerapan LKPD digital ini pada subjek yang lebih banyak untuk melihat konsistensi hasil.

INTRODUCTION

The 21st century is marked by rapid advancements in science and technology that have transformed various aspects of human life. These developments have created increasingly complex challenges, requiring human resources with high competencies across various fields (Putri et al., 2022). In the context of education, students are expected to master various skills in order to compete globally (Mahrunnisya, 2023). In this context, numeracy emerges as a core skill that bridges formal mathematics and functional real-world problem-solving. This skill is the ability to understand, explain, and use numbers, data, and mathematical symbols to solve problems in everyday life (Napsiyah et al., 2022; Yunarti & Amanda, 2022). Numeracy enables students to apply mathematical knowledge and skills appropriately according to needs and serves as a key to understanding the world, as well as recognizing the importance of mathematics in modern life (Azizah, 2022; Rohmah et al., 2022).

Despite its critical importance, numeracy remains a challenge for many Indonesian students. International assessments consistently show that students' performance in numeracy is still below the expected level. The results of the 2022 Programme for International Student Assessment (PISA) showed that Indonesia's mathematics score declined from 379 in 2018 to 366 points (Alfaruqi & Nurwahidah, 2025). Similarly, the latest Trends in International Mathematics and Science Study (TIMSS) in 2015 ranked Indonesia 46th out of 51 countries with a score of 397 (Triangela et al., 2024). Moreover, the Organisation for Economic Co-operation and Development (OECD) reported that approximately 72% of Indonesian students had not reached the minimum mathematics competency (OECD, 2019). These findings reveal that a significant number of students still struggle to grasp and apply mathematical concepts, both abstractly and in real-world situations (Deda et al., 2023). This reflects the low of Indonesia students' numeracy skills, especially in trigonometric ratios topic, where students frequently struggle to visualize and apply formulas to real-world scenarios (Gifari & Arifin, 2024; Firdaus et al., 2023; Safira & Andinny, 2024).

This widespread underperformance

cannot be separated from the instructional environments in classrooms. One factor contributing to low numeracy skills is the limited innovation in mathematics learning. Monotonous and repetitive teaching reduces students' motivation and interest, resulting in suboptimal understanding of the material and impacting on declining numeracy skills (Rosadi et al., 2025; Muhtarom et al., 2022). In addition, learning materials that are unengaging and do not facilitate active thinking also contribute to low numeracy skills (Widiastuti & Kurniasih, 2021). This aligns with Cholid et al. (2022) who stated that students' numeracy skills, particularly in trigonometric ratio topics, remain low due to one-way teaching methods and the limited use of supportive learning materials during the learning process. Therefore, innovative learning resources are needed to create more meaningful learning experiences and better support students' numeracy development.

One learning resource that has the potential to address this issue is the student worksheet. Student worksheets can guide learners through structured activities that encourage active participation in learning (Setiyaningsih et al., 2022). However, there are still very few student worksheets specifically designed to support students' numeracy skills. The commonly used worksheets only contain material, formulas, examples, and routine problems without encouraging active thinking (Tarigan & Siregar, 2024). Furthermore, student worksheets that are often developed by teachers are conventional print-based worksheets, even though worksheets should be designed according to the learning conditions and needs (Andriyani et al., 2020). This is in line with the development of 21st-century science and technology that printed learning media, including student worksheet, can be further developed into digital form (Ramadhani & Fitri, 2020). Therefore, developing digital worksheets that encourage active thinking and support numeracy skills become important in mathematics education.

Computational Thinking (CT) plays a crucial role in developing students' numeracy skills. CT is thinking processes used to solve complex problems using simplified approaches based on computer science concepts such as decomposition, pattern recognition, abstraction, and algorithmic (Kallia et al., 2021; Lestari & Annizar, 2020; Litia et al., 2023). The integration of CT into mathematics is highly logical. While numeracy defines the ability to solve problems, CT provides the methodology to deconstruct them. This is in line with the research findings of Sa'diyah & Eminita (2024), which found that embedding CT frameworks directly enhances students' mathematical numeracy skills. Since numeracy requires the ability to apply mathematics to solve real-life problems, integrating CT enables students to approach these problems more logically, analytically, systematically, effectively, and efficiently (Zafrullah et al., 2024). Consequently, integrating CT into digital worksheet may provide students with greater opportunities to develop numeracy skill.

Connecting mathematical concepts to students' everyday experiences is an important step toward developing numeracy skill. In this regard, the use of context in the learning process serves as a strategic solution, particularly in trigonometric ratio topics. Trigonometric ratios are strongly related to various real-life situations, so using context in learning can help students understand concepts more deeply (Cahyani & Aini, 2021; Wakiah, 2021). Using context

makes learning more meaningful because students can see the relevance of mathematics to everyday experiences (Soleha et al., 2024). One effective context is local culture that is close and familiar to students (Hutauruk, 2020; Sa'diah et al., 2021). From this perspective, integrating local wisdom into learning materials may help students connect abstract mathematical concepts with real-life situations. Thus, the digital worksheet developed in this study incorporates Palembang local wisdom, including its culture, traditions, values, and surrounding environment.

Several previous studies have developed student worksheet to support numeracy (Adrillian et al., 2024; Sopani et al., 2024), CT-based (Ostian et al., 2023; Septiani et al., 2023), or with Palembang local wisdom contexts (Fitri et al., 2024). These studies indicate that numeracy, CT, and local wisdom each have the potential to enhance students' numeracy skills. However, no study has comprehensively integrated all three aspects numeracy, CT, and Palembang local wisdom into a single digital worksheet. Therefore, this study aims to develop a digital worksheet on trigonometry based on CT with Palembang local wisdom context to support students' numeracy skills.

METHOD

Design Research

This study employed a design research method of the development studies type, consisting of three stages show in Figure 1 below.

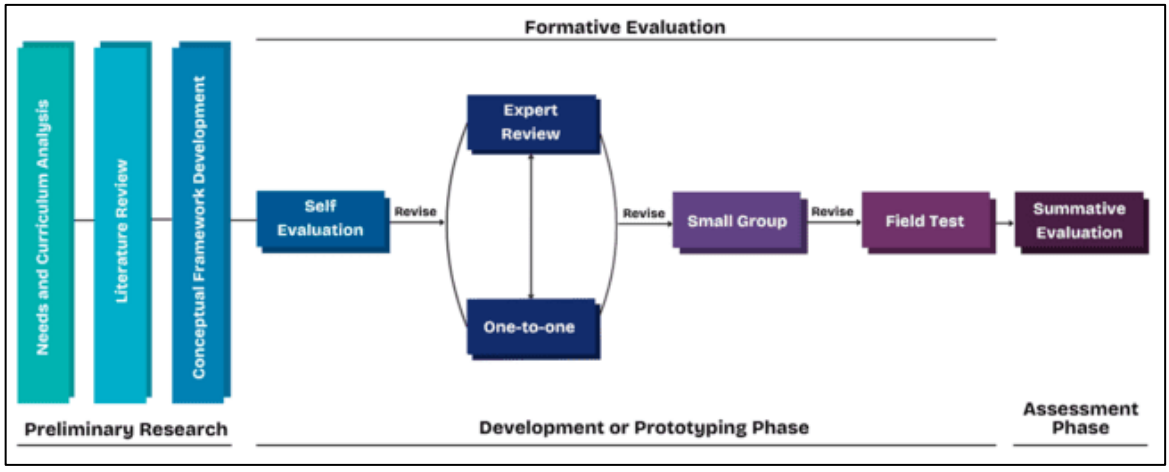


Figure 1. Development Studies Stages

Figure 1 illustrates the process of development studies research (Akker et al., 2006, 2013; Bakker, 2018). In the preliminary research stage, several activities were conducted, including: (1) analysis of needs and curriculum, (2) literature review related to development studies, digital worksheet, Computational Thinking, Palembang local wisdom, and numeracy skills, and (3) preparation of a conceptual or theoretical framework, which was developed into an initial prototype of the digital worksheet.

The development or prototyping stage was carried out iteratively through formative evaluation (Tessmer, 1993). This process involved five activities (1) self-evaluation, in which the initial prototype was evaluated by the

researcher to produce Prototype I, (2) expert review, in which Prototype I was validated by several experts regarding content, construct, and language, (3) one-to-one, conducted in parallel with the expert review, a trial of Prototype I with three students of low, moderate, and high cognitive ability, selected based on the mathematics teacher's recommendations considering their academic performance and participation in mathematics learning activities (4) small group, a trial of Prototype II with six students to assess the practicality of the digital worksheet, and (5) field test, the implementation of the digital worksheet in one class to evaluate the product's effectiveness on students' numeracy skills in real learning. The results from each stage were used to revise the prototype until the final product was obtained.

The final stage of development studies is the assessment phase, which involves a summative evaluation through the administration of a posttest to assess students' numeracy skills after using the developed digital worksheet. The posttest results were then compared with students' pretest scores obtained before the implementation to determine the effectiveness of the worksheet to supports students' numeracy skills.

Data Collection and Analysis Techniques

The research instruments used in this study consisted of questionnaires, tests, and interviews. The questionnaires included validity and practicality questionnaires. The validity questionnaire was administered during the expert review stage to experts in order to determine the level of validity of the digital worksheet based on CT on trigonometry topics with a Palembang local wisdom context in supporting students' numeracy skills. The validity questionnaire data from the expert review stage were evaluated according to the scoring guidelines provided. After obtaining the scores from the validity questionnaire, the results were categorized based on the validity criteria presented in Table 1 below.

Table 1. Validity Criteria

Validity Score (%)	Validity Criteria
$81 \leq N \leq 100$	Very Valid
$61 \leq N < 81$	Valid
$41 \leq N < 61$	Fairly Valid
$21 \leq N < 41$	Invalid

Modified from (Hariyati & Rachmadyanti, 2022)

N = Validity score

$$N = \frac{total\ score\ obtained}{maximum\ possible\ score} \times 100\%$$

The practicality questionnaire was administered to students during the small group stage. This questionnaire aimed to determine whether the developed digital worksheet based on CT met the practicality criteria. The collected practicality questionnaire data were evaluated according to the established scoring guidelines. After that, the results were categorized based on the practicality criteria as follows.

Table 2. Practicality Criteria

Practicality Score (%)	Practicality Criteria
$80 \leq N \leq 100$	Very Practical
$60 \leq N < 80$	Practical
$40 \leq N < 60$	Fairly Practical
$0 \leq N < 40$	Not Practical

Modified from dari Karim et al. (2024)

N = Practicality score

$$N = \frac{total\ score\ obtained}{maximum\ possible\ score} \times 100\%$$

The assessment stage is the evaluation phase conducted to assess the effectiveness of the digital worksheet in supporting students' numeracy skills. In

this stage, the researcher carried out a summative posttest evaluation after the entire learning sequence was completed. The posttest results were then compared with the pretest results. The numeracy test consisted of three essay questions presented in the context of Palembang local wisdom. The test shown in Figure 2 below.

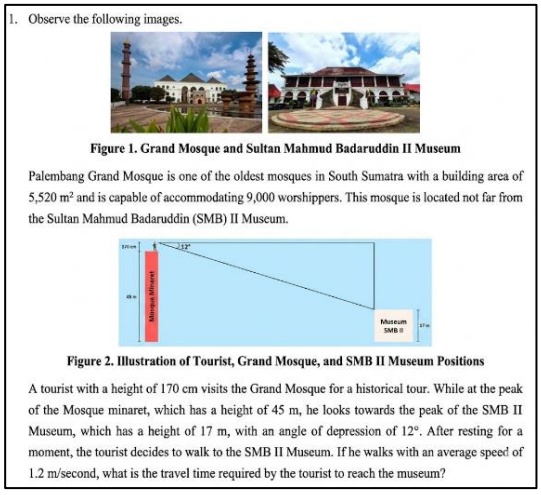

1. Observe the following images.

Figure 1. Grand Mosque and Sultan Mahmud Badaruddin II Museum

Palembang Grand Mosque is one of the oldest mosques in South Sumatra with a building area of 5,520 m² and is capable of accommodating 9,000 worshippers. This mosque is located not far from the Sultan Mahmud Badaruddin (SMB) II Museum.

Figure 2. Illustration of Tourist, Grand Mosque, and SMB II Museum Positions

A tourist with a height of 170 cm visits the Grand Mosque for a historical tour. While at the peak of the Mosque minaret, which has a height of 45 m, he looks towards the peak of the SMB II Museum, which has a height of 17 m, with an angle of depression of 12°. After resting for a moment, the tourist decides to walk to the SMB II Museum. If he walks with an average speed of 1.2 m/second, what is the travel time required by the tourist to reach the museum?

(a)

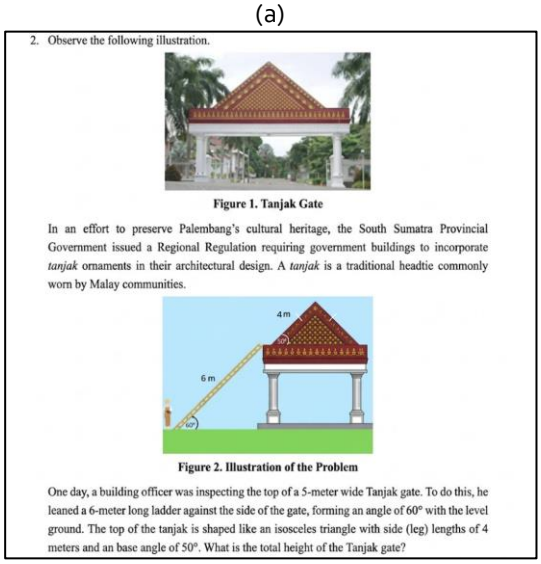

2. Observe the following illustration.

Figure 1. Tanjak Gate

In an effort to preserve Palembang's cultural heritage, the South Sumatra Provincial Government issued a Regional Regulation requiring government buildings to incorporate *tanjak* ornaments in their architectural design. A *tanjak* is a traditional headtie commonly worn by Malay communities.

Figure 2. Illustration of the Problem

One day, a building officer was inspecting the top of a 5-meter wide Tanjak gate. To do this, he leaned a 6-meter long ladder against the side of the gate, forming an angle of 60° with the level ground. The top of the tanjak is shaped like an isosceles triangle with side (leg) lengths of 4 meters and an base angle of 50°. What is the total height of the Tanjak gate?

(b)

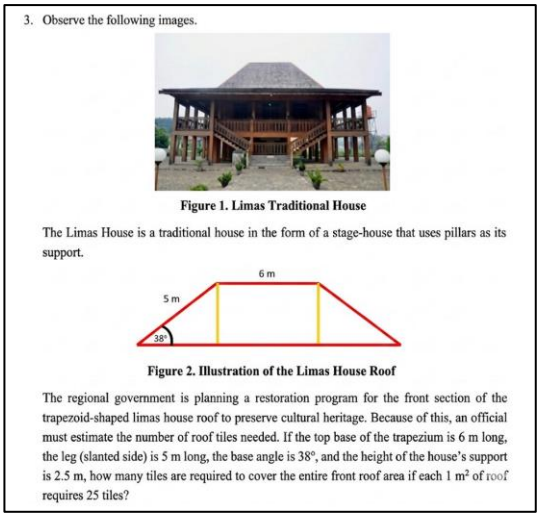

3. Observe the following images.

Figure 1. Limas Traditional House

The Limas House is a traditional house in the form of a stage-house that uses pillars as its support.

Figure 2. Illustration of the Limas House Roof

The regional government is planning a restoration program for the front section of the trapezoid-shaped limas house roof to preserve cultural heritage. Because of this, an official must estimate the number of roof tiles needed. If the top base of the trapezium is 6 m long, the leg (slanted side) is 5 m long, the base angle is 38°, and the height of the house's support is 2.5 m, how many tiles are required to cover the entire front roof area if each 1 m² of roof requires 25 tiles?

(c)

Figure 2. (a) Test Question Number 1; (b) Test Question Number 2; (c) Test Question Number 3

Each test question was developed based on three numeracy indicators (1) analyzing information presented in various forms, (2) using numbers and mathematical symbols to solve problems, and (3) interpreting the results of analysis to make predictions and decisions. The test was validated by experts to ensure its content validity and suitability for measuring students' numeracy skills

The pretest and posttest scores were analyzed using statistical tests with the assistance of SPSS. Since the data did not fully meet the assumptions of normality, the Wilcoxon Signed-Rank Test was employed to determine the effectiveness of the CT-based digital worksheet with Palembang local wisdom context in support students' numeracy skills.

RESULT AND DISCUSSION

Results

Preliminary Research

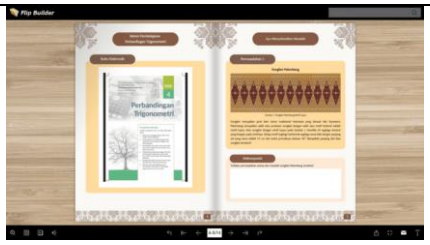
In the preliminary research stage, the researcher conducted three main activities, namely needs and curriculum

analysis, literature review, and the development of a conceptual framework. Needs analysis was carried out through initial observations and discussions with the 10th-grade mathematics teacher. The results indicated that trigonometry learning was still teacher-centered with limited learning resources, and the integration of local wisdom contexts in learning was rarely implemented. This resulted in students experiencing difficulties in understanding the basic concepts of trigonometric ratios and their applications in everyday life. In addition, curriculum analysis was conducted together with the teacher to review the Trigonometric Ratios material taught in 10th-grade, odd semester.

The literature review was conducted to strengthen the theoretical foundation for the development of the digital worksheet, covering the design research method of the development studies type, the integration of CT in mathematics learning, the development of numeracy skills, and the potential integration of Palembang local wisdom. The local wisdom used as the context for trigonometry topics included Palembang Songket for sine, the Monpera for cosine, and the Bidar Boat for tangent. The contextual problems required students to use sine ratios to determine songket length, cosine ratios to estimate the painted area of Monpera, and tangent ratios to determine the distance between two Bidar Boats. This integration connected trigonometric concepts with authentic local cultural contexts. These three contexts were selected because they are close to students' lives and relevant to the material. Based on the results of the needs analysis, curriculum review, and literature study, the researcher developed the initial prototype of the digital worksheet. This digital worksheet was designed using Canva and converted into a flipbook format via the Flip PDF Corporate application to make it more interactive and easily accessible to students. The initial prototype of the digital worksheet is presented in Table 3 below.

Table 3. Initial Prototype of the Digital Worksheet

Description	Display
Cover	
Introduction	

Description	Display
Problem 1	
Answer Sheet Problem 1	
Problem 2 and Answer Sheet Problem 2	
Problem 3	
Answer Sheet Problem 3	
Last Page	

Development of Prototyping Phase

Self-Evaluation

Based on the results of the self-evaluation stage of the initial digital worksheet prototype, the researcher identified several areas requiring improvement. In terms of content and construct, it was found that the digital worksheet lacked an introductory section explaining its purpose and function, and the learning objectives were not clearly formulated. In addition, the presented material was considered too dense, so it was decided to divide the digital worksheet into three

sections according to the subtopics, that are sine, cosine, and tangent as shown in Figure 3 below.

(a)

(b)

(c)

Figure 3. Digital Worksheet on (a) Sine Ratios; (b) Cosine Ratios; (c) Tangent Ratios

Furthermore, regarding the integration of CT in the digital worksheet, each CT stage did not have adequate explanations, and the sequence between the abstraction and pattern recognition stages needed to be swapped to be more systematic. Moreover, the problems presented were considered too simple, so their complexity would be increased. On the technical and media side, the learning videos and GeoGebra simulations, which were still sourced externally (YouTube and GeoGebra Classroom) will be created independently to align with the digital worksheet requirements. The functionality aspect was also improved by adding links for answer submission. Finally, visual improvements included enlarging the font size, which was too small, and adding a back cover to complete the digital worksheets.

Expert Review

Prototype I, produced during the self-evaluation stage, was subsequently validated by several experts. The validation process was conducted on three assessment aspects, that are content, construct, and language. The validation of prototype I involved three expert validators who are mathematics education lecturers, as well as one practitioner validator, namely a mathematics teacher. A summary of the validation results is presented in Table 4 below.

Table 4. Validation Results Summary

Aspect	Percentage				Total	Criteria
	V1	V2	V3	V4		
Content	96%	96%	90%	98%	95%	Very Valid
Construct	89%	94%	97%	94%	94%	Very Valid
Languange	96%	96%	84%	92%	92%	Very Valid
Average					94%	Very Valid

Based on Table 4, the validation results show an average score of 95% for the content aspect, 94% for the construct aspect, and 92% for the language aspect.

Overall, the digital worksheet obtained a total average score of 94%, which indicates that the developed product can be classified as very valid (Hariyati & Rachmadyanti, 2022).

One-to-One

The one-to-one stage was conducted in parallel with the expert review stage. In this stage, prototype I was trialed with three students of heterogeneous cognitive abilities (low, moderate, and high). The purpose of this stage was to identify difficulties experienced by students in completing the digital worksheet, assess the clarity of the language used, and review the students' understanding of the problem instructions. A summary of the difficulties encountered by students is presented in Table 5 below.

Table 5. Summary of Student Difficulties in One-to-One Stage

Student Difficulties	Revision Decision
Difficulty with several terms in the problems, such as "sub-problems" and "main problem".	Improving the problem narrative to be clearer and easier to understand.
Did not answer the problems sequentially.	Adding and highlighting step-by-step instructions to create a more guided workflow.
Confusion in writing answers because the problems were not numbered.	Adding numbering to each problem to make writing answers easier.
Unable to open the answer submission link in the algorithm stage of the Sine and Cosine worksheets.	Fixing the answer submission link so it can be accessed properly.
Confusion regarding the position of boats A and B in the 'Bidar Boat' problem image within the Tangent worksheet .	Revising the boat image layout to align with the questions asked.

The comments from the expert review stage and the difficulties experienced by students during the one-to-one stage served as the basis for revising prototype I. One recurring comment from the validators, which also posed a challenge for students, was related to the language or wording of the questions used in the digital worksheets. For example, the use of terms that were unfamiliar to students, such as decomposition, pattern recognition, abstraction, algorithm, conclusion, and sub-problems. In addition, the instructions provided were still difficult for students to understand. This aligns with the statement Nikita et al. (2018) that word choice and sentence construction in learning materials must be carefully considered to prevent student confusion. Based on this feedback, improvements were made to the language and question formulation to make them easier for students to understand (Khatimah & Asdarina, 2020).The revised version is referred to as prototype II.

Small Group

In the small group stage, Prototype II, which resulted from revisions made based one-to-one stage, was trialed with a small group of students. This stage was conducted to test the practicality of the developed digital worksheet. The trial was carried out over two meetings with six students divided into two heterogeneous groups. Each group consisted of three students with high, moderate, and low abilities.

The implementation of learning at this stage was almost the same as in the one-to-one stage. In the first meeting,

students completed the digital worksheets on sine and cosine trigonometry. In the second meeting, students completed the digital worksheets on tangent. At the end of the small group trial meetings, students were asked to complete a practicality questionnaire for the digital worksheet, covering aspects such as ease of use, attractiveness of the interface, clarity of the media, and language appropriateness. A summary of the practicality questionnaire results is presented in Table 6 below.

Table 6. Summary of Practicality Questionnaire Results

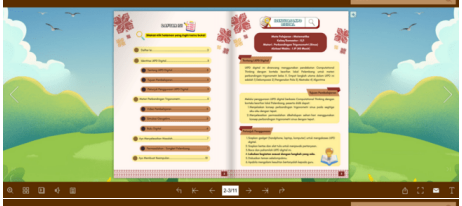
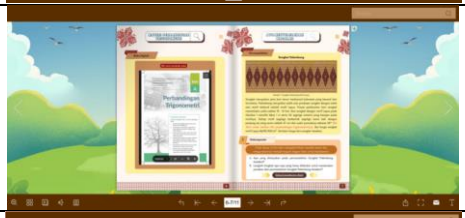
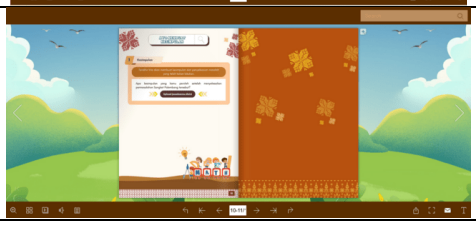
Aspect	Percentage						Total	Criteria
	S1	S2	S3	S4	S5	S6		
Ease of use	85%	95%	100%	80%	90%	90%	90%	Very Practical
Attractiveness	100%	100%	100%	80%	85%	100%	94%	Very Practical
Clarity of media	100%	95%	100%	80%	80%	100%	93%	Very Practical
Language appropriateness	93%	87%	87%	80%	93%	100%	90%	Very Practical
Average							**92%**	**Very Practical**

Based on the results of the practicality questionnaire in the small group stage show in Table 6, the digital worksheet obtained an average percentage score of 92%, categorized as very practical (Karim et al., 2024). Each assessment aspect also showed the same category. The ease of use aspect received a score of 90%, indicating that the digital worksheet was considered easy for students to use. The attractiveness aspect received the highest score of 94%, suggesting that the digital worksheets interface was engaging and capable of motivating students in learning. Furthermore, the media clarity aspect achieved a score of 93%, indicating that the media included in the digital worksheet was clear and easy to understand. Meanwhile, the language appropriateness aspect received a score of 90%, meaning that the language used in the digital worksheet was appropriate and understandable for students. Therefore, the results of the practicality questionnaire indicate that the developed digital worksheet is practical for use in learning.

Field Test

The field test stage was conducted in 10th-grade class 5, involving 34 students, and took place over four meetings to examine the implementation of the revised digital worksheet. The activities began with a pretest to measure students' initial numeracy skills, followed by three main learning sessions using the Problem-Based Learning (PBL) model. Each session covered trigonometry topics sequentially (sine, cosine, and tangent) while integrating contextual problems based on Palembang local wisdom, such as Palembang Songket, Monpera, and Bidar Boat. At this stage, the digital worksheets used was the version revised from the previous stage. One of the digital worksheets (sine) is presented in Table 7 below.

Table 7. Digital Worksheet on Sine Ratios

Description	Display
Cover	
Introduction	 
Palembang Songket Problem	
Answer Sheet	
Last Page	

During this process, the researcher acted as a facilitator, guiding the group discussions. The activities concluded with a posttest to measure students' numeracy skills after the intervention. Overall, the learning process ran smoothly, and group discussions were active. However, the main challenge identified was time management, as students required more time to complete the digital worksheets than initially anticipated. This was caused by two factors, technical issues such as unstable internet connections and students' unfamiliarity with solving mathematical problems using the stages of CT. As a result, some students were unable to complete the digital worksheets within the allocated time.

Assessment

The assessment stage is the evaluation phase conducted to assess the effectiveness of the digital worksheet in supporting students' numeracy skills. In this stage, the researcher carried out a

posttest after the entire learning sequence was completed. The posttest results were then compared with the pretest results. The students' scores were analyzed using statistical tests with the assistance of SPSS. This analysis was conducted to examine the effectiveness of the CT-based digital worksheet with a Palembang local wisdom context on students' numeracy skills before and after using the digital worksheet. The results of the statistical tests on the pretest and posttest data are as follows.

Normality Test

Before conducting the hypothesis test, the pretest and posttest numeracy data were first tested for normality using the Shapiro-Wilk. The normality test results are presented in Table 8 below.

Table 8. Normality Test Results

	df	Sig.
Pretest Numeracy Skill	34	.059
Postest Numeracy Skill	34	.026

.Based on the table, the significance value for the pretest data was 0.059 > 0.05, indicating that the pretest data were normally distributed. Meanwhile, the posttest data had a significance value of 0.026 < 0.05, indicating that the posttest data were not normally distributed. Since one of the datasets was not normally distributed, or the assumptions for parametric testing were not met, the hypothesis testing was continued using the non-parametric Wilcoxon Signed Rank Test (Zulkipli et al., 2024).

Wilcoxon Test

The results of the Wilcoxon test are presented in Tables 9 and 10 below.

Table 9. Wilcoxon Rank Test Results

		N	Mean Ranks	Sum of Ranks
Postest Numeracy Skill - Pretest Numeracy Skill	Negative Ranks	0[a]	.00	.00
	Positive Ranks	34[b]	17.50	595.00
	Ties	0[c]		
	Total	34		

a. Postest Numeracy Skill < Pretest Numeracy Skill
b. Postest Numeracy Skill > Pretest Numeracy Skill
c. Postest Numeracy Skill = Pretest Numeracy Skill

.The Wilcoxon test results indicate that all students (34 students) showed an improvement from the pretest to the posttest, with positive ranks = 34 and negative ranks = 0. This means that no student experienced a decrease in scores after learning using the CT-based digital worksheet with a Palembang local wisdom context.

Table 10. Wilcoxon Test Results

Test Statistics[a]

	Postest - Pretest Numeracy Skill
Z	-5.087[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Table 10 show that the significance value (Asymp. Sig. 2-tailed) obtained was 0.000 < 0.05, indicating that there is a significant difference between the pretest and posttest results of students' numeracy skills. Therefore, based on the Wilcoxon test analysis, it can be concluded that the use of the CT-based digital worksheet with a Palembang local wisdom context is effective in improving students' numeracy skills.

Discussion

Validity of CT-Based Digital Trigonometry Worksheet with Palembang Local Wisdom Context

The validation results of Prototype I indicate that the developed digital worksheet achieved a very valid category with an overall average percentage of 94%. This high score suggests that the developed product meets quality standards in terms of content, construct, and language aspects.

The content aspect obtained an average percentage of 95%. This result indicates that the material in the digital worksheet aligns with the learning outcomes and objectives of the curriculum and is integrated with CT steps and the local wisdom context of Palembang. Such alignment makes the trigonometry ratios concepts more meaningful through local context and assists students in systematically solving numeracy problems through the application of CT.

Regarding the construct aspect, the digital worksheet achieved an average percentage of 94%. This result demonstrates that the sequence of activities, visual layout, and CT steps in the digital worksheet are coherently organized to support numeracy skills. This is consistent with Hafriani (2021) who stated that structured learning facilitates students in solving mathematical problems.

The language aspect obtained an average percentage of 92%. This achievement indicates that the language used is easily understood, clear, and appropriate to the students' intellectual development, thereby aiding their understanding of trigonometric ratio concepts. This aligns with Yusuf et al. (2025) and Prediger & Neugebauer (2023) who emphasized that the use of clear language can enhance students' conceptual understanding.

Practicality of CT-Based Digital Trigonometry Worksheet with Palembang Local Wisdom Context

The practicality test of prototype II was conducted through a small group trial. Based on the results of the practicality questionnaire presented in Table 6, the developed worksheet obtained an average percentage of 92%, categorized as very practical. This finding indicates that the developed student worksheet is considered a learning medium that is easy to use, engaging, visually clear, and employs appropriate language.

The ease of use aspect achieved an average score of 90%. This result indicates that the digital worksheet is easy for students to operate. Such ease enables students to focus on content comprehension and numeracy problem-solving without being hindered by technical difficulties. This aligns with Ali et al. (2024) who stated that the ease of use of learning media allows students to concentrate on understanding the material.

The attractiveness aspect received the highest score of 94%. This percentage indicates that the visual

appearance and interactive elements of the digital worksheet are highly engaging for students. The design, which integrates Palembang local wisdom context with modern visuals, makes the learning experience relatable to students' daily lives while remaining culturally relevant. Additionally, Raudah et al. (2024) emphasized that interactive media presentation plays a significant role in increasing students' attention and learning interest. Similarly, research by Greener (2022) highlights that technology-supported interactive learning can strengthen student engagement.

The clarity of media aspect obtained an average score of 93%. This result indicates that the media's presentation, visualization, and illustrations in the digital worksheet are clear and easy to understand. This aligns with Türkoğlu & Yalçınalp (2024) and Stanciulescu et al. (2024) who asserted that clear visual media can strengthen conceptual understanding and help students transition from concrete to abstract understanding in mathematics.

The language appropriateness aspect achieved an average score of 90%. This result indicates that the language used in instructions, problems, questions, and explanations within the digital worksheet is easy to understand, unambiguous, and clear. The use of straightforward language assists students in comprehending tasks and numeracy problem contexts without confusion (Planas et al., 2025).

The Role of CT-Based Digital Trigonometry Worksheet with Palembang Local Wisdom Context in Enhacing Students' Numeracy Skill

The effectiveness test results indicate that the use of a CT-based digital worksheet with Palembang local wisdom context significantly improves students' numeracy skills. Based on the results of the Wilcoxon Signed-Rank Test presented in Table 9, all students showed an increase in scores from pretest to posttest. The significance value Asymp. Sig. (2-tailed) = 0.000 (< 0.05) in Table 10 further confirms that there is a significant difference between the pretest and posttest results.

This effectiveness demonstrates that the integration of CT stages in the problem solving process of the digital worksheet contributes to the enhancement of students' numeracy skills. CT emphasizes four main steps, that are decomposition, pattern recognition, abstraction, and algorithm (Tabesh, 2017). These steps help students simplify numeracy problems into logical and structured procedures (Yeni et al., 2024). Through CT, students not only solve mathematical problems procedurally but also understand the underlying meaning behind the calculation process (Wu & Yang, 2022).

In addition, the use of the Palembang local wisdom context plays a crucial role in supporting numeracy skills. Learning based on local cultural context facilitates the connection between mathematical concepts and students' real-life experiences, leading to improved understanding (Soleha et al., 2024). In this context, students not only practice calculations but also interpret the mathematical meaning behind phenomena in their local culture.

Furthermore, the digital format of the worksheet offers advantages in interactivity, concept visualization, and learning flexibility. finding is consistent with Weinhandl et al. (2025) who emphasized those well-designed digital mathematics environments can enhance conceptual learning by providing

opportunities for visualization and interaction. The digital worksheet facilitates the visual exploration of trigonometric ratio concepts, supporting the development of stronger conceptual understanding (Ziatdinov & Valles, 2022). Additionally, multimedia-based interactive designs have been shown to increase students' motivation and learning focus (Azzahro' & Handayani, 2025). These digital features not only make learning more engaging but also foster real-world mathematical problem-solving skills, which are central to numeracy development.

Overall, the effectiveness of this digital worksheet can be attributed to the synergy among the CT approach, which strengthens logical thinking structures, the use of local wisdom context, which enhances learning relevance and meaning, and the utilization of digital media, which supports visual and interactive concept exploration. These three elements form a solid foundation for improving students' numeracy skills.

The effectiveness observed in this study also highlights the contribution of integrating three elements that have often been examined separately in previous research, such as numeracy, CT, and Palembang local wisdom context. Previous studies have focused on one or two of these aspects. However, limited attention has been given to their integration within a single digital learning resource. The findings suggest that combining CT-based processes with culturally relevant contexts in a digital environment can provide a more meaningful learning experience and effectively support students' numeracy skills.

Implication

This study demonstrates that the integration of CT stages into the digital worksheet with a Palembang local wisdom context can effectively support the improvement of students' numeracy skills in trigonometry. This implies that mathematics learning designed with a CT-based approach and linked to students' cultural context can strengthen numeracy skills, particularly in connecting abstract concepts to real-life situations. Therefore, teachers can utilize similar digital worksheets as an alternative teaching strategy to foster numeracy skills in a more meaningful and contextualized manner.

Limitation

This study is not without limitations. First, the research was conducted with a limited number of participants in a specific educational context, which may limit the generalizability of the findings. Second, the use of a digital platform for the digital worksheets requires a stable internet connection. During the trials, unstable connectivity posed a challenge that affected the smoothness of learning and students' time management. Third, some students were not yet accustomed to solving mathematical problems using the CT approach, resulting in longer completion times for tasks. Finally, the development and testing process focused only on trigonometry topics within the Palembang local wisdom context. Therefore, further research is recommended to explore the effectiveness of this digital worksheet for other mathematics topics and in more diverse learning environments.

CONCLUSION

This study successfully developed three digital worksheets for trigonometric ratio topics (sine, cosine, and tangent)

designed based on Computational Thinking (CT) and integrated with the Palembang local wisdom context. Through a systematic development process, these three digital worksheets were proven to be of very high quality, with expert validation results indicating very valid with an average score of 94%, and small group trials showing that the product is very practical with a practicality score of 92%. Furthermore, this study demonstrated that the use of the developed series of digital worksheets is effective in improving students' numeracy skills. This is evidenced by the Wilcoxon Signed Rank Test results, which yielded a significance value of 0.000 ($p < 0.05$), indicating an increase in students' numeracy skills after the learning process. Therefore, it can be concluded that digital worksheets integrated with CT and relevant local wisdom contexts are valid, practical, and effective in supporting students' numeracy skills.

CONCLUSION

This study successfully developed three digital worksheets for trigonometric ratio topics (sine, cosine, and tangent) designed based on Computational Thinking (CT) and integrated with the Palembang local wisdom context. Through a systematic development process, these three digital worksheets were proven to be of very high quality, with expert validation results indicating very valid with an average score of 94%, and small group trials showing that the product is very practical with a practicality score of 92%. Furthermore, this study demonstrated that the use of the developed series of digital worksheets is effective in improving students' numeracy skills. This is evidenced by the Wilcoxon Signed Rank Test results, which yielded a significance value of 0.000 ($p < 0.05$), indicating an increase in students' numeracy skills after the learning process. Therefore, it can be concluded that digital worksheets integrated with CT and relevant local wisdom contexts are valid, practical, and effective in supporting students' numeracy skills.

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