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Design Thinking in Minimum Competency Assessment: Its Effect on Vocational Students' Numeracy Skills

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Abstract. *The 21st century requires individuals to have the ability to think comprehensively, especially in critical and creative thinking. However, there is a significant gap between global competency demands and student competency achievement in Indonesia. The results of the PISA study show that the literacy skills of Indonesian students are still relatively low, including in terms of numeracy or contextual problem solving. Based on a preliminary study of 658 vocational school students in Semarang, as many as 81.9% considered mathematics as a difficult subject. This research uses a qualitative approach with the Design Thinking method and ADDIE R&D model development design. The stages of Design Thinking applied include: the empathize stage to explore students' learning needs through interviews and observations; the definition stage to identify the main problems in learning; the ideate stage to design an AKM-based learning solution; prototype stage to create interactive media and LKPD; as well as the test stage to implement the media and assess its effectiveness through the Minimum Competency Assessment (AKM). Numeracy ability is studied through three main indicators, namely (1) the use of numerical and symbolic representations, (2) information analysis in the form of tables, graphs, images, and diagrams, and (3) the formulation of conclusions or predictions from available data. Data is collected through tests and analyzed descriptively as well as statistical tests. The results of the analysis showed that of 36 students in grade XI of SMK Negeri 1 Semarang, 86% had numeracy skills in the very high category and 14% in the high category, obtained a significance value (Sig.) for class XI TO 2 of 0.109 and for class XI TO 3 of 0.134. Both values are greater than 0.05, so it can be concluded that the data from both classes come from a normally distributed population. The average post-test score of the experimental class was 85.39 higher than the control class of 84.16. This indicates that the work on AKM questions and the use of media based on the Design Thinking approach contribute statistically significantly to improving students' numeracy skills. Thus, AKM has proven to be effective as a measuring tool as well as a strategy to increase numeracy in mathematics learning at vocational schools.*

Keywords: *Minimum Competency Assessment, Numeracy Ability of Vocational School Students, Design Thinking Approach in Mathematics.*

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INTRODUCTION

Entering the 21st century, education systems are increasingly expected to produce learners who possess critical thinking, creativity, communication, and collaboration skills (Trilling & Fadel, 2009). These competencies, known as 21st-century skills, cannot be cultivated through conventional teaching methods alone, but rather require contextual learning approaches that engage students in understanding real-world problems and reflecting on possible solutions (Silvia & Asdarina, 2024). Unfortunately, international assessments reveal that these fundamental competencies remain a major challenge for Indonesian students. According to the 2018 Programme for International Student Assessment (PISA) results, Indonesia scored below the OECD average in all domains: reading (371), mathematics (379), and science (396), showing a significant decline compared to previous assessments (OECD, 2019). These results indicate weaknesses in problem-solving abilities, conceptual understanding, and data interpretation in real-life contexts.

In response, the Indonesian Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) implemented the National Assessment (Asesmen Nasional), with the Minimum Competency Assessment (Asesmen Kompetensi Minimum or AKM) as its core component. This assessment aims to measure students' literacy in reading and numeracy. Within this framework, numeracy is no longer viewed merely as the ability to perform arithmetic operations; rather, it encompasses the capacity to apply mathematical knowledge in analyzing information, interpreting data in various representations, and making decisions based on logical reasoning (Pusat Asesmen dan Pembelajaran Kemendikbud, 2020; Han et al., 2017). According to the OECD (2019), strong numeracy skills are a critical indicator of students' preparedness for both the workforce and the demands of 21st-century life.

One of the key strengths of this policy direction lies in its emphasis on meaningful and contextual learning. In this regard, the Design Thinking approach emerges as a strategic opportunity to meet the demands of 21st-century education. This approach has been shown to enhance students' ability to develop creative solutions grounded in empathy and real-world problem analysis (Riyadi et al., 2024). Moreover, a study by Fitriani and Pratiwi (2021) demonstrated that the implementation of Design Thinking in mathematics instruction significantly improved student learning outcomes and fostered active student engagement. Similarly, Amelia and Suryadi (2022) found that this approach simultaneously promotes the development of students' problem-solving and collaborative skills.

However, field observations reveal that many students, particularly those in vocational high schools (SMK), continue to struggle with understanding fundamental mathematical concepts. A preliminary study involving 658 SMK students in Semarang City found that 81.9% perceived mathematics as a difficult subject, with most experiencing challenges in interpreting context-based numeracy problems (Utomo et al., 2024). This issue raises a fundamental question: how can we develop numeracy learning strategies that not only improve academic performance but also cultivate student mindsets to be better prepared for real-world challenges? In this context, the Design Thinking approach presents a promising solution for addressing the challenges of implementing the Minimum Competency Assessment (AKM). This approach consists of five stages—empathize, define, ideate, prototype, and test—that actively engage students, foster empathy for real-world problems, and promote systematic thinking in generating solutions (Riyadi et al., 2024). Design Thinking has also been shown to be effective in enhancing students' higher-order thinking skills by encouraging both emotional and cognitive engagement. Nugroho et al. (2020) found that an environment-based learning model—emphasizing contextual and problem-based learning—had a greater effect size (1.245) than the discovery learning model (0.762) in improving students' mathematical problem-solving abilities.

Based on the aforementioned discussion, this study aims to examine the effectiveness of the Minimum Competency Assessment (AKM) grounded in the Design Thinking approach on the numeracy skills of vocational high school (SMK) students. This research seeks to address the need for an applicable and meaningful instructional approach by integrating national assessment frameworks with 21st-century learning strategies. The findings of this study are expected to contribute not only theoretically to the development of numeracy learning models, but also practically by providing strategic recommendations for AKM-based instruction that can be implemented in schools—

particularly at the vocational level, where strong numerical competence is essential for workforce readiness.

RESEARCH METHODS

This study adopts a Research and Development (R&D) methodology, focusing on product development and testing its effectiveness within the context of mathematics instruction in vocational high schools (SMK). The development design follows the ADDIE model (Analysis, Design, Development, Implementation, Evaluation), which is integrated with the Design Thinking approach as an innovative strategy for designing assessments based on students' contextual realities. The Design Thinking approach consists of five stages: Empathize, Define, Ideate, Prototype, and Test. In the Empathize stage, researchers conducted classroom observations and distributed questionnaires to understand students' difficulties and needs in numeracy, particularly regarding problems related to the Minimum Competency Assessment (AKM). In the Define stage, data from observations and questionnaires were analyzed to construct user personas representing the characteristics and needs of SMK students. During the Ideate stage, brainstorming sessions were held with teachers and peers to design numeracy tasks integrated with vocational contexts, such as industrial data graphs, production unit conversions, and basic financial report analysis.

In the Prototype stage, the assessment tools were developed, including a test blueprint, AKM-style numeracy items, alternative answers, and scoring rubrics, all of which were constructed based on the numeracy literacy indicators set by the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek, 2020). The Test stage involved implementing the assessment in two classes: XI TO 2 as the experimental group and XI TO 3 as the control group. Sample selection employed purposive sampling, based on the similarity of class characteristics and previous academic performance. Although the number of participants (36 students) may appear limited, this sample size aligns with the formative evaluation requirements of product development research. As noted by Sugiyono (2015), a limited trial in R&D studies may involve 6–30 participants as an initial estimate to evaluate product effectiveness.

The instruments used in this study consisted of questionnaires and AKM-based numeracy test items, whose validity was assessed using the Pearson Product Moment correlation technique and reliability through Cronbach's Alpha. Pretest and posttest data were analyzed through normality and homogeneity tests as prerequisites, followed by a one-tailed independent t-test to determine whether the average numeracy performance of the experimental class was significantly higher than that of the control class. The criterion for the t-test was tcoun $t_{count} > t_{table}$, indicating a higher spatial ability mean score in the experimental group. The effectiveness of the assessment was measured based on the increase in students' average scores and the proportion of students achieving the Minimum Mastery Criteria (KKM) of 75%. The results indicated a significant improvement in the experimental class compared to the control class, suggesting that the AKM-based numeracy assessment integrated with the Design Thinking approach can support students in understanding contextual problems and enhancing their critical numerical reasoning.

RESULTS AND DISCUSSION

In the *empathize* stage, an in-depth analysis was conducted to identify the learning challenges students face in mathematics, which served as the basis for constructing an empathy map. The common perception that mathematics is a difficult subject—dominated by formulas and only mastered by certain students has led many learners to experience anxiety when engaging with mathematical content (Muhtarom et al., 2017). To explore this issue further, a needs analysis survey was administered to 658 students from three vocational schools in Semarang (SMKN 1, SMKN 2, and SMKN 10). The results revealed that 81.9% of students perceived mathematics as a difficult subject, while only 18.1% considered it easy (see Figure 1).

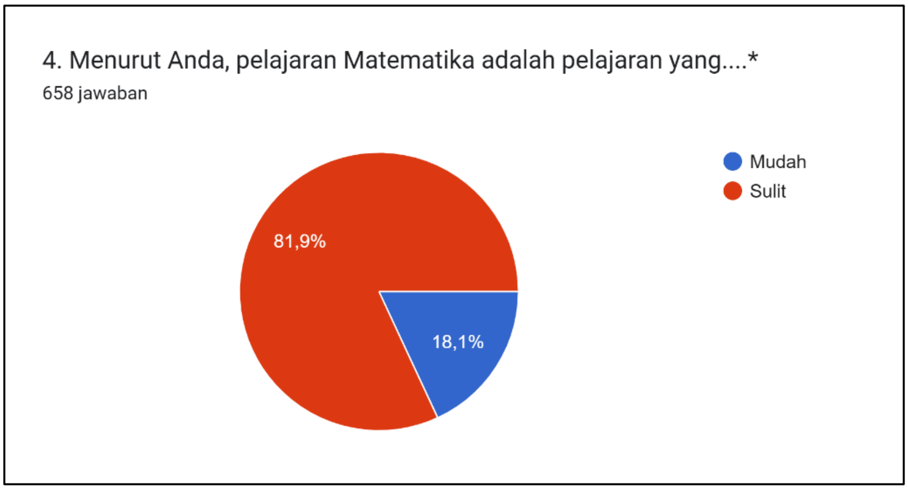

Figure 1. Students' Perception of the Level of Difficulty of Mathematics Lessons

These findings reinforce Seymour Papert's assertion that *"The scandal of education is that every time you teach something, you deprive a student of the pleasure and benefit of discovery."* This suggests that learning difficulties may stem from the lack of opportunities for students to independently explore mathematical concepts. Furthermore, when asked to identify the main challenges they face in learning mathematics, the majority of respondents (73.3%) reported difficulty in understanding the material presented by the teacher. Additionally, 18.8% indicated that the instructional methods used did not align with their preferred learning styles, and only 7.9% recognized that their difficulties stemmed from their own learning habits. These results are illustrated in Figure 2 below.

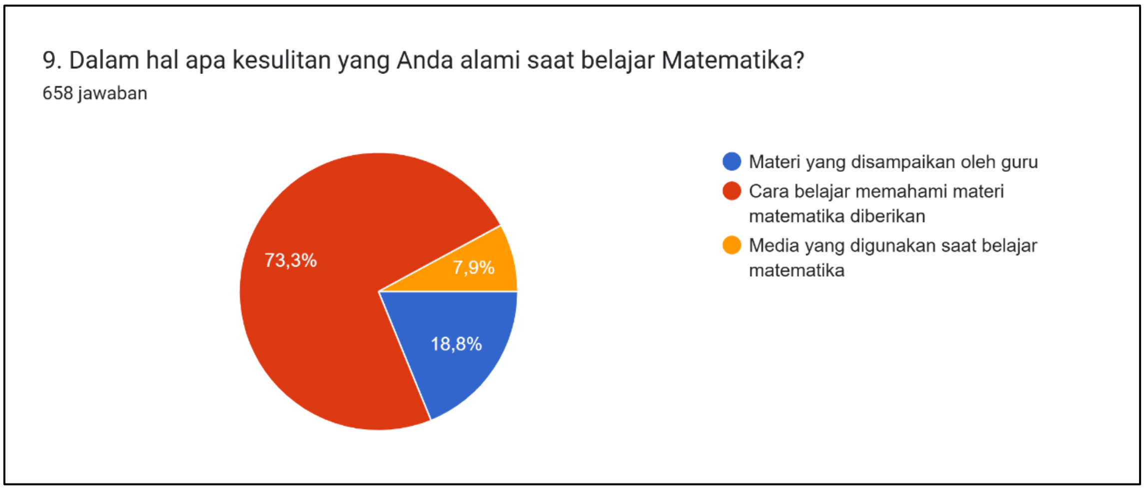

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Figure 2. Aspects of Difficulties Students Face When Learning Mathematics

These findings affirm that the core issue does not lie solely in students' intrinsic motivation, but rather in instructional approaches that fail to adapt to their learning needs. This aligns with Vygotsky's perspective that effective learning should occur within the *zone of proximal development*—a space where students can achieve optimal learning outcomes with appropriate guidance.

In terms of specific subject areas perceived as the most difficult, the majority of students (51.5%) identified Algebra and Functions, followed by Geometry (26.4%) and Data Analysis and Probability (22%) (Figure 3). These findings indicate that students experience difficulties not only in mathematics generally, but also particularly in topics that require abstract understanding and higher-order logical reasoning.

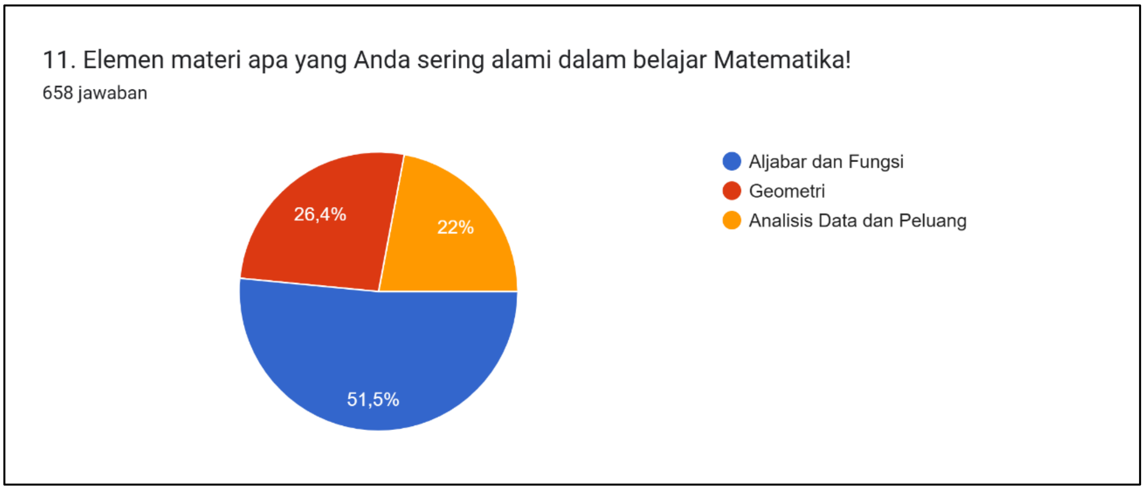

Figure 3. The math material that students experience the most.

Based on these overall findings, it can be concluded that the primary challenge in mathematics learning at vocational high schools lies in the teachers' instructional approaches and the lack of meaningful learning experiences for students. Therefore, it is essential to design learning that is human-centered, such as through the Design Thinking approach, so that students are not merely passive recipients but active participants in the learning process. The percentages from the initial research data are presented in Table 1.

Table 1. Percentage of Initial Data Research.

Preliminary data research analysis	Presentase (%)
Math is a difficult subject	81,9
Difficulties in learning to understand Mathematics material	73,3
Material student learning difficulties	51.5

These findings serve as a crucial foundation for designing the *Empathy Map*, a user-centered tool aimed at understanding experiences from the learners' own perspective (Bratsberg, 2019). By identifying what students think, feel, see, hear, say, and do during the mathematics learning process, the Empathy Map enables researchers to gain a comprehensive picture of the challenges and needs students face. The design of the Empathy Map for this context is presented in Figure 4.

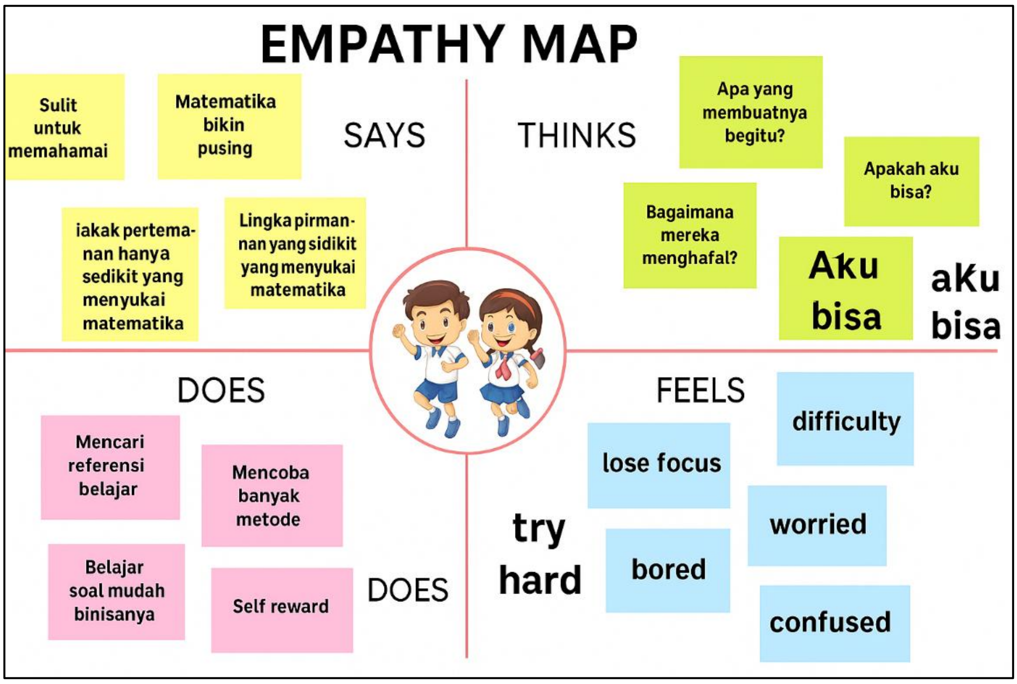

Figure 4. Empathy Map

The next phase is the *Define* stage, which aims to formulate the core problem based on the observations and data gathered during the *Empathize* phase. This stage also involves the development of a user persona to better understand and address the specific needs of the learners as end users (Jonathan, 2022).

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Collection of information that has been made during the *Empathize stage*. *User persona* for SMKN 1 Semarang students in Figure 5.

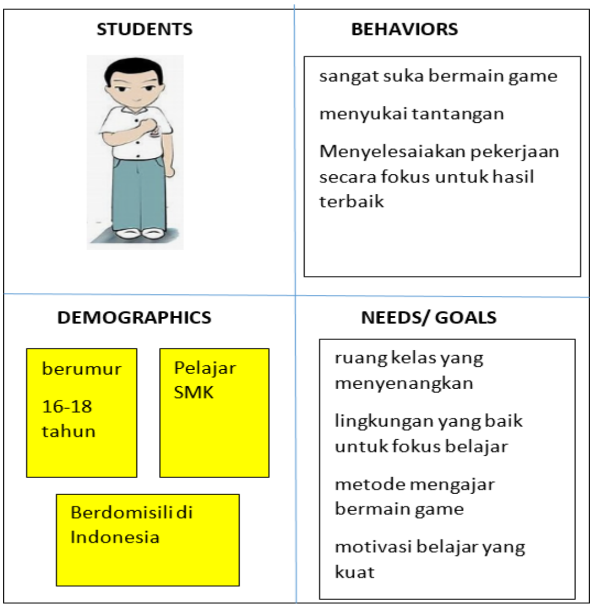

Figure 4. Empathize User

Based on the results of the empathy mapping, it was found that the majority of students at SMKN 1 Semarang are male, which aligns with the school's specialization in technology and engineering programs. During learning activities, students tend to become easily bored, particularly when exposed to conventional teaching methods that are repetitive and lack challenge. This condition has led some students to seek distractions, such as playing games during lessons, which inevitably affects their focus and academic performance.

Psychologically, students aged 16–18 are in an adolescent stage that is highly susceptible to environmental influences. If their social environment tends to favor playing games and shows little enthusiasm for learning, there is a strong likelihood that they will conform to such behaviors. Consequently, this habit can become a barrier to the learning process, particularly in subjects like mathematics, which require sustained concentration and deep conceptual understanding.

Based on the results of the empathy map, students expressed feelings of losing focus, confusion, and anxiety, as well as a general lack of understanding of the learning material. They reported a need for more enjoyable, interactive, and pressure-free learning methods that allow them to "try hard" naturally. Therefore, a supportive and non-threatening learning environment, along with adaptive assessment methods such as the *Asesmen Kompetensi Minimum* (AKM), is essential in fostering more meaningful learning experiences. This aligns with the spirit of the *Merdeka Curriculum* and the values of the *Profil Pelajar Pancasila*.

Understanding this context, the problem formulation in the *define* stage focuses on how to design a mathematics learning intervention that is adaptive to the characteristics of vocational school students, minimizes learning fatigue, and enhances focus and motivation through an approach grounded in students' real needs.

After completing the *define* stage, which focuses on formulating the core problem from the user's perspective, the process proceeds to the *ideate* phase. This stage aims to explore various possible solutions through open and creative brainstorming sessions. In line with the view of Kelley & Kelley (2013), *"The best way to get a good idea is to get a lot of ideas,"* the researcher, in this phase, sought to generate as many potential ideas as possible to address the students' needs identified earlier through the empathy map.

Among the various ideas generated, the final choice fell on implementing the *Asesmen Kompetensi Minimum* (AKM) as a strategy to authentically and relevantly assess and map students' numeracy skills. This idea was selected because it serves as a bridge between students' actual learning conditions and the expectations of meaningful instruction. AKM is considered well-aligned with the *Merdeka Curriculum*, which emphasizes competency-based learning and promotes contextualized, student-centered pedagogy.

The researcher then designed a Minimum Competency Assessment (AKM) based on three core indicators of numeracy skills, structured to comprehensively assess students' understanding of mathematics in real-life contexts. These three numeracy indicators are presented in Table 2.

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Table 2. Numeracy Ability Indicators

Yes	Numeracy Ability Indicators
1	Using various forms of symbols and numbers in solving mathematical literacy problems.
2	Analyze the information presented in the form of tables, graphs, images and diagrams.
3	Provide interpretation of the results of the analysis and provide conclusions or predictions.

The researcher conducted an analysis of students' numeracy test results based on the scoring rubric presented in Table 3, which outlines the achievement criteria for each numeracy indicator. This rubric was designed to measure the extent to which students are able to comprehend, interpret, and utilize quantitative information within real-life contexts.

Table 3. Achievement Criteria for Numeracy Indicators

Indicator	Score	Description
Using various forms of symbols and numbers in solving mathematical literacy problems.	1	Sufficient proficiency in mathematics numbers and symbols
	2	Have skills related to numbers and mathematical symbols.
Analyze the information presented in the form of tables, graphs, images and diagrams.	0	No analysis of the questions/no effort to analyze the questions
	1	Not understanding the problem thoroughly, so that the settlement planning is not appropriate
	2	Have not understood most of the problems so that the solution is correct, but most of them are wrong
	3	Have not understood a small part of the problem, so the solution is correct, but there are still mistakes
	4	Understand the problem but there is a slight error in the solution
	5	Understand the problem but there are still errors in the solution

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	6	Understand the problem and solve it with the right solution procedure
Provide interpretation of the results of the analysis and provide conclusions or predictions.	0	Can interpret the results of the analysis but miscalculation or incorrect answers resulting from improper completion.
	2	Can interpret the results of the analysis correctly.

The analysis was conducted quantitatively by classifying the results into three ability levels: high, medium, and low. These categories allowed the researcher to identify general patterns in students' numeracy skills and to pinpoint specific aspects that require improvement. The percentage calculation for each numeracy indicator is presented below, along with the categorization of numeracy proficiency levels in Table 4.

Table 4. Numeracy Ability Level

Interval Score (%)	Level categories
81 -100	Very high
61-80	Tall
41-60	Keep
0-40	Low

In the prototyping stage, the researcher designed assessment items based on the three numeracy skill indicators as previously outlined in Table 5.

Table 5. Numeracy Ability Indicators

No.	Numeracy Ability Indicators	The number question
1	Using various forms of symbols and numbers in solving mathematical literacy problems	1,2,3
2	Analyze the information presented in the form of tables, graphs, drawings and diagrams	2
3	Provide interpretation of the results of the analysis and provide conclusions or predictions	1,2,3

Each indicator has a relevant question number, with a breakdown of the assessment referred to Table 6 below.

Table 6. Numeracy Question Scores

Indicator	Question Number	Shoes
1	1, 2, 3	2,2,2
2	2	6
3	1,2,3	2,2,2
Maximum Score		**18**

Table 6 shows that each indicator has a maximum score of 6, derived from the contribution of several items (for example, Indicator 1 consists of questions number 1, 2, and 3, each worth 2 points). The total maximum score is 18. An assessment rubric was used to calculate students' achievement percentages by dividing the total score obtained by the maximum possible score and then multiplying by 100%.

The design of the questions in this prototyping stage is not merely intended to measure students' abilities quantitatively, but also to identify the patterns of numeracy thinking they employ. In line with Brown's (2009) perspective, "Assessment is not about measuring how much students know, but about making their thinking visible." Therefore, the questions at this stage were developed to be contextual and reflective, aiming to reveal the depth of students' understanding of numeracy concepts.

In the final stage of the Design Thinking procedure—the Test phase—a pre-test was administered to two groups of students: the experimental class (XI TO 2, consisting of 36 students) and the control class (XI TO 3, consisting of 32 students). The objective of this pre-test was to determine whether the students' learning outcomes originated from populations with a normal distribution, which is a prerequisite for the application of parametric statistical analysis. The normality test was conducted using the *Shapiro-Wilk* method, as presented in Table 7.

Table 7. Normality Test

“PreTest”		**‘Shapiro-Wilk’**					
		“Statistic”	**“df”**	**“Sig.”**	**“Statistic”**	**“df”**	**“Sig.”**
Student Learning Outcomes	XI TO2	0.159	32	0.038	0.946	32	**0.109**
	XI TO3	0.146	36	0.049	0.953	36	**0.134**

Based on the results of the test, the significance values (Sig.) for class XI TO 2 and class XI TO 3 were 0.109 and 0.134, respectively. Since both values are greater than 0.05, it can be concluded that the data from both classes are normally distributed. Therefore, the pre-test data meet the assumption of normality and are appropriate for further analysis in evaluating the implementation of the learning design.

Subsequently, a homogeneity test was conducted to determine whether the variance in students' learning outcomes in classes XI TO 2 and XI TO 3 originated from populations with equal or homogeneous variances. This test is essential before proceeding to parametric statistical analyses such as the t-test. The results of this test are presented in Table 8.

Table 8. Homogeneity Test

Test of Homogeneity of Variance				
Hasil Belajar Siswa	**Levene Statistic**	**df1**	**df2**	**Sig.**
Based on Mean	0.351	1	66	**0.556**
Based on Median	0.282	1	66	**0.597**
Based on Median and with adjusted df	0.282	1	65.965	**0.597**
Based on trimmed mean	0.348	1	66	**0.557**

The results of Levene's test showed a significance value (Sig.) of 0.556 for the "Based on Mean" method, which is greater than 0.05. This indicates that there is no significant difference in variance between the two groups, suggesting that the data come from populations with homogeneous variances. Similarly, the significance values for the "Based on Median" and "Based on Trimmed Mean" methods were 0.597 and 0.557, respectively—both exceeding 0.05. Therefore, the assumption of homogeneity is fulfilled, and it is appropriate to proceed with parametric analysis to compare the learning outcomes after the intervention.

After it was determined that the students' learning outcome data from classes XI TO 2 and XI TO 3 were normally distributed (based on the *Shapiro-Wilk* test) and had homogeneous variances (based on *Levene's* test), the analysis proceeded with an independent samples t-test. This test was conducted to determine whether there was a significant increase in the mean numeracy ability of the experimental class compared to the control class.

Table 9. *T Test*

Class	**n**	t_{hitung}	t_{tabel}	**Conclusion**
Ecesperimen	36	3,93	2,0	The average numeracy ability of the experimental class was better than that of the control class
Control	36			

The results above indicate that at a 5% significance level, the calculated t-value t_{count} was 3,93 and t_{table} was 2,0. This shows that the price was rejected. Based on these calculations, it can be concluded that the average $t_{count} > t_{table}$ H_0 numeracy ability of the experimental class is better than that of the control class. Followed by *the Independent Samples T-Test* to find out the difference in post-test results between the two classes. The test results are shown in table 10 below.

Table 10. *Independent T-Test*

	Numeracy Ability	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Student Learning Outcomes	Post Test XI TO 2	36	85.39	4.357	.726
	Post Test XI TO3	32	84.16	4.800	.849

The results show that the average post-test score of students in the experimental class (XI TO 2) was 85.39, while the control class (XI TO 3) had an average score of 84.16. Although the difference in mean scores is not numerically substantial, it indicates that students who received instruction using AKM-based problem sets achieved slightly higher learning outcomes than those in the class without such treatment.

The findings of this study indicate that the Design Thinking approach in numeracy assessment has a positive impact on improving students' numeracy skills in vocational high schools. However, the relatively small difference suggests that, although the approach enhances students' numerical understanding, it did not result in a statistically significant quantitative difference within the context of this study. This outcome may be attributed to several factors, such as the limited duration of the intervention, the readiness of teachers to fully implement the stages of Design Thinking, or the possibility that students in the control class also experienced effective learning, even without the same instructional approach.

When compared to the study by Firmasari et al. (2024), which reported an n-gain of 0.60—equivalent to a 20-point improvement in geometry learning following the development of an e-test based on numeracy literacy and the Design Thinking approach—the improvement obtained in this study can still be categorized as moderate. Meanwhile, a descriptive study by Anggraini and Setianingsih (2022) on senior high school students' numeracy skills using AKM-type questions found an average score of 65.1, with the majority falling in the moderate category. This reinforces the idea that AKM-based assessments have the potential to enhance numeracy, though not as sharply as interventions integrated with Design Thinking. Both studies indicate that the integration of Design Thinking and the utilization of AKM have the capacity to improve mathematics learning outcomes in a contextual manner—though the magnitude of impact is highly influenced by the type of assessment instruments used, the depth of the empathize-to-test stages, and the nature of the media implemented.

Furthermore, to determine the level of numeracy ability more specifically, a descriptive analysis was carried out on the distribution of students' numeracy ability categories in the experimental class (XI TO 2), as shown in table 10.

Table 10. Percentage of Students' Numeracy Ability

Category	Number of Students	Percentage (%)
Very high	31	86 %
Tall	5	14 %
Number of students	36	

Based on Table X, 86% of students (31 individuals) fell into the "very high" numeracy ability category, while 14% (5 individuals) were categorized as having "high" numeracy skills. No students were classified under the "moderate" or "low" categories. These data indicate that the majority of students were able to successfully complete AKM-based tasks after participating in a learning process specifically designed to enhance their numeracy skills.

Although the findings of this study demonstrate the positive potential of the Design Thinking approach in numeracy assessment, several limitations should be noted as points for reflection and future development. First, the limited duration of implementation constrained the depth of engagement in each phase of the Design Thinking process, particularly the ideate and test stages, which ideally require multiple iterations and in-depth discussions. Second, the study's scope was restricted to a single vocational school with two classes, which limits the generalizability of the findings to the broader population of vocational students, although the results still provide a reasonably representative initial overview. Third, although the AKM-based assessment items underwent a validation process, the item characteristics tended to be of moderate difficulty, potentially limiting their capacity to effectively differentiate students' levels of understanding. These limitations do not diminish the value of the findings but rather highlight opportunities for refinement in future research.

Thus, based on the results of the statistical tests, it can be concluded that AKM-based learning is effective in improving students' numeracy skills. Both types of statistical analyses provide quantitative evidence supporting the effectiveness of the learning intervention implemented in the experimental class.

CONCLUSION

The results of this study indicate that the implementation of numeracy assessment based on the Minimum Competency Assessment (AKM) using the Design Thinking approach significantly contributes to improving vocational high school students' numeracy skills. The experimental class, which received explicit instruction from the teacher on how to solve problems based on three numeracy indicators—(1) the use of numbers/symbols, (2) data analysis, and (3) interpretation of results—achieved a post-test mean score of 85.39, slightly higher than the control class with 84.16. Although the difference is relatively small, these findings suggest that students' conceptual and contextual understanding improved when they were directly guided to comprehend the structure and meaning of numeracy-based problems.

These findings are consistent with the assertion by Bransford, Brown, and Cocking (2000) that *"students learn best when they actively construct their own understanding based on prior knowledge and guided instruction."* Accordingly, systematic teacher guidance within the context of AKM becomes a key element in fostering more meaningful numeracy literacy. Furthermore, as noted by Razzouk and Shute (2012), Design Thinking as a pedagogical approach can enhance students' problem-solving abilities, creativity, and critical thinking skills—components that are highly relevant to the demands of the Minimum Competency Assessment.

Furthermore, the findings of this study are in line with research conducted by Handayani and Zen (2024), which demonstrated that the Design Thinking approach enhances student engagement and fosters a more learner-centered classroom environment. In addition, Rahayu and Hidayah (2021) also found that contextual numeracy assessments can significantly improve students' logical and analytical thinking competencies.

Based on the findings, it is recommended that the implementation of numeracy assessment based on the Minimum Competency Assessment (AKM) through the Design Thinking approach be continuously developed, particularly at the vocational school (SMK) level, where functional numeracy literacy is essential for entering the workforce. Future studies should involve larger and more diverse samples, as well as further exploration of integrating this approach with interactive digital media. Additional recommendations include examining which numeracy indicators present the greatest challenges for students, in order to better target instructional strategies. While the current results demonstrate the effectiveness of the model, strengthening instructional design and diversifying assessment strategies remain essential for further development.

REFERENCES

Amelia, A., & Suryadi, D. (2022). Penerapan Pendekatan Design Thinking Dalam Pembelajaran Matematika Untuk Meningkatkan Kemampuan Pemecahan Masalah. *Jurnal Pendidikan Matematika, 16*(2), 115–126. https://doi.org/10.24815/jpm.v16i2.22456

Anggraini, K. E., & Setianingsih, R. (2022). Analisis kemampuan numerasi siswa sma dalam menyelesaikan soal asesmen kompetensi minimum (AKM). *MATHEdunesa*, *11*(3), 837-849.

Ardianingtyas, I. R., Sunandar, S., & Dwijayanti, I. (2020). Kemampuan berpikir kritis siswa SMP ditinjau dari kemampuan pemecahan masalah matematika. *Imajiner: Jurnal Matematika dan Pendidikan Matematika, 2*(5), 401–408. https://doi.org/10.26877/imajiner.v2i5.6661

Arikunto, S. (2012). *Dasar-dasar evaluasi pendidikan* (Edisi Revisi). Bumi Aksara.

Ayu, A., Nursyahidah, F., & Prayito, M. (2024). Development of Learning Media Using Ethnomathematics-Based Augmented Reality on Cube and Block Material. *Phenomenon : Jurnal Pendidikan MIPA*, *13*(2), 207–225. https://doi.org/10.21580/phen.2023.13.2.17130

Ayuni, S., Pasaribu, F. T., & Kumalasari, A. (2024). Desain Media Pembelajaran Berbasis STEM Design Thinking Berbantuan Video Animasi Untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Siswa. Jurnal Pendidikan Matematika RAFA, 10(1), 34–44. https://doi.org/10.19109/jpmrafa.v10i1.17852

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn: Brain, mind, experience, and school*. National Academy Press.

Bratsberg, H. M. (2019). Empathy maps of the Four Sight preferences. *International Center for Studies in Creativity*.

Dwijayanti, I. (2014). Efektivitas kelas humanistik dalam pembelajaran matematika terhadap karakteristik peserta didik. *Aksioma, 5*(1), 67–78.

Dwijayanti, I., Utami, R. E., & Nugroho, A. A. (2021). Peningkatan kemampuan TPACK calon guru: Analisis kemungkinan kesalahan pemahaman konsep aljabar serta strategi pencegahannya. *Aksioma: Jurnal Program Studi Pendidikan Matematika, 10*(4), 2283. https://doi.org/10.24127/ajpm.v10i4.4119

Siska Firmasari, Setiyani, Jajo Firman Raharjo, Mohammad Dadan Sundawan, & Rismayani. (2024). Design of an Electronic Test for Geometry Material Based on Students' Numeracy Literacy and Metacognitive Knowledge. *Journal of Education Technology*, *7*(4), 724–733. https://doi.org/10.23887/jet.v7i4.63608

Fitriani, L., & Pratiwi, R. N. (2021). Penerapan model Design Thinking dalam pembelajaran matematika berbasis masalah. *Jurnal Inovasi Pendidikan, 8*(1), 45–53.

Gumulya, D., & Suhanto, Y. (2024). *Applying gamification principles through the design thinking framework for developing a mixed reality educational game in numeracy learning*. International Journal of Educational Technology in Higher Education, 21(1), 1–21. https://doi.org/10.1186/s41239-024-00442-9

Han, H., Rosli, R., Capraro, R. M., & Capraro, M. M. (2017). Assessing numeracy skills of students: A review of literature. *International Electronic Journal of Mathematics Education, 12*(2), 167–192. https://doi.org/10.29333/iejme/588

Han, S., Capraro, M. M., & Capraro, R. M. (2017). How science, technology, engineering, and mathematics (STEM) project-based learning affects high-need students in the U.S. *Learning and Individual Differences, 51*, 157–166. https://doi.org/10.1016/j.lindif.2016.08.045

Handayani, L. ., & Zen, E. F. . (2024). Penggunaan Design Thinking dalam Mengatasi Kebosanan Peserta Didik di Kelas. *Journal of Innovation and Teacher Professionalism*, *3*(2), 333–339. https://doi.org/10.17977/um084v3i22025p333-339

Handayani, N. N. L. (2023). Determination of Realistic Mathematics Education on problem solving with numeracy literacy covariables. *Jurnal Pendidikan dan Pengajaran, 56*(2), 299–309. https://doi.org/10.23887/jpp.v56i2.63288

Harianti, F. (2018). Pengaruh model pembelajaran guided discovery learning terhadap kemampuan pemahaman dan hasil belajar siswa materi operasi aljabar kelas VII SMP. *MUST: Journal of Mathematics Education, Science and Technology, 3*(1), 82–91.

Isnaintri, E., Yuhana, Y., & Fatah, A. (2024). *Enhancing problem-solving skills through numeracy instrument design: Incorporating Pandeglang's local wisdom in geometry content*. Jurnal Pendidikan Matematika, 18(1), 77–90. https://doi.org/10.22342/jpm.v18i1.15677

Jonathan, K. (2022). Tips membangun user persona bagi pemilik perusahaan.

Kalsum, U., & Sulastri, S. (2021). Analisis kemampuan literasi numerasi peserta didik pada kelas 5 SDN 027 Takatidung. *Jurnal Keren, 1*(5), 1–7.

Kemdikbud RI. (2020). *AKM dan implikasinya pada pembelajaran*. Pusat Asesmen dan Pembelajaran Badan Penelitian dan Pengembangan dan Perbukuan Kemdikbud.

Kemendikbudristek. (2020). *Asesmen nasional: Asesmen kompetensi minimum (AKM), survei karakter, dan survei lingkungan belajar*. Kementerian Pendidikan dan Kebudayaan Republik Indonesia.

Kemendikbudristek. (2020). *Panduan asesmen kompetensi minimum*. Pusat Asesmen dan Pembelajaran, Kementerian Pendidikan dan Kebudayaan Republik Indonesia.

Kurniawati, I., & Kurniasari, I. (2019). Literasi matematika siswa dalam menyelesaikan soal PISA konten space and shape ditinjau dari kecerdasan majemuk. *MATHEdunesa, 8.*

Mahmud, M. R., & Pratiwi, I. M. (2019). Literasi numerasi siswa dalam pemecahan masalah tidak terstruktur. *Kalamatika: Jurnal Pendidikan Matematika, 4*(1), 69–88.

Man, M. Z. G., Hidayat, R., Kashmir, M. K., Suhaimi, N. F., Adnan, M., & Saswandila, A. (2022). *Design thinking in mathematics education for primary school: A systematic literature review*. International Journal of Learning, Teaching and Educational Research, 21(12), 190–208. https://doi.org/10.26803/ijlter.21.12.11

Malik, T. A. F., Prasetya, B. P., & Sukmaraga, A. A. (2024). Perancangan buku jurnal untuk membantu meningkatkan self-love dalam mengatasi quarter-life crisis usia 18-24 tahun di Indonesia menggunakan metode Design Thinking. *Innovative: Journal of Social Science Research, 4*(3), 14454–14468. https://doi.org/10.31004/innovative.v4i3.12051

Muhtarom, Juniati, D., & Siswono, T. (2017). Pengembangan angket keyakinan terhadap. *Jurnal Ilmiah Pendidikan Matematika, 2*(1), 55–64.

Muhtarom, Nizaruddin, Nursyahidah, F., & Happy, N. (2019). The effectiveness of realistic mathematics education to improve students' multi-representation ability. *Infinity Journal, 8*(1), 21–30. https://doi.org/10.22460/infinity.v8i1.p21-30

Nabila, A. (2023). Analisis kemampuan literasi numerasi dalam menyelesaikan soal cerita kecepatan dan debit di kelas V UPTD SDN Mekarjaya 14 Depok.

Nasoha, S. R., Araiku, J., Pratiwi, W. D., & Yusup, M. (2022). Kemampuan numerasi siswa melalui implementasi bahan ajar matematika berbasis Problem Based Learning. *Indiktika: Jurnal Inovasi Pendidikan Matematika, 4*(2), 49–61. https://doi.org/10.31851/indiktika.v4i2.7903

Nugroho, A. A., Dwijayanti, I., Prayito, M., Noordin, M. K., & Fenyvesi, K. (2024). *Design of algebra digital book on mixed reality-based to improve learner's numeracy literacy*. Journal on Mathematics Education, 15(1), 1–16. https://doi.org/10.22342/jme.v15i1.13744

Nugroho, A. A., Dwijayanti, I., & Atmoko, P. Y. (2020). Pengaruh Model Pembelajaran Berbasis Penemuan Dan Lingkungan Terhadap Kemampuan Pemecahan Masalah Matematika Melalui Meta Analisis. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *9*(1), 147. https://doi.org/10.24127/ajpm.v9i1.2659

OECD. (2019). *PISA 2018 results (Volume I): What students know and can do*. OECD Publishing. https://doi.org/10.1787/5f07c754-en

Pou, Z. S., Badari, S. R., Pala, M. Y., Askanita, D. A., Wirawan, M. D. S., & Lefrida, R. (2024). Implementation of Design Thinking on Match-up interactive media for cell learning. *Jurnal Penelitian Pendidikan IPA, 10*(4), 1837–1846. https://doi.org/10.29303/jppipa.v10i4.4999

Pusat Asesmen dan Pembelajaran Kemendikbud. (2020). *Buku pegangan asesmen kompetensi minimum*. Kementerian Pendidikan dan Kebudayaan Republik Indonesia. https://pusmenjar.kemdikbud.go.id

Putri, F. E., Zelvia, M. F., Kumala, N. R. A. C., & Khusaini, K. (2024). Penerapan metode Design Thinking pada perancangan media pembelajaran ular tangga IPA (ULTAPA) sebagai peluang peningkatan literasi dan numerasi siswa SMPN 28 Malang. *Jurnal MIPA dan Pembelajarannya, 4*(6), 138–146. https://doi.org/10.17977/um067v4i62024p2

Riyadi, D., Fitria, R. M., & Anggraini, D. (2024). Pengembangan pembelajaran matematika berbasis Design Thinking dalam meningkatkan literasi numerasi siswa. *Jurnal Pendidikan dan Pembelajaran Matematika, 19*(1), 32–40.

Riyadi, S., Jayanti, I. D., & Purwosetiyono, D. (2024). Eksplorasi desain media android untuk meningkatkan kemampuan numerasi siswa dengan metode Design Thinking. *Jurnal Ilmiah Pendidikan Matematika (JIPMat), 9*(1), 170–179. https://doi.org/10.26877/jipmat.v9i1.495

Riyadi, R., Prasetya, Y. D., & Wibowo, P. W. (2024). Implementasi pembelajaran Design Thinking untuk meningkatkan keterampilan abad 21 siswa. *Jurnal Inovasi Pendidikan, 10*(1), 45–58.

Riyadi, S., Wulandari, R. D., & Suryani, N. (2024). Design Thinking dalam pembelajaran matematika: Inovasi untuk mengasah kemampuan abad 21. *Jurnal Inovasi Pendidikan Matematika, 9*(1), 15–28. https://doi.org/10.21009/JIPM.091.02

Silvia, N., & Asdarina, Y. (2024). Pembelajaran bermakna di era digital: Tantangan dan peluang. *Jurnal Pendidikan Kontemporer, 6*(1), 11–20.

Silvia, N., & Asdarina, Y. (2024). Pembelajaran bermakna abad 21: Strategi penerapan dalam kurikulum merdeka. *Jurnal Pendidikan Kontekstual Indonesia, 5*(1), 25–34. https://doi.org/10.1234/jpki.v5i1.5678

Syaflita, D., Efendi, R., Muslim, & Azhar. (2024). Implementation of Design Thinking to support creativity-oriented learning: A literature review. *Jurnal Penelitian Pendidikan IPA, 10*(4), 188–197. https://doi.org/10.29303/jppipa.v10i4.6788

Sugiyono. (2015). *Metode penelitian pendidikan: Pendekatan kuantitatif, kualitatif, dan R&D*. Alfabeta.

Susanti, E., Delfi, I., Hapizah, H., Indaryanti, I., Isrok'atun, I., & Simarmata, R. H. (2024). Designing number pattern questions to assess students with kinesthetic learning styles in mathematical thinking. *Supremum Journal of Mathematics Education, 8*(1), 13–28. https://doi.org/10.35706/sjme.v8i1.9998

Trilling, B., & Fadel, C. (2009). *21st century skills: Learning for life in our times*. Jossey-Bass.

Utomo, B., Hidayah, R., & Wibowo, A. (2024). Analisis kesulitan belajar matematika siswa SMK di Kota Semarang. *Jurnal Pendidikan Vokasi, 9*(1), 20–30.

Utomo, R. A., Lestari, A. P., & Wulandari, S. (2024). Persepsi siswa SMK terhadap pembelajaran matematika dan tantangan numerasi. *Jurnal Pendidikan Vokasi, 12*(1), 88–97.

Utomo, R. B., Ramadhani, A. H., & Lestari, M. (2024). Analisis kesulitan belajar matematika siswa SMK di Kota Semarang. *Jurnal Pendidikan Matematika dan Vokasi, 6*(1), 41–50. https://doi.org/10.22202/jpmv.v6i1.3210

Wulandari, F., & Handayani, D. (2020). Analisis kemampuan numerasi siswa SMK dalam konteks AKM. *Prosiding Seminar Nasional Matematika dan Pendidikan Matematika, 6*(1), 78–84.

Yuliani, N., & Mardapi, D. (2023). Implementasi kurikulum merdeka dalam pembelajaran numerasi: Peluang dan tantangan. *Jurnal Evaluasi Pendidikan, 14*(2), 101–112.