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Integrated Differentiated Learning Social-Emotional Competence: An Innovative Solution to Numeracy Skills

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ABSTRACT

A crucial aspect in various disciplines is numeracy skills. The purpose of the study was to determine the difference in the average social-emotional competence and numeracy skills of students before and after the implementation of differentiated learning that integrated social-emotional competence. The research was conducted at SMP Negeri Satu Atap 1 Cimanggu, Cilacap. The sample in this study was selected using the saturated slicing technique involving 22 grade VIII students. The type of research is an experimental study that uses a pre-experimental design with a one-group pre-test post-test method. The data collection techniques used include observation, tests, and questionnaires. There are 20 questions in the questionnaire. Data analysis was carried out quantitatively using paired sample t-tests and descriptive statistics. Before conducting the analysis, a prerequisite test was carried out using a normality test to test the distribution of data. The results of the study showed that the numeracy skills had a significance value of 0.200 (>0.05) and the social-emotional competence had a significance value of 0.11 (>0.05) which showed that the data was normally distributed. The results of the analysis showed that the value of the t-test of numeracy was 49.423 (t-test > ttable), with a significance value (2-tailed) < 0.05 (0.00 < 0.05). For KSE, the statistical value of the t-test was 27.54 with a very small p-value (5.75×10^{-18}) indicating that there is a significant difference in the average value of numeracy skills and KSE before and after the implementation of integrated differentiation learning KSE. Integrated differentiation learning KSE can be applied to improve numeracy skills. The results of this study can be used as a solution to overcome the low mathematical numeracy skills of students.

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A. INTRODUCTION

In the context of social life and education, numeracy has an ideal position in solving complex problems (Angermeier & Ansen, 2020; Tout, 2020). In order to solve problems completely, good numeracy skills are needed. Numeracy skills have a crucial role in mathematics learning because it facilitates students to understand the basic concepts of numbers, patterns, and operations in mathematics. With good numeracy skills, students can develop logical reasoning skills, solve problems, and apply mathematics in daily life, such as managing finances, reading data, and making the right decisions (Jusmirad et al., 2023; Xiao et al., 2019). Numeracy is the basis for learning more complex mathematical concepts at higher education levels. But in reality, in the classroom, students have difficulty in understanding, applying, and interpreting existing information, especially in solving problems related to the

real world, this is related to the nature of numeracy skills (Verschaffel et al., 2020). This condition is a serious concern in the mathematics learning process in the classroom. The skills to identify information, plan solutions, apply it, and interpret mathematical concepts or procedures in the context of problem solving is the definition of numeracy skills (Geiger et al., 2015; Nortvedt & Wiese, 2020: Ferdianto et al., 2022). One of the efforts to improve numeracy skills occurs in the learning process, including differentiated learning, which is a learning that is made based on the learning needs of students.

Differentiated learning that is integrated with the development of social-emotional competencies (KSE) is essential to create a holistic and inclusive learning environment (Budianto, 2023). With this approach, teachers can adjust teaching methods to meet students' academic needs, while also supporting emotional development and social relationships during the learning process. This learning helps students develop empathy, self-awareness, emotional management, and effective interaction skills, which are essential for success in school and in later life (Praditya et al., 2023). This research is relevant to information from Jati et al. (2023) which also uses differentiated learning to improve numeracy skills. The difference lies in the subject and factors studied, which are based on RME in grade VII junior high school students. It is also in line with the research of Indrawatiningsih et al. (2024) and Apriliawan et al. (2024) that learning that uses differentiated learning is able to develop the potential of students' numeracy skills. In addition, Putra et al. (2024) developed an innovative product in the form of student worksheets that differentiate in online learning. This study made several student worksheets based on learning needs (adversity quotient) to be applied in learning. The results obtained are differentiated student worksheets that integrate social-emotional aspects, in this case the adversity quotient provides an improvement to students' understanding of mathematical concepts. This is certainly related to numeracy skills in the use of mathematical concepts.

Previous research including Subekti et al. (2022) explained the relationship between the social-emotional aspect, in this case self-efficacy, and numeracy skills, that students who have low self-efficacy tend to have difficulty interpreting information and are hesitant to apply it in problems. These results provide information that one of the social-emotional competencies of self-efficacy has relevance to students' numeracy skills. In order to have good numeracy skills, students need to have good social-emotional competence as well. Research conducted by Lee-Post (2019) applies interventions to the learning process to overcome learning barriers in an effort to improve numeracy skills and positive attitudes. Learning is designed based on the learning needs of students by paying attention to the learning obstacles experienced by students. These results show the relevance between differentiated learning or learning that suits students' learning needs with numeracy skills that are able to have a positive impact. There are still many people who are still lacking in practical mathematical skills, such as information analysis and risk, and evaluation of results (Reyna & Brainerd, 2023). This is related to a lack of numeracy skills and will result in the process of giving final decisions. Aunio's (2019) research uses evidence-based intervention methods to improve numeracy skills and learning difficulties in mathematics from an early age. The development of numeracy from an early age is very necessary to support education to the next level. Different treatment is also carried out by Nurhasanah et al. (2024) by providing a project-based learning model. Based on

the results of statistical analysts, it was obtained that the increase in student numeracy was better compared to direct learning. Research by Tassignon et al. (2021) explains the role of differentiated learning regarding the improvement of student learning outcomes before and after the assessment. There is a difference in learning outcomes, meaning that the acquisition of grades after differentiated learning is better than before differentiated learning is applied. The above references prove the role of differentiated learning and students' social-emotional competence in the process of improving numeracy skills and learning outcomes. Differentiated learning in collaboration with social-emotional competencies is an interesting innovation applied in the learning process for the development of students' numeracy results.

The results of the observations made by the researcher on the implementation of mathematics learning in grade VIII show that the learning process carried out is still conventional and teacher-centered. The learning process has not used a differentiated approach, with teachers dominating the teaching and learning process through lectures. Student learning outcomes are also still relatively low, as evidenced by the mathematics mid-semester exam scores that are integrated with the characteristics of numeracy questions for grade VIII students of SMP Negeri Satu Atap 1 Cimanggu in the 2024/2025 school year which is still below the minimum completeness criteria (KKM) value set, which is 65. Of all 22 students, only four students met the final score or 18.2% of the total students. The remaining 81.8% of students did not meet the learning completion score. The lowest score obtained was 46 and the highest score was 76 out of a range of 100. This result shows that the graduation rate of numeracy results is still very low. The learning needs between students who meet the complete score are certainly different from those who do not complete it. Students have difficulty in solving numeracy problems. Students are not used to solving problems that are contextual and require high or complex thinking. Lack of experience using mathematical concepts in solving problems is one of the obstacles for students in developing numeracy. This condition is related to the problem of numeracy skills. The cognitive characteristics of students are different from one another. The learning styles of students from one to the other also have different variations. This condition certainly has an impact on the treatment given during classroom learning. The learning that has been carried out seems monotonous and not centered on student activities. In addition, students' habits in learning are still lazy to try new things, not disciplined in completing schoolwork, and lack of interaction in learning discussions with their classmates. This condition reflects the lack of social-emotional competence of students and learning that is not in accordance with the learning needs of students. The need for learning to be carried out is in accordance with the learning needs of students and to be able to develop competencies related to social, emotional and numeracy. Differentiated learning design that is integrated with students' social-emotional competencies can have a positive impact on the habituation of numeracy skills. These results are interesting to further examine whether integrated differentiated learning of social emotional competencies has a positive influence on students' numeracy skills.

This study aims to determine the difference in the results of numeracy skills and social-emotional competence before and after the implementation of differentiated learning integrated with social-emotional competence (KSE). In its application, the researcher adjusts the learning needs of students based on learning readiness that is adjusted to the characteristics

of students. KSE integrated differentiated learning is carried out through the learning process and working on student worksheets that allow students to make decisions in solving problems and collaborating with group friends. The results of this research will later provide scientific solutions to educators for the development of student numeracy in schools.

B. METHODS

The design model implemented in this study is a pre-experimental type quantitative with a one-group pre-test post-test design, a positivist research with the aim of explaining and testing hypotheses (Sugiyono, 2018). A total of 22 students from grade VIII of SMP Negeri Satu Atap 1 Cimanggu participated as research subjects. Sample performance using a saturated sampling technique, which means that all students in one class are sampled. The selection of the sample on the grounds that the class VIII population is only one class of 22 students. Research data was obtained through the results of pre-test and post-test, which served as an indicator to determine the achievement of the hypothesis proposed. The pre-test is held before the action while the post-test is held after the action to evaluate the impact the action has on the group. The action in question is the implementation of KSE integrated differentiated learning. The design of the one group pre-test post-test research is represented in table 1.

Table 1. One Grup Pre-Test Post-Test Design

Pre-test	Independent Variabel	Post-test
Y1	X	Y2

In Table 1, the pre-test symbolized by (Y1) is carried out before the researcher treats a sample consisting of grade VIII students. After the implementation of the pre-test, students received treatment in the form of implementing differentiated learning integrated with KSE, which is denoted by the letter X. This treatment is considered an independent variable, because differentiated learning functions as an influencing variable, while the dependent variable measured is mathematical numeracy skills. The researcher conducted a post-test on 22 grade VIII students, which is symbolized as Y2. This research process can be reviewed from the flow shown in Figure 1. This research begins with the identification of problems in schools, followed by an evaluation of the learning models applied. Furthermore, research instruments were made, pre-test implementation, learning implementation, then followed by post-test implementation. The last stage is data analysis which is carried out by implementing SPSS version 25 and providing conclusions.

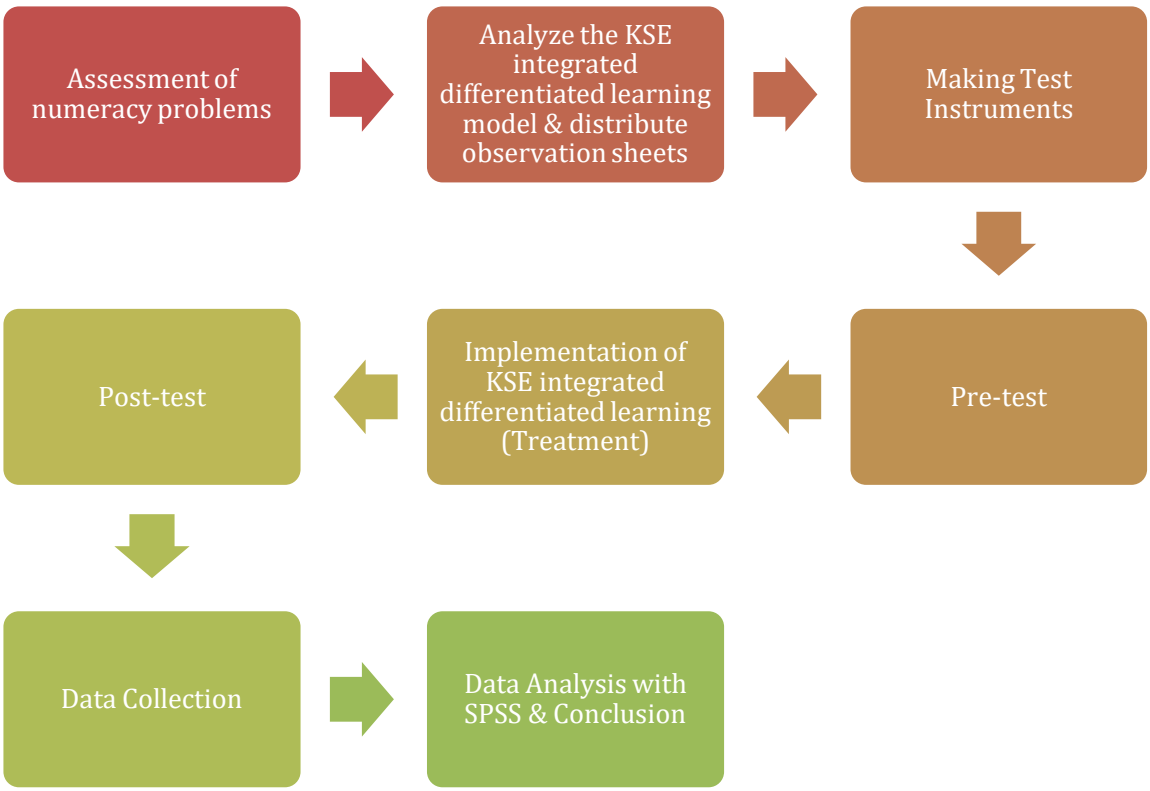

Figure 1. Research Flow

Data collection techniques were obtained through numeracy skills tests, social-emotional competency questionnaires, and observations. The test is used to measure numeracy skills. Two aspects of numeracy skills that will be measured are: (1) competence in the use of mathematical symbols and numbers in daily life; and (2) competence in analyzing data in various forms, both tables and graphs. The numeracy skills test consists of two questions. To measure social-emotional competence, a questionnaire sheet is used. The social-emotional components assessed are self-awareness, self-management, social awareness, relationship skills, and decision-making. Observation sheets are used to observe the implementation of differentiated learning. In its use, it involves one observer who focuses on observing differentiated learning. Before use, test instruments and questionnaires are tested for validity and reliability. The validity test uses Pearson correlation with the criterion if $r_{hit} > r_{table}$, then the question is said to be valid. The reliability test uses the Cronbach Alpha value, if the Cronbach Alpha > 0.6 then the question is said to be reliable. The significance value used is 5%. Based on the SPSS statistical test, the data in Table 2 was obtained.

Table 2. Validity and Reliability Tests

Instruments	Numeracy Test Questions		KSE Questionnaire	Category
	Question 1	Question 2		
Validation Test	$r_{hit.} = 0.886 > r_{table} = 0.432$	$r_{hit.} = 0.761 > r_{table} = 0.432$	$r_{hit.} = 0.933 > r_{table} = 0.432$	Valid
Reliability Test	Cronbach Alpha Values = 0.521 > 0.60		Cronbach Alpha Values = 0.843 > 0.60	Reliable

Table 2 explains that each of the numeracy test instruments and the KSE questionnaire meets the validity criteria, namely the $r_{hit.} > r_{table}$. In addition, both instruments also meet the reliability criteria, namely the Cronbach Alpha value > 0.60. In addition to using statistical validity, the validity test of the numeracy test and KSE questionnaire was also tested by experts. The criteria for experts involved include learning evaluation experts, active research in the study of literacy and numeracy skills, and active activities in driving schools in the Independent Learning curriculum. Based on the validity results, both test instruments and questionnaires show valid aspects by experts. Thus, the numeracy test instruments and KSE questionnaires meet the valid and reliable aspects.

The data analysis admitted was a normality test and paired sample t-test on the pre-test and post-test results using the help of the SPSS version 25 application. Before the t-test, a normality test is first carried out. This is done to find out that the samples taken are normally distributed and as a preliminary requirement to carry out a t test. Furthermore, a t-test was carried out on the results of the pre-test and post-test still the results of the numeracy test and the KSE questionnaire. The learning applied is differentiated learning integrated with social-emotional competencies (KSE). The hypothesis of this study is: H0 is the average pre-test and post-test scores are not significantly different; and H1 is the average pre-test and post-test scores different significantly. The final decision-making criteria are as follows.

1. The significance value is more than 0.05, meaning that there is acceptance of H0 and rejection of H1.
2. The significance value is not more than 0.05, meaning that there is a rejection of H0 and acceptance of H1 so that the dependent variable (X) is affected by the independent variable (Y).

C. RESULT AND DISCUSSION

1. Numeracy Skills

a. Normality Test

The purpose of the normality test is to evaluate whether or not there is a normally distributed research sample. The type of normality test implemented is in the form of Kolmogorov-Smirnov. In this study, a homogeneity test was not carried out because only one group or one class was implemented. Table 3 represents the results of the normality test.

Table 3. Normality Test Results

One Sample Kolmogorov-Smirnov Test		
N		22
Normal Parameters[a,b]	Mean	0.000000
	Std. Deviation	1.46936600
Most Extreme Differences	Absolute	0.090
	Positive	0.075
	Negative	-0.090
Test Statistic		0.090
Asymp. Sig. (2- tailed)		0.200

1) Test distribution is normal
2) Calculated from data

The significance value obtained from the results of the normality test as represented in table 3, exceeds 0.05, which is 0.200, meaning that the data is normally distributed. Thus, statistical parameters can be continued in hypothesis testing. In this study, the number of samples was only limited to one class, so a paired sample t-test was implemented.

b. Numeracy Skills Test Results

This research involves three stages: pre-test, application of the learning model, and post-test. The pre-test and post-test use the KSE integrated differentiated questions, which include two numeracy commands. The assessment score for each question can be seen in the following Table 4.

Tabel 4. Post-Test Results

Information	**Score**
Minimum Completeness Criteria	65
Highest score	85
Lowest score	68
Grade point average	76.3

Table 4 shows a significant increase in the highest, lowest, and average grades. The highest score increased from 70 (pre-test) to 85 (post-test), the lowest score increased from 50 (pre-test) to 68 (post-test), and the class average increased from 59.1 (pre-test) to 76.3 (post-test). The following Table 5 presents a comparison of data between pre-test and post-test.

Table 5. Pre-test and Post-test Results of Numeracy

Types of Tests	**Mean**	**Highest Scores**	**Lowest Score**	**Number of Complete Students**	**Number of Incomplete Students**
Pre-test	59,1	70	50	4	18
Post-test	76.3	85	68	22	0

Table 5 shows that in the pre-test only 4 students (18%) completed it, while 18 students (82%) did not complete it. In the post-test, 22 students (100%) passed, with an average grade of 76.3. After the post-test and pre-test analysis, a hypothesis test based on the paired sample t-test was carried out, as the results are represented in Table 6.

Table 6. Paired Sample Test Results

		Mean	**Std. Deviation**		**95% Confidence Interval of the Difference**				
					Lower	**Upper**	**t**	**df**	**Sig. (2-tailed)**
Pair 1	Pre-test-post-test	-17.045	1.618	0.345	-17.763	-16.328	-49.423	21	0.000

The significance value obtained from the t-test of paired samples as represented in table 6, does not exceed 0.05 which is 0.000 and the t-count value > t-table (49.423 > 1.721), meaning that there is H1 acceptance and H0 rejection. This condition proves that there is a difference in the average value of numeracy skills before and after the implementation of KSE integrated differentiated learning. The average numeracy score before learning was 59.1 and the average numeracy score after KSE integrated differentiated learning was applied to 76.3. In addition, the results of the paired sample t-test with a sig value of 0.000 < 0.05. Thus, KSE's integrated differentiated learning can be applied to improve students' numeracy skills. In line with the results of the research, Indrawatiningsih et al. (2024) explained that differentiated learning designed in accordance with students' learning needs has a positive impact on improving numeracy and literacy skills. This learning also makes it easier for teachers to adjust learning according to learning readiness.

Differentiated learning divides students into three groups based on learning readiness. This study shows that social-emotional learning is important in improving numeracy skills. After the implementation of this learning, students' learning motivation increased, as evidenced by higher activity and improved numeracy skills, with the average class score rising from 59.1 in the pre-test to 76.3 in the post-test. This learning is effective because it is in accordance with the needs of students and environmental conditions, and encourages problem solving. Overall, the learning applied had a significant effect on the numeracy skills of grade VIII students of SMPN Satu Atap 1 Cimanggu. After implementation, the average pre-test score of students was 59.1, while the average post-test score reached 76.3. These results show a significant improvement in the numeracy skills of students who meet the KKM. In line with Jensen (2024) explains that learning made based on student needs and integrating social emotions is proven to result in students being able to manage and regulate emotions during learning which will then obtain good mathematics learning outcomes as well, in this case the results of numeracy skills.

Significant improvements were seen in the post-test, with all students completing it. In the pre-test, the average score of students was only 59.1, influenced by low motivation to learn and lack of parental supervision as well as environmental factors. In line with research, Cao Thi et al. (2023) explained that the motivation factors for learning and parental supervision have a large role in numeracy skills. Students who have a lot of attention from parents will have good numeracy skills. The role of parents is very important in regulating student activities that are able to develop numeracy skills. The same is true of motivational factors that help students improve numeracy skills. Motivation is able to encourage and create stability in students' interest in facing learning challenges and can affect mathematics learning outcomes from the initial stage to the next stage in a long period of time (Mercader et al., 2018).

Differentiated learning is not only limited to growing student learning outcomes, but also strengthens reasoning and critical thinking skills, which helps improve numeracy skills. Differentiated learning is more effective when applied in a broader context (Deunk et al., 2018). In addition, it can be applied in various types of curriculum, including the

Independent Curriculum that is currently in force. Differentiated learning integrated with KSE provides a more contextual and relevant approach, by analyzing cases to create active and meaningful learning. KSE's integrated differentiated learning also improves students' numeracy skills, as well as helping them interact and collaborate with their peers, as well as make more informed decisions when solving problems (Zehner et al., 2024). In mathematics learning, numeracy skills play an important role because these skills involve the application of mathematical concepts in daily life (Angermeier & Ansen, 2020).

2. Social-Emotional Competencies

a. Normality Test

Students' social-emotional skills were measured using a CASEL theory-based questionnaire consisting of five components, namely self-awareness, self-management, social awareness, relationship skills, and responsible decision-making. The following are the results of the KSE normality test on the responsible decision-making component, as shown in Table 7.

Table 7. Normality Test Results

One Sample Kolmogorov-Smirnov Test		
N		22
Normal Parameters[a,b]	Mean	0.000000
	Std. Deviation	1.01069843
Most Extreme Differences	Absolute	0.212
	Positive	0.156
	Negative	-0.212
Test Statistic		0.212
Asymp. Sig. (2- tailed)		0.11

1) Test distribution is normal
2) Calculated from data

The significance value of the normality test results as presented in Table 7 exceeded 0.05, which is 0.11, meaning that the data was said to be normally distributed and the hypothesis test based on parametric statistics could be continued. However, in this study, the hypothesis test implemented was a paired sample t-test. Because the number of samples determined in the study is only limited to students in one classroom. Then the scores obtained are tested by implementing post-test and pre-test.

b. Results of Social-Emotional Competence

This research was carried out in several stages, namely the stage of implementing the pre-test, implementing the learning model, and carrying out the post-test. The components involved in designing pre-test and post-test questions are Social and Emotional Skills according to CASEL. The determination of the assessment weight of each question is represented in the following Table 8.

Table 8. Post-Test Results

Information	Score
Minimum Completeness Criteria	65
Highest score	85
Lowest score	68
Grade point average	76.3

Table 9. Statistical Test Results

Types of Tests	N	Min	Max	Mean	Std. Deviation	Average Difference	t	P-value
Pre-test	22	12	17	13.95	1.327			
Post-test	22	15	19	17.05	1.133			
Valid (listwise)	22					0.53	27.54	5.75×10^{-18}

Based on the result data in Table 9, it is obtained: (1) The average score after the intervention increased from 13.95 to 17.05, with an average increase of 3.09; (2) The standard deviation before the intervention was 1.33 and after the intervention was 1.13, indicating less variation between students after the intervention; and (3) The paired t-test yielded a t-statistic of 27.54 with a very small p-value (5.75×10^{-18}). It is clear that (5.75×10^{-18}) is less than 0.05, meaning that H0 is rejected and H1 is accepted. This shows that there is a difference in the average value of social-emotional competence before and after KSE integrated differentiated learning. It can be concluded that KSE integrated differentiated learning is appropriate to improve the social-emotional competency component.

It can be concluded that the interventions carried out have a significant effect in improving students' social-emotional skills. This is in line with research conducted by Low et al. (2019) that a curriculum that uses social-emotional competency learning provides improvements to affective aspects including emotional management and student learning skills. Another relevant result about social-emotional competence and numeracy skills is that both have the characteristic of being able to predict their respective improvements, in this case social-emotional competence as a predictor of improvement in numeracy skills (Wolf & McCoy, 2019).

The integration of social-emotional skills (KSE) in mathematics learning, in this case adversity quotient, has a positive impact on students, especially their understanding of mathematical concepts (Putra et al., 2024). Learning designed by paying attention to the five aspects of social-emotional competence, namely self-awareness, self-management, social awareness, relationship skills, and decision-making can help students not only in understanding academic material, but also in managing emotions, collaborating with friends, and making better decisions in facing challenges. The five aspects of KSE are realized through teacher and student learning activities. For example, students are created groups to discuss. In these activities, teachers can build aspects of self-awareness, self-management, and decision-making in solving a problem and can build social relationships with their group members. This increase shows that students are able to develop in their social and emotional aspects during the math learning process. Relevant to the results of the research Subekti et al. (2022) which explain the same thing

that the social-emotional aspect has a strong correlation with numeracy skills. This is evidenced by the achievement of numeracy skills indicators completely in students who have a positive attitude. The importance of KSE integrated differentiated learning can improve students' numeracy skills. Students will be able to interact and collaborate with other students and be able to make responsible decisions in solving every problem.

D. CONCLUSION AND SUGGESTIONS

The results showed a significant improvement in students' numeracy skills and social-emotional competency components using social-emotional competency integrated differentiation learning (KSE) compared to conventional models. The significance value obtained from the t-test results did not exceed 0.05 which means that there was a difference in the average value of numeracy skills and the social-emotional competency component before and after the implementation of KSE integrated differentiation learning. The increase in scores from pre-test to post-test is accompanied by the number of students who meet the KKM scores. These results provide confidence that KSE's integrated differentiated learning can be applied in a real and scientific way in order to improve numeracy skills and social-emotional competency components.

This study has limitations, such as covering only junior high school levels, a one-class sample, and focusing on an integrated learning model differentiated by KSE without comparing with other models. This condition certainly has an impact on more subjects with different student characteristics. Provide opportunities for other learning models or approaches that are able to adopt students varied cognitive characteristics and can improve numeracy skills. Thus, KSE's integrated differentiated learning can be collaborated with other approaches that suit diverse cognitive conditions and environments, for example with an open-ended approach. However, this research can be a reference for educators and researchers in implementing this learning, especially in mathematics learning, and can study other subjects in the context of the Independent Curriculum.

Along with the changes in the curriculum that apply and change, the challenges that can be encountered include developing an innovative learning model and digital learning media, especially in order to improve students' literacy and numeracy. The integration of the new Deep Learning curriculum approach and the use of artificial intelligence (AI) in the learning process is a strategic way that can be done. Being able to collaborate integrated differentiated learning KSE and Deep Learning with the help of AI media or teaching materials will be an opportunity that can be developed next.

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