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Montessori method assisted by activity books for enchancing social skills and information literacy

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Abstract

Amid the demands of the 21st century, elementary school students often face challenges in interpersonal cooperation and in processing critical information. This study empirically examines the effect of the Montessori Method, supported by a Natural and Social Sciences (IPAS) activity book, on the social skills and information literacy of sixth-grade students. Using a quantitative, quasi-experimental design with a non-equivalent control group, the study involved a sample of 56 students at SDN Jatisari, utilizing validated questionnaires and objective tests, and was analyzed using MANOVA. Descriptive results showed that the experimental group achieved significantly higher mean scores for social skills (M = 82.07; N-Gain = 0.61) and information literacy (M = 91.89) than the control group (M = 59.25; N-Gain = 0.04; M = 68.50). The MANOVA simultaneous test confirmed high statistical significance (p = 0.000; Wilks' Lambda = 0.066) with robust univariate R-squared values of 0.932 and 0.676. In conclusion, this application effectively mitigates class conflict whilst optimizing scientific data verification skills. This research makes a new scientific contribution by integrating traditional Montessori physical principles into a modern printed activity book format and by expanding their pedagogical application in social studies instruction at the upper elementary school level.

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1. Introduction

As we enter the era of Industry 4.0 and Society 5.0, elementary education faces multidimensional challenges, including a decline in the quality of social interaction and a limited ability to filter information among students, due to massive digital disruption. In the context of a social crisis driven by the dominance of information technology and social media, digital literacy and information literacy are no longer merely technical skills but rather the cornerstones for

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fostering responsible digital citizenship to minimize social (Milenkova & Lendzhova, 2021). The success of the digitalization process in educational institutions lies not merely in the implementation of hardware or digital technology, but also in pedagogical transformation and comprehensive organizational change to shift students' learning patterns towards more meaningful outcomes (Pettersson, 2021). Globally, bibliometric and scientometric studies indicate that current research emphasizes the importance of integrating information literacy with student-centered instructional strategies to enhance motivation and decision-making skills in early adolescence (Nurikhsani et al., 2026).

Furthermore, in the implementation of Social Studies (IPS) in elementary schools, modern curriculum requirements now place a strong emphasis on fostering social interaction and instilling character values so that children can actively contribute to global society (Shih, 2024). This pedagogical framework is strongly supported by Rosidah et al. (2026), who argue that the teaching of social studies must systematically integrate sustainability values in order to foster students' social literacy and citizenship awareness. However, this ideal reality stands in stark contrast to the empirical conditions at SDN Jatisari, where initial observations indicate a high level of interpersonal conflict among students, triggered by their inability to filter valid information, leading them to spread misinformation. School counseling records confirm this behavioral crisis: 67% of Grade 6A students and 60% of Grade 6B students are involved in social issues, exacerbated by the fact that 73% of Grade 6A students and 57% of Grade 6B students do not understand the ethics of information use. The root of this problem lies in the Social Studies learning process, which remains conventional and dominated by a normative-cognitive approach focused on memorizing texts, thereby neglecting the development of students' social skills and information literacy. To address the lack of social-emotional skills, self-regulation, and cooperation from an early age, the implementation of a structured Social and Emotional Learning (SEL) program based on a cognitive-behavioral approach is urgently needed to prevent future behavioral problems (Hosokawa et al., 2024).

In the context of alternative methods, the Montessori Method offers a robust theoretical and practical solution, as it focuses on the holistic development of the child through a prepared learning environment (Johnson et al., 2025). Philosophically, this method builds individual character and social solidarity by focusing on meaningful work and guided freedom, thereby fostering a deep respect for others' rights (Lillard et al., 2021). Empirical evidence from large-scale longitudinal studies has also confirmed that Montessori education can significantly improve and level out children's outcomes in executive function, cognitive abilities, and socio-emotional competencies compared to conventional methods (Sierens, 2020). This assertion is reinforced by a systematic review of global meta-analyses, which demonstrates that Montessori educational interventions have a consistent positive impact on students' academic and non-academic domains (Randolph et al., 2023). To optimize this potential at the elementary school level, the effectiveness of the physically-based Montessori Method needs to be enhanced through media that stimulate critical thinking, such as project-based or activity books (Nurhamidah et al., 2023).

Although previous studies have extensively evaluated the effectiveness of the Montessori Method or the use of activity books separately, there remains a significant research gap regarding the integration of both approaches to simultaneously enhance social skills and information literacy at the elementary school level. The novelty of this study lies in the conceptual synthesis of the pillars of social interaction and solidarity in the Montessori Method with the literacy guidance structure in the activity book titled 'The 6 Continents of the World'. This combination is not merely a variation in the implementation of standard teaching materials, but rather a holistic, integrated approach that bridges affective-psychomotor needs (cooperating and regulating emotions within a Montessori group) and cognitive needs (filtering data and validating geographical information in the activity

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book). Therefore, this study aims to empirically test the impact of using the Montessori Method supported by an activity book on students' social skills and information literacy at SDN Jatisari, whilst also making a new scientific contribution to the literature on social studies learning that is adaptive to global crises and challenges.

2. Method

This study employed a quantitative, quasi-experimental design with a non-equivalent control group. This design was chosen because random assignment of individuals could not be carried out in order to maintain the stability of the natural learning environment at the school (Ballance, 2024). The sampling technique applied was intact cluster sampling, in which groups were determined using existing intact classes without altering the composition of the students. This selection aligns with the methodological framework updated by Khalid (2024). The subjects of this study were sixth-grade students at SDN Jatisari, Semarang, divided into two groups: Class 6B (experimental group; n = 28) and Class 6A (control group; n = 28). The experimental intervention was conducted over two sessions (each lasting 2 x 35 minutes), excluding the administration of the pretest and posttest. The experimental group received treatment through the implementation of the Montessori Method, supported by an activity book on Natural and Social Sciences (IPAS) covering the topic 'The 6 Continents of the World'. The intervention procedure followed a modified Montessori syntax by Saha & Adhikari (2023), comprising: (1) Preparation of Environment, where the classroom was arranged to provide independent work corners; (2) Introduction/Presentation, where the teacher demonstrated structured work instructions using visual aids and interactive features in the activity book (contour maps, crossword puzzles, case studies on information ethics); (3) Free Choice and Independent Work, where students, either individually or in pairs, select activities to explore world geography; and (4) Repetition and Perfection, where students review their work independently. Meanwhile, the control group followed conventional learning through face-to-face lectures, structured group discussions, and standard school worksheets, with identical content and time allocation. To minimise threats to internal validity, experimental controls were strictly enforced by ensuring both classes were taught by the same teacher with equivalent competence, as well as monitoring treatment fidelity using a syntax implementation observation sheet by an external observer.

Data collection was carried out using standardized psychometric tests and non-test instruments. The social skills variable (Y1) was measured using a 5-point Likert-scale questionnaire covering indicators of environmental concern, social concern for peers, collaborative cooperation, emotional regulation, individual responsibility, and task completion. The integration of these interpersonal and social indicators aligns with the framework of Mahartini et al. (2023) on character development in elementary schools, which indicates that positive social attitudes directly contribute to the development of adaptive skills in older students.

Meanwhile, the information literacy variable (Y_2) was measured using a hybrid instrument that combines a multiple-choice objective test (20 items) to assess the cognitive dimension (the ability to formulate information needs, evaluate the credibility of sources, and filter out misinformation) and a Likert-scale questionnaire to assess the affective-behavioural dimension, information usage ethics and self-assessment of work outcomes (Park et al., 2021). Students' final information literacy scores were calculated as a composite of both instruments, with equal weighting.

Prior to use, all instruments underwent a content validity stage, assessed by three expert validators (expert judgment). This evaluation ensured that the structure of the Montessori activity books was adapted to students' limited cognitive capacity by systematically simplifying, organizing,

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and integrating the content to prevent cognitive overload (Cavanagh & Kiersch, 2023). Subsequently, a pilot study was conducted to assess the questionnaire's item validity using Product-Moment correlation, whilst reliability was calculated using Cronbach's Alpha. For the objective test instrument, item validity was assessed using the Point Biserial Correlation (Rpbis), and reliability was evaluated using the Kuder-Richardson 21 (KR-21) formula; all instruments were deemed valid and reliable, with a reliability coefficient above the minimum threshold of 0.70. Data analysis was conducted using SPSS version 27, divided into descriptive and inferential stages. Descriptive analysis was used to present the mean, standard deviation, minimum, and maximum for the pretest-posttest results.

Inferential analysis began with formal prerequisite tests, including the Shapiro-Wilk normality test (since the sample size per group was $n < 50$) and Levene's test of homogeneity of variances. An equivalence test of initial ability between the two groups was analyzed using an independent-samples t-test on the pretest scores. To test the main hypothesis regarding the simultaneous effectiveness of the treatment on both dependent variables, a Multivariate Analysis of Variance (MANOVA) was conducted, using Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root as significance criteria. The decision criteria for hypothesis testing were set at a significance level of $\alpha = 0.05$, whereby if the Asymptotic Significance (p-value) is < 0.05, the Null Hypothesis (H_0) is rejected, and the Alternative Hypothesis (H_a) is accepted. The statistical hypotheses in this study are formally formulated as follows:

Hipotesis 1

H_0 1: Activity book-assisted Montessori method has no significant effect on students' social skills.
H_a 1: Activity book-assisted Montessori method has a significant effect on students' social skills.

Hypothesis 2

H_0 2: Activity book-assisted Montessori method has no significant effect on students' information literacy.
H_a 2: Activity book-assisted Montessori method has a significant effect on students' information literacy.

Hypothesis 3

H_0 3: Activity book-assisted Montessori method has no significant simultaneous effect on students' social skills and information literacy.
H_a 3: Activity book-assisted Montessori method has a significant simultaneous effect on students' social skills and information literacy.

3. Results

The initial stage analysis of the research findings focused on assessing the instrument's validity and reliability to ensure the credibility of the data prior to hypothesis testing. Based on the content validity assessment by three experts, all items in the instrument were deemed conceptually relevant. In the initial stage, the cognitive objective test instrument for the information literacy variable comprised 30 pilot test items (Items 1-30) covering all indicators of the ability to formulate information needs, evaluate sources, and filter out hoaxes. Based on empirical testing using the Point Biserial Correlation formula (R_{apbis}) by comparing the value of t_{count} against t_{table} (0,312) at a 5% significance level, it was found that 10 items did not meet the validity criteria (invalid), namely Items 4, 5, 8, 12, 14, 15, 17, 20, 22, and 28. Consequently, out of the total 30 items tested, the researchers

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eliminated 10 invalid items and retained only 20 items proven to be valid (Items 1, 2, 3, 6, 7, 9, 10, 11, 13, 16, 18, 19, 21, 23, 24, 25, 26, 27, 29, and 30) as the final instrument for measuring information literacy during the pretest and posttest stages.

Table 1. Difficulty level distribution of valid information literacy test items

Criteria	Question Items
Easy	1, 3, 6, 9, 10, 11, 16, 19, 23, 24, 25, 27, 29, 30
Currently	2, 7, 13, 18, 21, 26
Difficult	-

A more detailed summary of item validity, discriminating power, difficulty index, and reliability is presented in Table 2.

Table 2. Item validity, discriminating power, difficulty index, and reliability of the information literacy test

Analysis	Criteria	Question Items
Validity of questions	Valid	1, 2, 3, 6, 7, 9, 10, 11, 13, 16, 18, 19, 21, 23, 24, 25, 26, 27, 29, 30
	Invalid	4, 5, 8, 12, 14, 15, 17, 20, 22, 28
Distinguishing the power of questions	Very good	2, 7, 21, 26
	Good	1, 6, 10, 13, 16, 18, 24, 30
	Enough	19, 23, 27
	Signs	3, 9, 11, 25, 29
Question difficulty index	Easy	1, 3, 6, 9, 10, 11, 16, 19, 23, 24, 25, 27, 29, 30
	Currently	2, 7, 13, 18, 21, 26
	Difficult	-
Reliability of questions	High	Reliability value = 0.762

This screening process resulted in a final instrument structure that is highly suitable and proportionate for measuring student achievement. Based on the distribution of difficulty levels across the 20 valid items, a balanced combination was obtained, with 14 items categorised as easy (Items 1, 3, 6, 9, 10, 11, 16, 19, 23, 24, 25, 27, 29, and 30) and 6 items fall into the moderate difficulty index (Items 2, 7, 13, 18, 21, and 26), with no items categorised as too difficult. In terms of distinguishing students' abilities, the discriminant analysis showed satisfactory quality, with the following breakdown: 4 items were classified as very good (Items 2, 7, 21, and 26), 8 items were classified as good (Items 1, 6, 10, 13, 16, 18, 24, and 30), 3 items were classified as adequate (Items 19, 23, and 27), and 5 items were classified as weak but were retained as they conceptually supported content validity (Items 3, 9, 11, 25, and 29). After 20 valid items were finalized, a final reliability test was conducted using the Kuder-Richardson 21 (KR-21) formula, yielding a reliability coefficient of 0.762. This coefficient value, which exceeds the minimum threshold of 0.700, scientifically demonstrates that the objective information literacy test instrument possesses robust

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internal consistency and is reliable for use in this study. The difficulty classification of the retained items is summarised in Table 1, while the complete empirical item analysis is reported in Table 2.

3.1 Social skills data

The initial conditions of the control and experimental groups must be identical before treatment is administered. Therefore, a preliminary analysis is necessary, including normality, homogeneity, and mean similarity tests. The data used in the preliminary analysis are the pretest scores of students' social skills in the '6 continents of the world' materials. The initial social skills profile of both classes is presented in Table 3.

Table 3. Pretest scores of students' social skills in the control and experimental classes

Class	Number of Students'	The highest score	Lowest Value	Rate-rate (Value range: 0-100)
Control	28	71	45	57.36
Experiment	28	70	46	56.40

The final stage analysis was carried out to determine the difference in the average posttest results between the two classes: the control class (class VI A SDN Jatisari), which applies the conventional method, and class VI B SDN Jatisari. The control class average of 59.25 was lower than the experimental class's average of 82.07.

Table 4. Posttest scores of students' social skills in the control and experimental classes

Class	Number of Students'	The highest score	Lowest Value	Rate-rate (Value range: 0-100)
Control	28	73	47	59.25
Experiment	28	98	68	82.07

3.2 Information literacy data

A preliminary analysis, including normality, homogeneity, and equality-of-means tests, was used to ensure that the initial conditions before collecting information literacy data for both the control and experimental classes were the same. The data used in the preliminary analysis were the information literacy pretest scores, as shown in Table 5.

Table 5. Pretest scores of students' information literacy in the control and experimental classes

Class	Number of Students'	The highest score	Lowest Value	Rate-rate (Value range: 0-100)
Control	28	68	52	61.29
Experiment	28	67	56	61.43

The final stage analysis was carried out to determine the difference in the average posttest results between the two classes: the control class, class VI A SDN Jatisari, which applies the conventional method, and class VI B SDN Jatisari, which applies the Montessori method assisted by IPAS activity books for elementary school. The control class average of 68.50 was lower than the experimental class's average of 91.89. The detailed information literacy posttest scores for both classes are presented in Table 6.

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Table 6. Posttest scores of students' information literacy in the control and experimental classes

Class	Number of Students'	The highest score	Lowest Value	Rate-rate (Value range: 0-100)
Control	28	74	63	68.50
Experiment	28	98	85	91.89

3.3 Prerequisite test

3.3.1 Normality test results

The results of the normality test for social skills show that the Shapiro-Wilk test (sample size less than 50) was significant for the Control Group (p = 0.367) and the Experimental Group (p = 0.258). The significance values for both groups were greater than 0,05, indicating that the data were normally distributed, as shown in Table 7.

Table 7. Shapiro-Wilk normality test results for social skills data

Test	Class	Mark	Information
Normality	Control	Sig = 0.367	Data is normally distributed
	Experiment	Sig = 0.258	Data is normally distributed

The information literacy data shows that the Control Group has a significance value of 0,290 and the Experimental Group has a significance value of 0.293. Both groups' significance values are greater than 0.05, indicating a normal distribution of the data. These normality results are summarised in Table 8.

Table 8. Shapiro-Wilk normality test results for information literacy data

Test	Class	Mark	Information
Normality	Control	Sig = 0.290	Data is normally distributed
	Experiment	Sig = 0.293	Data is normally distributed

3.3.2 Homogeneity test results

The results of the homogeneity test for social skills data showed a significance value of 0,05. The results of the homogeneity test were 0,707, indicating that it was greater than the significance value, so the conclusion was that both data sets were homogeneous. The social skills homogeneity result is reported in Table 9.

Table 9. Homogeneity test results for social skills data

Test	Class	Mark	Information
Homogeneity	Control and experiment	0.707	two-class homogeneous variant

The information literacy data show a value of 0,98, which is greater than the significance value of 0,05, as shown in Table 10.

Table 10. Homogeneity test results for information literacy data

Test	Class	Mark	Information
Homogeneity	Control and experiment	0.98	two-class homogeneous variant

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3.3.3 Results of the mean equality test

The results of the equality test of the average pretest scores, calculated using an independent t-test with the SPSS 27 program, t-count = -0.449. If t-table with DF n-2 = 56-2 = 54 and probability 0,05 or 5%, namely 2.005, then t-count (0.449) < t table(2.005). So the hypothesis is to accept H0: there was no difference in the average between the control and experimental classes. The three tests conducted showed that classes VI A and VI B at Jatisari Elementary School had the same initial conditions. The mean equality result for social skills is presented in Table 11.

Table 11. Mean equality test results for social skills pretest scores

Test	Class	Mark	Information
Similarity of two averages	Control and experiment	$t_{(count)} = 0.449$	There is no difference in the average of the two classes

The results of the equality test of the average pretest scores, calculated using an independent t-test with the help of the SPSS program: t-count = -0.146. face t-count (-0.146) < t table(2.005), the hypothesis is to accept H0: there was no difference in the average between the control and experimental classes. The three tests conducted showed that classes VI A and VI B at Jatisari Elementary School had the same initial conditions. The mean equality result for information literacy is presented in Table 12.

Table 12. Mean equality test results for information literacy pretest scores

Test	Class	Mark	Information
Similarity of two averages	Control and experiment	$t_{(count)} = -0.146$	There is no difference in the average of the two classes

The assessment of students' information literacy skills used not only questionnaire data but also a written test consisting of multiple-choice questions. Data analysis using a normality test revealed p-values of 0.209 for the control class and 0.325 for the experimental class. Because both values are greater than 0.05, it can be concluded that the information literacy test data in both classes are normally distributed.

The results of the homogeneity test of students' information literacy scores showed a p-value of 0.536. Since the value of 0.536 is greater than 0.05, it can be concluded that the data variance between the control and experimental classes is homogeneous (the same). The average score for the control class was 61.61, while the average score for the experimental class was 80.71. This indicates that the experimental class has higher knowledge than the control class.

3.4 Hypothesis testing

3.4.1 Independent sample t-test

T-test analysis Independent Sample T-Test was conducted to prove 2 hypotheses, including: the Montessori method assisted by IPAS activity books for elementary school is effective for the development of social skills, and the Montessori method assisted by IPAS activity books for elementary school is effective for the development of information literacy.

On social skills t-test analysis Independent Sample T-Test was conducted to prove, whether the hypothesis (Ha) of the experimental class is higher than the control class is accepted or not. The analysis states that the calculated t is 10.608. If df is 54 and the significance level is 0.05, then the t-value is 1.674. Because the calculated t > the t table value, then H0 is rejected and Ha is accepted. This means the average of the experimental class is higher than that of the control class. This shows

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that students' social skills improve more with the Montessori method, using an activity book, than with conventional methods. Therefore, it can be concluded that the Montessori method, assisted by IPAS activity books for elementary school, effectively improves students' social skills. The magnitude of the increase in social skills was assessed based on a comparison of the normalized gain (N-gain) values between the experimental and control groups. The N-Gain comparison for social skills is shown in Table 13.

Table 13. N-Gain comparison for students' social skills

Class	N	Average N-Gain Value	Criteria
Control	28	0.04	Low
Experiment	28	0.61	Currently

The results of the N-Gain test using Excel calculations produced an N-Gain value of 0.04 for the Control Class and 0.61 for the Experimental Class. According to the N-Gain value criteria table, the Control Class falls into the low criteria because "g" is less than 0,3 and the Experimental Class falls into the medium criteria because "g" is less than 0,7. From these data, it can be concluded that the N-Gain in the experimental class is higher than in the control class.

The results of the analysis of student information literacy state that the calculated t is 27.237. If the df is 54 and the significance level is 0.05, then the t table is 1.674. Since the calculated t-value is greater than the t-value from the table, then H0 is rejected, and Ha is accepted. This means the average of the experimental class is higher than that of the control class. This shows that students' information literacy using the Montessori method, assisted by IPAS activity books for elementary school, is better than applying conventional methods, so it can be concluded that the Montessori method, assisted by IPAS activity books for elementary school, effectively improves students' information literacy. The magnitude of the increase in information literacy was assessed by comparing normalized gain (N-gain) values between the experimental and control groups. The N-Gain comparison for information literacy is shown in Table 14.

Table 14. N-Gain comparison for students' information literacy

Class	N	Average N-Gain Value	Criteria
Control	28	0.18	Low
Experiment	28	0.79	High

The results of the N-Gain test using Excel calculations produced an N-Gain value of 0.18 for the Control Class and 0.79 for the Experimental Class. According to the N-Gain value criteria table, the Control Class falls into the low criteria because "g" is less than 0.3, and the Experimental Class falls into the medium criteria because "g" is more than 0.7. From these data, it can be concluded that the N-Gain in the experimental class is higher than in the control class.

3.4.2 Manova Test

Based on research data, the following is a comparison of achievements between the experimental class (Montessori method) and the control class (conventional). For Information Literacy, the experimental class had an average (mean) of 91.89, while the control class had an average of 68.50. This indicates a significant difference in cognitive superiority for students who use Montessori activity books. On Social Skills, the experimental class scored an average of 82.07, much higher than the control class, which scored only 59.25. Test results Wilks' Lambda show a significance value of 0.000 ($p < 0.05$) with an F value of 372.362. Mark observed a power of 1.000,

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indicating that the statistical power of this study is good. Because the significance value is < 0.05, H0 is rejected, indicating that the use of the Montessori method assisted by activity books has a significant simultaneous effect on students' social skills and information literacy. The multivariate MANOVA results are presented in Table 15.

Table 15. MANOVA multivariate test results for class effect

Effect	Test	Value	F	Sig.	Observed Power
Class	Pillai's Trace	.934	372.362	.000	1.000
	Wilks'Lambda	.066	372.362	.000	1.000
	Hotelling's Trace	14.051	372.362	.000	1.000
	Roy's Largest Root	14.051	372.362	.000	1.000

After the simultaneous test was declared significant, a univariate test was carried out to see the influence on each variable. As shown in Table 16, information literacy obtained F = 741.830 with Sig. = 0.000 and R Squared = 0.932, indicating that the Montessori method contributed 93.2% to the increase in information literacy. Social skills obtained F = 112.525 with Sig. = 0.000 and R Squared = 0.676, indicating a contribution of 67.6% to social skills.

Table 16. Univariate test results for information literacy and social skills

Source	Dependent Variable	df	F	Sig.	R Squared
Class	Information Literacy	1	741.830	.000	. 932
	Social Skills	1	112.525	.000	.676

The pairwise comparison in Table 17 shows the magnitude of the mean difference between groups. For social skills, the average difference between the experimental and control classes was 22.821 with Sig. = 0.000, indicating a statistically significant increase in the experimental class. For information literacy, the average difference was 23.393 with Sig. = 0.000, indicating a significant advantage of the experimental class in information literacy.

Table 17. Pairwise group comparison results for social skills and information literacy

Dependen Variable	(I) Class	(J) Class	Mean Difference (I-J)	Sig.
Social Skills	Experiment	Control	22.821*	.000
Information Literacy	Experiment	Control	23.393*	.000

All test results show significant values 0.000 < 0.05, so it can be concluded that Ha accepted. The Montessori method assisted by science activity books has proven to be very effective in improving the social skills and information literacy of sixth grade students compared to conventional methods.

4. Discussion

The significant improvement in the social skills of the experimental group, with a final average score of 82.07, compared to the control group, which achieved an average score of only 59.25, provides strong empirical evidence of the positive contribution of the implementation of the Montessori Method supported by an activity book (IPAS). Theoretically, this wide gap in scores not only demonstrates the technical effectiveness of the medium used but also reflects the

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reconstruction of the learning ecosystem through the principle of the Prepared Environment. Through this principle, the elementary school activity book (IPAS) on the topic of 'The 6 Continents of the World' is not treated merely as a worksheet containing a collection of one-way questions, but is designed as a stimulating medium that facilitates structured social interaction within the classroom. The elementary mechanism for this behavioural change lies in the design of collaborative tasks within the book, such as instructions where students are required to share pieces of information or findings with one another in order to solve blank maps or crossword puzzles in groups. This phenomenon aligns with the findings of Nurikhsani et al. (2026) regarding the importance of creating meaningful learning in social studies education in elementary schools. Nurikhsani et al. (2026) emphasise that the essence of Social Studies is not the passive mastery of raw content, but rather how students construct social understanding and civic awareness through active participation in the classroom, condition successfully accommodated by the interactive design of this Montessori intervention.

The essential Montessori components that most influence this social behaviour dynamic are the stimulation of independence and the provision of self-correcting materials. The integration of visual feedback and interactive answer keys within the activity book enables sixth-grade students to identify and correct their own errors independently without having to rely on direct validation from the teacher. This autonomy indirectly reduces the teacher's instructional burden in monitoring correct and incorrect answers, allowing the teacher to redirect their focus towards facilitating interpersonal communication, guiding group negotiations, and mitigating conflicts arising between students. This aligns with the premise of Lillard (2023), who state that a Montessori-based learning environment can enhance pro-social interactions because its system minimises direct individual competition and shifts students' focus towards cooperation through the use of shared resources. The development of self-regulation arising from the use of these independent resources is crucial for children's developmental readiness. As demonstrated by Risma et al. (2025), structured learning interventions that adopt inclusive and child-friendly principles make a significant contribution to students' social-emotional readiness to cope with transitions and higher academic demands. By minimising rigid instructional pressure, students in the experimental group in this study had a healthier emotional space to build their social-emotional well-being. A literature review conducted by Risma et al. (2025) confirms that children's social-emotional well-being is a key predictor of learning readiness and long-term academic success. If students feel emotionally secure because their learning environment is adaptive and non-punitive, social competencies such as empathy, tolerance, and group cooperation can develop to an optimal level.

These empirical findings also reinforce the theoretical basis proposed by Randolph et al. (2023), who asserts that the Montessori educational model has a positive impact on students' executive functions and social competencies due to the presence of a measured structure of freedom. Nevertheless, this study offers conceptual novelty by demonstrating that Montessori principles can still be adaptively transformed into the printed format of an activity book. This step represents a progression in educational media that bridges the gap between traditional Montessori physical materials and learning tools that are relevant and practical for implementation in the Society 5.0 era. This pedagogical transformation aligns with the research by Risma et al. (2025), whose bibliometric analysis indicates that the integration of character education and social-civic values within the science and social studies curriculum is now required to be delivered through innovative and integrated pedagogical approaches to address the complexities of modern society.

In contrast to the classical study conducted by Le Diagon et al. (2025) which restricted the application of the Montessori method to the development of social skills in early childhood, the results of this study expand the scope of application by demonstrating the relevance of this method

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for the upper elementary school level. At this stage of cognitive development, the activity book serves as a mental navigation tool for students in organising complex social studies material. In contrast to the findings of Cavanagh & Kiersch (2023), who reported that the use of conventional media often results in superficial social interaction, the integration of Montessori principles in this study fosters deeper interaction as students feel they have full control over the pace and process of their own learning. The benefits of meaningful social conditioning through social studies education are consistent with the research by Rosidah et al. (2026), which demonstrated that elementary school social studies learning contextualised with real world issues, such as the integration of global values can significantly boost students' social literacy, as they are encouraged to discuss phenomena in their immediate environment collaboratively.

The experimental group's exceptionally high average information literacy score of 91.89, outperforming the control group's score of 68.50, demonstrates the success of integrating this media into Social Studies learning. This indicates that the elementary school Social Studies activity book functions as an active information curator, facilitating a paradigm shift in students from passive information recipients through lecture-based methods to active information explorers. To optimize this paradigm shift, the use of interactive learning games can serve as an effective intervention to alleviate student boredom and stimulate enthusiastic participation in the classroom (Zega & Tangkin, 2023). Furthermore, the creation of this active learning environment goes hand in hand with the development of independent learning skills, which empower students to overcome challenges in time management and actively guide their own behavior to achieve optimal learning outcome (Nurjanah, 2022). The instructions to search within the book, which guide students to trace, sort, and map specific data regarding the '6 Continents of the World', directly hone their skills in identifying and verifying the validity of data—two crucial pillars of information literacy in a digital age rife with disinformation. The success of this cognitive process is theoretically supported by the achievement of a state (deep, unburdened concentration) found within the Montessori method. The success of integrating these cognitive processes is theoretically underpinned by the attainment of a state (deep, unburdened concentration) inherent in the Montessori method. As stated by Randolph et al. (2023), the freedom to choose activities within the structured framework of the Montessori method allows students to focus their full attention on a single topic without being overwhelmed by anxiety or excessive psychological burden. Evidence regarding the effectiveness of this self-directed activity-based medium is also consistent with the research by Nurhamidah et al (2023), which demonstrates that the transformation of elementary school IPAS teaching materials into an interactive digital format (such as *E-Flipbook*) is empirically capable of significantly enhancing students' cognitive learning outcomes, as it presents a visual structure and self-directed navigation that captures children's interest.

Based on the latest findings by Muslim et al. (2025) regarding the optimisation of information literacy through student-centred learning, as well as previous research conducted by Riski (2021) on identifying reading interest as the sole factor influencing intellectual development, supplemented by the results of this study, which provide new evidence that sixth-grade students' information literacy improves significantly when reading activities are combined with discovery tasks systematically organised in an activity book. In contrast to the study conducted by Teknowijoyo & Marpelina (2022), which discusses digital literacy within the overly broad theoretical framework of Society 5.0, this study presents empirical evidence that the reconstruction of the '6 Continents of the World' material using the Montessori approach is capable of simplifying the complexity of information into a coherent sequence of discovery. The enhancement of information literacy through structured project-based tasks at this elementary level reinforces the findings of Muslim et al. (2025), which demonstrated a very strong positive correlation between students' perceptions of

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creativity and information literacy skills (the ability to identify, evaluate, and apply data) following the implementation of a project-based discovery model (Project-Based Learning). Through the Montessori approach supported by an activity book, the operational strength of this instrument lies in the use of educational games that act as a visual guide for students to distinguish facts from opinions when differentiating socio-geographical characteristics across continents. This successfully addresses the challenge identified during initial observations regarding the low information processing skills of elementary school-aged children.

Through this combination, students do not merely collect data but learn to manage knowledge independently an outcome that distinguishes this research from the study conducted by Bavlı and Uslu Kocabaş (2022), which emphasised conventional cognitive learning outcomes. This approach is in line with the innovation proposed by Haryanti et al. (2026), namely the use of differentiated hypermedia electronic modules in elementary school social studies to foster sustainable social attitudes. Hypermedia modules and Montessori activity books share a strong theoretical common ground, in that both seek to eliminate the dominance of one-way learning and replace it with student-centred, multi-path exploration. The self-verification mechanisms and exploratory tasks embedded in Montessori-based activity books fundamentally implement the core principles of authentic assessment. As summarised in a comprehensive framework by Vlachopoulos and Makri (2024), authentic assessment methods require students to undertake real-world tasks that mimic actual situations, thereby shifting the focus of education from mechanical memorisation to the meaningful application of knowledge, skills and attitudes. In this study, the activity book serves not merely as a passive medium for text comprehension but functions as a continuous formative authentic assessment tool through which students actively curate geographical data and complete social simulations. The systematic application of an authentic assessment system directly fosters the development of 21st-century skills such as critical thinking, independent problem-solving, and collaborative digital curation, which are essential for future civic and professional environments. Thus, the use of Montessori-based activity books has proven to be an effective alternative solution to bridge the gap in social science learning materials, capable of holistically integrating 21st-century competencies.

Although quantitative data demonstrate convincing advantages in the experimental group, researchers must exercise caution and avoid making absolute claims in order to maintain scientific objectivity. As methodologically highlighted by Ballance (2024), the majority of experimental and quasi-experimental studies in the field of education often fall into the trap of overconfident conclusions due to neglecting weaknesses in sampling procedures and the absence of full subject randomisation. This study at SDN Jatisari employed a quasi-experimental design using pre-existing classes; consequently, the researchers could not entirely eliminate the potential influence of various external confounding factors that might affect the differences in scores between groups.

One of the key confounding factors that must be critically considered is the emergence of the novelty effect. The higher scores achieved by students in the experimental class may have been triggered by a fleeting enthusiasm resulting from their interest in the visuals, colourful illustrations, and new game mechanics within the activity book elements they had not previously encountered meaning that the observed increase in motivation is likely to be temporary rather than a reflection of the development of long-term intrinsic motivation. Bertotti's (2024) semiotic-discursive critique regarding the commercialisation and construction of Montessori based subjectivity also reminds researchers not to become trapped by the mere 'Montessori' label. Bertotti's (2024) highlights that the visual appeal and learning freedom of Montessori are often discursively constructed to trigger external fascination in the subject. In the context of this research, researchers must critically examine whether improved learning outcomes stem purely from the internalisation of information

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literacy or are merely an affective response by students to the comparative visual aesthetic appeal of this new medium. In addition to the novelty effect, differences in teachers' teaching styles and the personal enthusiasm of the teachers in charge of each class pose a serious challenge to the internal validity of this design. Although the intervention procedures were strictly standardised through the use of the same teaching guidebook, variations in teachers' intonation, level of commitment, work experience, and creativity when transforming themselves into Montessori facilitators in the experimental classes could create a far more positive and supportive classroom atmosphere, in stark contrast to the psychological conditions of the control class, which was deliberately conditioned using monotonous conventional methods. This confirms that the reported effectiveness of the intervention does not stem solely from the superiority of the Montessori activity book itself, but rather depends heavily on the teachers' readiness, flexibility, and competence in adopting the role of non-instructive facilitators. The limited duration of the intervention, which lasted for only two sessions, also prevents the researchers from claiming that these social skills and information literacy have crystallised into permanent latent traits in the students. Therefore, to enhance academic credibility and balance the interpretation of the findings, the researchers consider that this specific classroom environment bias must be viewed as a crucial moderating variable. Acknowledgement of these methodological limitations does not diminish the significance of the findings, but rather provides a more objective, balanced, and credible scientific basis for readers to interpret the scope and generalisability of the results of this quasi-experimental study.

5. Conclusion and implications

This study successfully demonstrated that the implementation of the Montessori Method, supported by the IPAS activity book in elementary schools, has a significant positive impact both simultaneously and individually, on the improvement of social skills and information literacy among sixth-grade students. The principal findings indicate the consistent superiority of the experimental group's performance, where the average final score for social skills reached 82.07 with a Normalised Gain (N-Gain) value of 0.61 (Moderate criterion), significantly outperforming the control group which only achieved an average final score of 59.25 with an N -Gain of 0.04 (Low criterion). In line with these achievements, regarding the information literacy variable, the experimental group successfully recorded a very high final average score of 91.89, far surpassing the control group, which remained at an average of 68.50. The results of the convergent MANOVA test confirm that the use of Montessori-based activity books is not only statistically effective but also capable of stimulating students' literacy and social adaptation skills in a tangible way within the classroom.

In terms of theoretical significance, the findings of this study expand the scope of Montessori application, which has been dominated by early childhood education towards the reconstruction of social science teaching materials for upper elementary school levels through the transformation of traditional physical materials into interactive and self-directed activity books. The results of this experiment reinforce the validity of flow theory and the principle of the Prepared Environment in reducing cognitive barriers and fostering students' self-regulation. Through the provision of structured materials, abstract and complex social science content can be deconstructed into meaningful stages of independent exploration that support children's development.

In practical terms, the findings of this study recommend a restructuring of the role of elementary school teachers through three pillars of academic strategy; Restructuring the Independent Learning Environment, the significance of improving information literacy underscores the importance of transforming the teacher's role from a sole source of information to that of an active facilitator. The implementation of Montessori based independent activity books, featuring

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clear visual instructions and self verification features, has proven effective in reducing the teacher's instructional burden of checking for correct or incorrect answers. This allows educators to shift their focus to providing guidance on students' higher-order analytical processes. Architecture of Non-Competitive Collaboration, to sustain the development of students' social skills, classroom activities must shift from individual competition to structured collective problem solving. Group assignments within learning materials need to be designed to foster positive interdependence. This approach promotes the development of pro-social communication, negotiation, and conflict resolution skills among upper-grade elementary school students. Systematic Integration of Literacy Curation, teachers are recommended to replace monotonous rote learning of social studies texts with guided discovery based materials. Learning steps should guide students to identify, sort, and critically verify the validity of scientific data on global characteristics. This approach simplifies complex material into systematic discovery phases, thereby training students' ability to distinguish empirical facts from subjective opinions in the digital age.

To address the limitations of the quasi-experimental design and enhance the generalisability of the findings, future research is recommended to replicate the study in educational institutions with different socio-geographical backgrounds (such as a comparison between urban and rural areas). Future researchers are also advised to employ a pure experimental design to isolate the independent effects of the Montessori Method from the aesthetic features of the activity book technology, and to extend the duration of the intervention to at least a full semester to verify whether the observed improvement in competence is permanent or merely a temporary manifestation of the novelty effect of the medium.

6. Limitation

Although this study yielded significant results, several methodological limitations must still be critically considered. First, the study's sample size was relatively small and confined to a single school setting specifically, 56 sixth-grade students at SDN Jatisari, so the results cannot be broadly generalized to schools with different sociogeographic characteristics. Second, the use of a quasi-experimental design with pre-existing classes resulted in a lack of true randomization, which limits the researchers' ability to control for external confounding variables. Third, there is a potential for teacher effects, such as teaching style and level of enthusiasm that could affect the internal validity between groups. Fourth, the short duration of the intervention (eight sessions) does not yet allow for verification of whether the improvement in students' social competencies and information literacy is permanent or merely a temporary manifestation of the novelty effect of the media. Fifth, the focus of this study is limited to a single social studies subject (within the social sciences cluster) with a specific geographic topic, which may have different dynamics of effectiveness if applied to more abstract or exact subjects.

From a formal legal standpoint, the conduct of this research has definitively met all regulatory standards and academic bureaucratic licensing requirements. All operational procedures for data collection in the field have been approved and are based on the Research Permit issued by PGRI University of Semarang, No. 235/T.56/PL/IX/2025. Before the experiment began, informed consent forms were completed transparently with the parents or guardians of students in classes VI A and VI B at SDN Jatisari. All student participation was voluntary, free from psychological or academic coercion; subject identities were protected through anonymization codes; and families retained the full right to withdraw from the experiment at any time without penalty. The inclusion of these formal details confirms the validity, permanence, and credibility of the research documentation for journal reviewers.

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Credit authorship contribution statement

Yussi Martha Sukma Astuti, contributed to the conceptualization, methodology, formal analysis, data curation, data collection, validation, and preparation of the original manuscript draft. **Dr. Agus Sutono, S.Fil., M.Phil** provided supervision, resources, methodological guidance, validation, project administration, and contributed to the review and editing of the manuscript. **Prof. Dr. Achmad Buchori, M.Pd**. contributed through supervision, methodological guidance, validation, funding acquisition, formal analysis, and critical review of the manuscript. All authors have read and approved the final version of this article.

Declaration of competing interest

The authors declare that they have no financial interests or personal relationships that could have influenced the work reported in this paper.

Ethical Declaration

This research was conducted in accordance with ethical standards for educational research involving minors. Ethical approval was obtained from the institutional review committee (or the Faculty Research Ethics Committee). Official permission to conduct the research was granted by the Principal of Jatisari Elementary School. Given that the participants were elementary school students, written informed consent (*informed consent*) is carried out through a two-stage procedure: first, parental or guardian consent (*parental consent*) obtained in writing after being given a detailed explanation of the research objectives and procedures; second, verbal consent from the student (*assent*) was also taken to ensure voluntary participation. All collected data were anonymized to ensure confidentiality, and no personal identities were disclosed. The authors affirm that this study upholds the principles of honesty, transparency, and academic integrity, and avoids any form of plagiarism or unethical research practices.

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