



Research Article

The Effect of TPACK-Integrated Project-Based Learning on Social Care Character and Learning Outcomes in Pancasila Education among Elementary School Students

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Abstract. This study aims to examine the effect of the Project Based Learning (PjBL) model integrated with Technological Pedagogical Content Knowledge (TPACK) on social care character and learning outcomes of Pancasila Education for fifth-grade elementary school students. The study employed a quantitative approach with a quasi-experimental posttest-only control group design. The sample consisted of 36 students equally divided into an experimental group (n=18) and a control group (n=18). The experimental group received TPACK-based PjBL instruction, while the control group followed conventional instruction. Research instruments included a multiple-choice test to measure learning outcomes (20 items, K-R 20=0.704) and a Likert-scale questionnaire to measure social care character (14 items, Cronbach's Alpha=0.738). The results showed that the TPACK-based PjBL model significantly affected social care character ($t=3.243$; $p=0.003$; $\eta^2=0.236$), learning outcomes ($t=4.123$; $p<0.001$; $\eta^2=0.333$), and simultaneously affected both (Wilks' Lambda=0.623; $F=10.001$; $p<0.001$).

$\eta^2=0.377$) with large effect categories. In the experimental group, the average learning outcomes increased from 48.89 to 75.83 (N-Gain=0.556, medium category) and social care character increased from 37.39 to 45.89 (N-Gain=0.498, medium category). The mastery learning proportion in the experimental group reached 61.1%, much higher than the control group which only reached 11.1%. These findings strengthen the TPACK framework in the context of Pancasila Education in elementary schools as an approach that can support the integrated development of character and academic abilities.

Keywords: PjBL, TPACK, Social Care Character, Learning Outcomes, Pancasila Education, Elementary School.

INTRODUCTION

The rapid development of science and technology (S&T) in the digital era necessitates a fundamental transformation in education. Twenty-first-century learning can no longer rely solely on traditional teacher-centered approaches; instead, it requires the integration of technology to encourage students to engage actively in learning, develop a deeper understanding, and explore knowledge independently (Syabrina et al., 2025). Law of the Republic of Indonesia No. 20 of 2003 on the National Education System emphasizes that education is a conscious and planned effort to create a learning environment and learning process that enables students to actively develop their potential, including spiritual strength, self-control, personality, intelligence, noble character, and the skills necessary for themselves, society, the nation, and the state.

Pancasila Education in elementary schools plays a strategic role in shaping students' character. This subject is intended not only to enhance students' cognitive abilities but also to instill Pancasila values deeply, particularly the character of social care (Rohmawati & Chumdari, 2026). Social care character refers to an attitude and behavior characterized by a consistent willingness to provide assistance to others and to communities in need (Zuchdi, 2021). However, various studies have shown that Pancasila Education at the elementary school level is still predominantly delivered through teacher-centered approaches that emphasize the transmission of content, causing students to tend to memorize concepts without fully understanding their meaning and relevance to real-life situations (Wahyuni, 2020). Students' involvement in constructing their own social experiences also remains limited, resulting in the inadequate authentic internalization of social care values (Siregar, 2021). Furthermore, technology has not been sufficiently integrated into pedagogical practices, making learning less engaging and limiting opportunities for the development of students' critical thinking skills (Mishra & Koehler, 2006).

A similar condition was identified at SDN 28 Luaor, Majene Regency, based on the results of preliminary observations. The implementation of Pancasila Education in Grade V has not yet been optimal. Most students' learning outcomes remained below the Minimum Mastery Criterion (KKM) of 75, with mastery levels in the 2023/2024 academic year reaching only 70.37% in Class VA and 71.35% in Class VB. The learning process rarely incorporated innovative technology-based learning models, and teachers continued to rely predominantly on lecture-based methods.

Consequently, students had limited opportunities to collaborate, interact, and develop social care character.

One learning model considered capable of addressing these challenges is Project-Based Learning (PjBL). This model positions students as the primary actors in the learning process through the completion of projects related to real-world problems in their surrounding environment (Nawir, 2023; Pirdaus, 2024). In PjBL, students are encouraged to work collaboratively in groups, gather information, engage in discussions, design solutions, produce tangible outcomes, and present their work. These processes provide students with deeper learning experiences, enabling them not only to acquire knowledge but also to develop critical thinking, creativity, communication, and collaboration skills.

To optimize the implementation of PjBL, the integration of the Technological Pedagogical Content Knowledge (TPACK) framework, first introduced by Mishra and Koehler (2006), is essential. TPACK represents a synthesis of three types of knowledge—technological, pedagogical, and content knowledge—that are integrated to facilitate effective and meaningful learning (Mishra & Koehler, 2008). Integrating TPACK into PjBL enables students to access information, create digital products, and communicate more effectively, thereby making the learning process more engaging and meaningful (Koehler & Mishra, 2006).

This study is important to provide empirical evidence regarding the effect of TPACK-integrated PjBL on students' social care character and learning outcomes in Pancasila Education at the elementary school level. Specifically, this study aims to: (1) examine the effect of TPACK-integrated PjBL on students' social care character; (2) examine the effect of TPACK-integrated PjBL on students' learning outcomes; and (3) analyze the simultaneous effect of TPACK-integrated PjBL on students' social care character and learning outcomes.

RESEARCH METHOD

Research Design

This study employed a quantitative approach using a quasi-experimental posttest-only control group design (Gall et al., 2003). This design was selected because random assignment was not feasible in the school-based field research setting. The sample was divided into two groups: an experimental group that received instruction using TPACK-integrated Project-Based Learning (PjBL) and a control group that received conventional instruction through lectures and discussions. To ensure the initial equivalence of the two groups, the researchers compared students' Pancasila Education report card scores from the previous semester. The results of an independent-samples t-test indicated no significant difference between the two groups ($t(34) = 0.423$, $p = 0.675$).

Research Location, Time, and Participants

The study was conducted at SDN 28 Luaor, Pamboang District, Majene Regency, from June to August 2026. The study population comprised all 36 fifth-grade students distributed across two classes. The sample was selected using a cluster random

sampling technique, resulting in Class VA being assigned as the experimental group (18 students) and Class VB as the control group (18 students).

Definisi Operasional Variabel

TPACK-Based PjBL Model is defined as a learning model that engages students in problem-solving activities and independent knowledge construction through project completion by integrating technology (Technological Knowledge/TK), pedagogy (Pedagogical Knowledge/PK), and content (Content Knowledge/CK) in a balanced manner (Sari & Angreni, 2018; Mishra & Koehler, 2006). The learning syntax consists of six stages: (1) presenting the problem, (2) project planning, (3) scheduling, (4) project implementation and monitoring, (5) assessment, and (6) evaluation and reflection.

Social Care Character is defined as an attitude and behavior that demonstrates concern for the surrounding social environment and motivates students to help those in need (Zuchdi, 2021; Anas, 2020). The indicators include acting politely, being tolerant of differences, demonstrating empathy toward others, being willing to share, cooperating with others, promoting peaceful relationships, and engaging in social activities (Samani & Hariyanto, 2013; Darmiatun, 2013). Social care character was measured using a four-point Likert-scale questionnaire: Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2, and Strongly Disagree (SD) = 1.

Learning Outcomes are defined as changes in students' behavior that occur after participating in the teaching and learning process in accordance with educational objectives (Komariyah et al., 2018). The instrument used was a multiple-choice test consisting of 20 items designed to measure higher-order cognitive domains at levels C4–C6.

Research Instruments and Instrument Testing

The research instruments consisted of three types. *First*, an observation sheet was used to assess the implementation of the TPACK-integrated PjBL model and to monitor the implementation of the treatment. *Second*, a multiple-choice learning outcomes test was developed based on the competency indicators and learning objectives. The test consisted of 20 items that had been subjected to a pilot test. Item validity was assessed using Pearson's correlation with 36 students participating in the pilot test ($df = 34$, $r\text{-table} = 0.329$). All 20 items were declared valid, with r -calculated values ranging from 0.341 to 0.513 and significance values of < 0.05 . Test reliability was calculated using the Kuder–Richardson Formula 20 (KR-20), yielding a coefficient of 0.704, which was categorized as strong reliability. The item difficulty analysis showed that 13 items were categorized as moderately difficult and 7 items as easy. Meanwhile, the discrimination indices ranged from 0.300 to 0.600, with 17 items categorized as very good and 3 items as good.

Third, a social care character questionnaire consisting of 14 statements was administered. The validity test indicated that all items were valid, with r -calculated values ranging from 0.354 to 0.644 and significance values of < 0.05 . The reliability of the questionnaire was assessed using Cronbach's Alpha, which yielded a coefficient of 0.738, indicating strong reliability.

Data Analysis Technique

Data were analyzed using descriptive and inferential statistics. The prerequisite tests consisted of the Shapiro–Wilk normality test and Levene’s test for homogeneity of variance. Hypothesis testing was conducted using an independent-samples *t*-test to examine differences between groups, a paired-samples *t*-test to assess changes within groups, and a one-way multivariate analysis of variance (MANOVA) to examine the simultaneous effects of the intervention. Effect sizes were calculated using Cohen’s *d* and partial eta squared, with values of 0.01, 0.06, and 0.14 representing small, medium, and large effects, respectively (Ellis, 2010). N-Gain analysis was also performed to measure the magnitude of improvement, with values >0.7 categorized as high, 0.3–0.7 as moderate, and <0.3 as low (Hake, 1999). All statistical analyses were conducted using IBM SPSS Statistics version 29.0.

RESULTS AND DISCUSSION

Research Data Description

The study involved 36 students who were equally divided into an experimental group (18 students) and a control group (18 students). In the experimental group, the mean pretest score for learning outcomes was 48.89 (SD = 16.68), which increased to 75.83 (SD = 14.06) in the posttest. Similarly, the mean pretest score for social care character was 37.39 (SD = 6.47), increasing to 45.89 (SD = 6.34) in the posttest.

The comparison of posttest scores between the groups showed that the experimental group achieved a substantially higher mean learning outcome score (75.83) than the control group (55.00), with a difference of 20.83 points. Likewise, the mean social care character score in the experimental group (45.89) was higher than that of the control group (39.22), with a difference of 6.67 points.

Prerequisite Test Results

The Shapiro–Wilk normality test indicated that all pretest and posttest data in both groups were normally distributed ($p > 0.05$). Levene’s test for homogeneity of variance showed that the variances of the two groups were homogeneous for learning outcomes ($F = 0.232$; $p = 0.633$) and social care character ($F = 0.043$; $p = 0.837$). Furthermore, Box’s *M* test indicated that the covariance matrices were homogeneous ($M = 1.115$; $p = 0.791$), confirming that the assumptions for MANOVA were satisfied.

Effect of TPACK-Integrated PjBL on Social Care Character

The results of the independent-samples *t*-test indicated a significant difference in social care character between the experimental and control groups ($t(34) = 3.243$; $p = 0.003$). The effect size, as measured by Cohen’s *d*, was 1.081, while the partial eta squared was 0.236, both indicating a large effect. In the experimental group, social care character also increased significantly from pretest to posttest ($t(17) = -13.326$; $p < 0.001$), with an absolute Cohen’s *d* of 3.141, indicating a very large effect. The Wilcoxon signed-rank test further confirmed that all 18 students in the experimental group demonstrated an increase in social care character scores ($Z = -3.727$; $p < 0.001$). These findings indicate that project activities involving discussion, task delegation,

collaboration, and group-based problem solving provided students with authentic experiences through which they could develop greater concern for others. This finding is consistent with the study by Rohmawati and Chumdari (2026), which reported that PjBL improved elementary school students' social care character, increasing from 53% in Cycle I to 85% in Cycle II. According to Mishra and Koehler (2008), TPACK, as a teacher knowledge framework that integrates technology, pedagogy, and content in a balanced manner, enables technology to be used to strengthen collaborative activities, shared responsibility, and mutual support among students.

However, the improvement in social care character was not uniform across all students. Based on the observation data, students in the low N-Gain category generally had low initial abilities (pretest scores below 30), were less actively involved in group discussions, experienced difficulties using technology, particularly the Canva application, and did not attend one of the learning sessions. These findings indicate that the effectiveness of TPACK-integrated PjBL is determined not only by the learning model itself but also by students' individual readiness and the support provided throughout the learning process.

Effect of TPACK-Integrated PjBL on Learning Outcomes

The results of the independent-samples *t*-test indicated a significant difference in learning outcomes between the experimental and control groups ($t(34) = 4.123$; $p < 0.001$). The effect size, as measured by Cohen's *d*, was 1.374, while the partial eta squared was 0.333, both of which indicated a large effect. In the experimental group, learning outcomes increased significantly from pretest to posttest ($t(17) = -15.237$; $p < 0.001$), with an absolute Cohen's *d* of 3.591, indicating a very large effect. The Wilcoxon signed-rank test further confirmed that all 18 students demonstrated an improvement in their scores ($Z = -3.740$; $p < 0.001$).

These findings are consistent with the study by Andriani et al. (2025), which reported that PjBL assisted by TPACK-based interactive multimedia resulted in a mean posttest score of 81.36 in the experimental group and 68.48 in the control group ($t = 7.040$; $p < 0.001$). Similarly, Puspitasari and Wibawa (2025) reported an improvement in Pancasila Education learning outcomes from a pretest mean of 61.11 to a posttest mean of 86.67 following the implementation of TPACK-based PjBL.

More broadly, these findings support the meta-analysis conducted by Zhang and Ma (2023) of 66 experimental and quasi-experimental studies, which demonstrated that PjBL had a positive and significant effect on learning outcomes, with a pooled standardized mean difference (SMD) of 0.441 ($p < 0.001$). Kokotsaki et al. (2016) explained that the effectiveness of PjBL in improving learning outcomes is influenced by the appropriate use of technology, the quality of group work, teachers' ability to provide scaffolding, and the alignment between assessment and project objectives.

Within the TPACK framework, Content Knowledge (CK) is reflected in the accuracy of the concepts being learned; Pedagogical Knowledge (PK) is demonstrated through project organization, group work, and reflection; while Technological Knowledge (TK) is implemented through the use of digital resources to search for information, develop products, and present project outcomes. This integration

enables students not merely to receive explanations but also to apply their knowledge in completing authentic tasks, consistent with Bloom's Taxonomy (2014), which describes the progression of cognitive processes from remembering to creating.

Nevertheless, the improvement in learning outcomes was not uniform, as 7 out of 18 students (38.9%) in the experimental group had not yet achieved the Minimum Mastery Criterion (KKM). The mean N-Gain of 0.556, categorized as moderate, and the effectiveness interpretation of 55.55%, categorized as less effective, indicate that considerable room for improvement remains.

Simultaneous Effect of TPACK-Integrated PjBL on Social Care Character and Learning Outcomes

The results of the one-way MANOVA indicated that TPACK-integrated PjBL had a significant simultaneous effect on students' social care character and learning outcomes (Wilks' Lambda = 0.623; $F(2, 33) = 10.001$; $p < 0.001$; partial eta squared = 0.377). This effect size was categorized as large, indicating that the model accounted for 37.7% of the combined variance in the two dependent variables. Follow-up univariate analyses revealed significant effects on learning outcomes ($F(1, 34) = 17.000$; $p < 0.001$; eta squared = 0.333) and social care character ($F(1, 34) = 10.519$; $p = 0.003$; eta squared = 0.236). The correlation between the two variables was 0.535 ($p < 0.001$), indicating a moderate positive relationship.

These simultaneous findings are particularly important because Pancasila Education is not solely oriented toward the acquisition of knowledge but also toward character development. TPACK-integrated PjBL enables both objectives to be achieved through an integrated learning experience. Problem solving and project development support students' cognitive development, while collaboration and reflection foster affective and social development.

These findings are consistent with Febriana (2017), who reported that PjBL was effective in simultaneously improving students' social attitudes and learning outcomes. In that study, 40.3% of students reported that PjBL improved their social behavior, while the experimental group achieved a higher mean score of 7.67 compared with 4.67 in the conventional learning group. Zamiaty et al. (2023) likewise found that students' social skills and learning outcomes in the experimental group were significantly higher than those in the control group ($p < 0.001$). Using MANOVA, Bagiada et al. (2024) also found significant differences in learning outcomes and nationalism attitudes, both partially and simultaneously, between students who participated in PjBL and those who received conventional instruction. Furthermore, Rahayu et al. (2024) reported that the implementation of TPACK-integrated PjBL improved learning outcomes among 91% of fifth-grade students. Similarly, Hermanto et al. (2019) demonstrated that PjBL improved students' social skills from 67.91 to 82.15.

N-Gain Analysis and Learning Mastery

The mean N-Gain score for learning outcomes in the experimental group was 0.556, which was categorized as moderate, while the mean N-Gain score for social care character was 0.498, also categorized as moderate. For learning outcomes, 16

students (88.9%) were classified in the moderate category and 2 students (11.1%) in the high category, with no students falling into the low category. Regarding social care character, 13 students (72.2%) were classified in the moderate category, 3 students (16.7%) in the high category, and 2 students (11.1%) in the low category.

Based on the Minimum Mastery Criterion (KKM) of 75, 11 out of 18 students (61.1%) in the experimental group achieved the mastery criterion, compared with only 2 out of 18 students (11.1%) in the control group. Thus, the proportion of students achieving mastery in the experimental group was 50 percentage points higher than that of the control group. Nevertheless, 7 students (38.9%) in the experimental group had not yet achieved the KKM, indicating the need for follow-up interventions, including enrichment, remedial instruction, and differentiated support.

Observation Results of Model Implementation

Observations of model implementation comprised 12 activities, of which 11 activities (91.7%) were successfully implemented, while 1 activity (8.3%) was not implemented. The activity that was not optimally implemented was the development of a project timeline using Canva during the scheduling stage, primarily due to time constraints and unstable internet access. Nevertheless, the high level of implementation supports the validity of the treatment implementation.

Research Limitations

This study has several limitations. First, the relatively small sample size (36 students) limits the generalizability of the findings to broader populations, and such generalization should therefore be made with caution. Second, the study examined TPACK-integrated PjBL as a unified intervention, meaning that the specific contributions of the technological components, project-based strategies, and their interactions could not be empirically isolated. Third, learning outcomes and social care character may have been influenced by implementation-related factors, including students' prior abilities, digital literacy, access to technological devices, and the intensity of teacher support. Fourth, the N-Gain scores for both variables remained in the moderate category, while learning mastery in the experimental group reached only 61.1%, indicating that the model has not yet achieved optimal outcomes for all students.

CONCLUSION

Based on the findings of this study, the following conclusions can be drawn:

1. TPACK-integrated PjBL had a significant and large effect on students' social care character ($\eta^2 = 0.236$). This finding reinforces the TPACK framework in the context of Pancasila Education at the elementary school level by emphasizing the importance of integrating technology, pedagogy, and content through project-based activities to foster students' social care character.
2. TPACK-integrated PjBL had a significant and large effect on students' learning outcomes ($\eta^2 = 0.333$). This finding further supports the TPACK framework, which emphasizes the integration of technology, pedagogy, and content to facilitate effective Pancasila Education learning.

3. Simultaneously, TPACK-integrated PjBL had a significant and large effect on students' social care character and learning outcomes ($\eta^2 = 0.377$). This finding provides a theoretical contribution by strengthening the integration of the TPACK framework and PjBL in elementary-level Pancasila Education as an approach capable of supporting students' character development and academic achievement in an integrated manner.

Given that 38.9% of students had not yet achieved the Minimum Mastery Criterion (KKM), teachers are encouraged to administer pretests to identify students' prior abilities, ensure equitable distribution of roles within groups, extend the duration of project activities, increase the frequency of reflection sessions, and utilize technology as a means of collaboration and assessment. Schools are encouraged to provide adequate technological facilities and organize TPACK-integrated PjBL training for teachers. Future researchers are recommended to employ stronger experimental designs incorporating pretests for both groups, extend the duration of the intervention, include behavioral observation instruments, and involve participants from more than one school.

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