

Relationships between Culture-Based School Programs, Students' Attitudes, Students' Engagement, and Spatial-Cultural Literacy in Geography Learning

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ARTICLE INFO

Article History:

Received: 2025-12-30

Accepted: 2026-03-13

Published: 2026-09-30

Keywords:

Culture-based schools;
Geography learning;
Spatial-cultural literacy;
Students' attitudes;
Students' engagement

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DOI: 10.37905/jgej.v7i2.36474

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ABSTRACT

The implementation of Javanese–Yogyakarta cultural values within formal education has been manifested through culture-based school programs, including their integration into geography instruction. This study investigates the structural relationships among culture-based school programs, students' attitudes, students' engagement, and spatial-cultural literacy. A quantitative survey design was employed using Structural Equation Modeling-Partial Least Squares (SEM-PLS). The population comprised 201 tenth-grade students enrolled in geography, of whom 178 participated in the study. The findings reveal that culture-based school programs were not significantly associated with spatial-cultural literacy ($p = 0.801$). Similarly, students' cultural attitudes were not significantly associated with spatial-cultural literacy ($p = 0.575$). In contrast, students' engagement showed a significant positive association with spatial-cultural literacy ($p = 0.001$). These findings suggest that culture-based school programs have not yet made a substantial contribution to enhancing students' spatial-cultural literacy. Meanwhile, students' active involvement in various school activities emerges as the strongest predictor among the variables examined in developing their understanding of the relationship between space and culture. This study refines the conceptual linkage between culture-based school programs and spatial literacy by underscoring engagement as a key pedagogical mechanism in geography education. Overall, the results emphasize the importance of engagement and contextual learning experiences in supporting the internalization of spatial-cultural values. Therefore, culture-based school programs need to be re-evaluated to ensure stronger integration with geography learning practices.

How to Cite: Asyraf, D., Susetyo, B. B., Rizqiana, Z. D., Caesario, D., Putra, F. R., & Khadijah, S. (2026). Relationships between Culture-Based School Programs, Students' Attitudes, Students' Engagement, and Spatial-Cultural Literacy in Geography Learning. *Jambura Geo Education Journal*, 7(2), 191–205. <https://doi.org/10.37905/jgej.v7i2.36474>

1. Introduction

The Special Region of Yogyakarta (*Daerah Istimewa Yogyakarta; DIY*) is recognized as a region where communities consistently preserve Javanese cultural values and traditions. These values are not only maintained in daily community life but are also implemented through various public policies, including those in the education sector. One form of this implementation is the development of culture-based schools, which aim to internalize philosophical values, social norms, and local cultural perspectives among students. In geography education, the integration of cultural elements is relevant because geography examines not only spatial and environmental aspects but also human interactions with space that are shaped by cultural meanings (Kabha, 2019; Knecht et al., 2026; Nursa'ban & Mukminan, 2023). Therefore, strengthening cultural values in geography learning is considered important in supporting students' understanding of the relationship between space and cultural identity (Silviariza & Handoyo, 2020).

Along with developments in geographical studies, spatial-cultural literacy is understood as the ability to comprehend the relationships between culture, space, and social activities. This ability includes recognizing cultural patterns within geographic landscapes, interpreting cultural symbols and artifacts, and linking them to spatial processes and dynamics (Bednarz & Kemp, 2011; Dikmenli, 2014; Jarvis, 2011). However, empirical studies that specifically examine spatial-cultural literacy at the secondary education level in Indonesia remain limited. Most previous studies have focused on general spatial literacy or character education through culture-based school programs, while the role of spatial-cultural

literacy has not been examined in a comprehensive manner (Briguglio & Debattista, 2017; Sugiyanto, 2022).

This gap becomes more apparent considering that culture-based school programs are often assumed to have a strong influence on students' learning outcomes. Empirical evidence that specifically examines their contribution to spatial-cultural literacy is still limited. Similarly, students' attitudes toward culture are frequently assumed to support contextual learning, but their relationship with spatial-cultural literacy has not been widely tested. Students' engagement in school activities is also considered important, as direct experience and active involvement are closely related to students' understanding of space and culture (Grevle, 2025; Hadley et al., 2025; Martens et al., 2019). However, studies that examine culture-based school programs, students' cultural attitudes, and students' engagement simultaneously within a single analytical model are still uncommon.

Against this background, this study aims to examine the relationships among culture-based school programs, students' cultural attitudes, students' engagement in school activities, and spatial-cultural literacy at SMAN 9 Yogyakarta. This study provides empirical evidence to support school evaluation of culture-based programs and the development of geography learning that is responsive to local cultural contexts. Structural Equation Modeling-Partial Least Squares (SEM-PLS) enables the relationships among variables to be examined within an integrated model, an approach that remains relatively uncommon in geography education research (Huang, 2021; Prayitno et al., 2021). This integrated perspective enables a more comprehensive evaluation of the school's culture-based program by considering multiple factors associated with its implementation. From a geographical perspective, this evaluation should explicitly address students' interactions with space, the environment, and regional complexity. This is particularly important because students' learning experiences and engagement during program implementation remain relatively underexplored in prior studies on culture-based school programs, especially those examining the role of geography education alongside student attitudes and engagement. In practice, however, geography learning has largely been limited to discussions of physical and social environmental interactions, and it has not been widely used for internalizing spatial values grounded in school culture. Consequently, geography education has not yet been optimally positioned to foster spatial citizenship that enables students to sustain local cultural values through their place-based spatial experiences.

2. Method

2.1 Research Design

This study employed a quantitative cross-sectional correlational research design to examine the structural relationships among culture-based school programs, students' attitudes, students' engagement, and spatial-cultural literacy. This design was selected to assess the strength and statistical significance of relationships among the study variables within an integrated analytical model. Data analysis was conducted using SEM-PLS, which is suitable for research involving latent variables, complex models, and moderate sample sizes, particularly in school-based studies (Hair & Alamer, 2022; Liday, 2025). SEM-PLS hypothesis testing involves two stages: the measurement (outer) model, which assesses relationships between indicators and constructs, and the structural (inner) model, which tests relationships among latent constructs (Nurhalizah et al., 2024). Given the cross-sectional design, the estimated structural paths are interpreted as statistical associations rather than evidence of causal effects. Figure 1 summarizes the SEM-PLS research workflow.

The overall research design followed four main stages, as illustrated in Figure 1. The first stage was data preparation, which focused on preparing the research instrument in accordance with the research objectives. This stage included preliminary analysis through validity and reliability testing of the questionnaire using data from tenth-grade students. The second stage involved measurement model evaluation, which examined discriminant validity and indicator reliability. The third stage focused on structural model analysis to test structural relationships among research variables using predictive assessment and hypothesis testing. The final stage involved visualization and description of the analyzed data to support interpretation of the results.

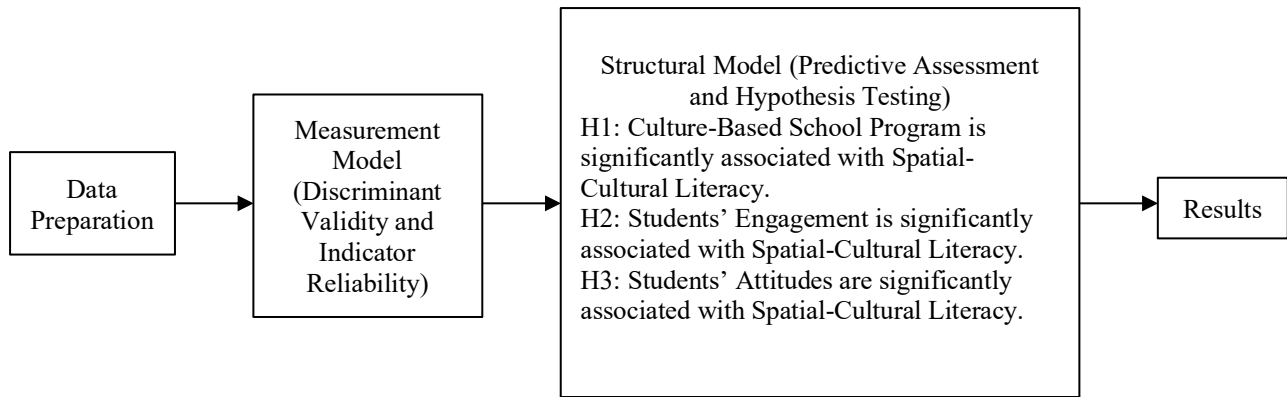


Figure 1. Research Flow Diagram

2.2 Research Participants

The population of this study consisted of all tenth-grade students enrolled in geography courses at SMAN 9 Yogyakarta during the research period, totaling 201 students. The research location is presented in Figure 2.

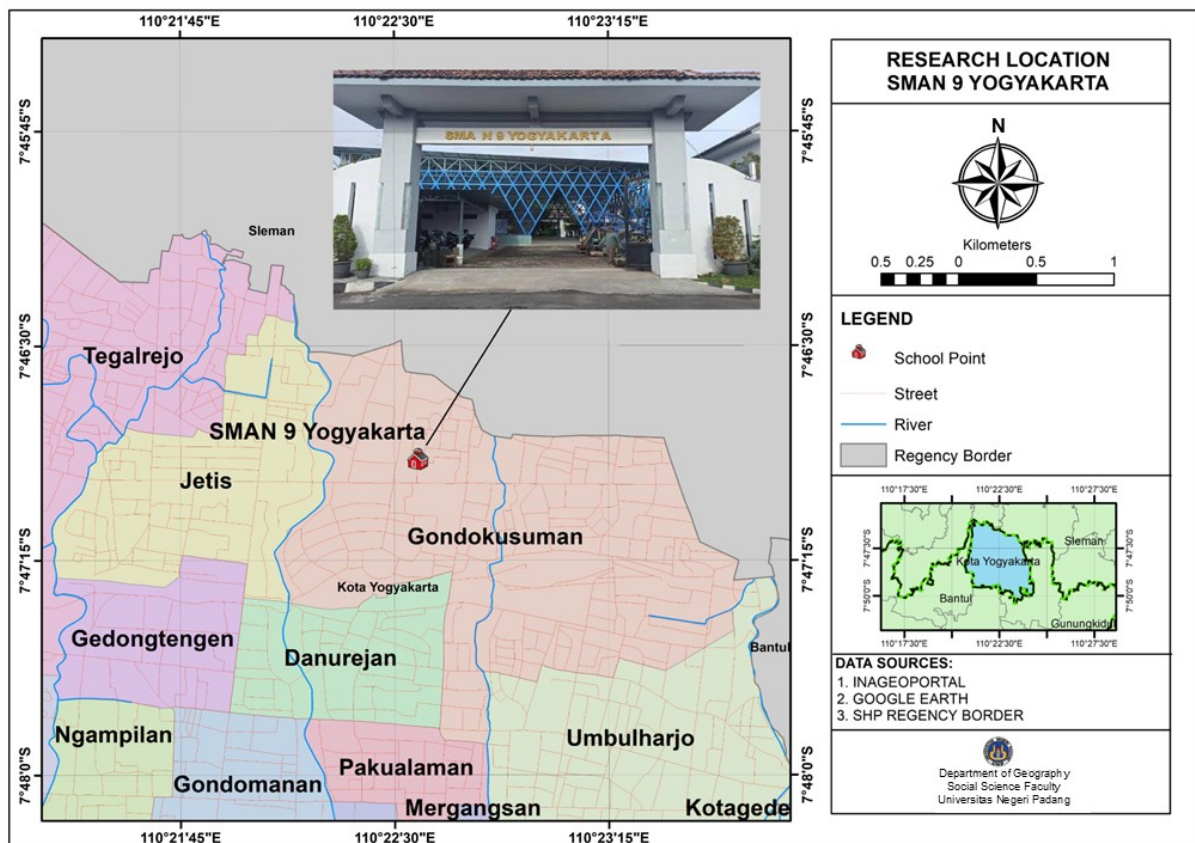


Figure 2. Research Location Map

Figure 2 shows the location of SMAN 9 Yogyakarta in Gondokusuman District, Yogyakarta City. The school carries the branding “The Art and Culture School of Jogja,” which reflects its emphasis on character development and social culture rooted in the special values and traditions of the Yogyakarta Palace. These values are integrated into the school’s vision, mission, and programs with the aim of producing graduates who are globally oriented while remaining grounded in local culture.

The unit of analysis and the sampling unit in this study were individual students. Of the total population, 178 students were selected as the study sample. The sample size was determined based on

two considerations: (1) including a large proportion of the population to strengthen representation within the school context, and (2) meeting the minimum sample size requirements for SEM-PLS analysis based on indicator and path model considerations. The sample size was determined by power analysis based on the part of the model with the largest number of predictors. This study included four variables: one endogenous variable and three exogenous variables. Based on the power analysis for SEM-PLS, the minimum sample size for this study was 77 respondents (Hair & Alamer, 2022; Hair et al., 2017).

A proportionate stratified random sampling technique was applied based on tenth-grade class groupings. Each class group was treated as a stratum to ensure proportional representation. The sampling procedure involved compiling a complete list of students, grouping them by class, determining the proportional sample size for each group, and randomly selecting respondents within each stratum. This approach was used to minimize sampling bias related to differences in learning conditions across classes.

2.3 Data Collection Technique

Data were collected using a structured questionnaire distributed to tenth-grade students at SMAN 9 Yogyakarta. The questionnaire was developed based on research constructs, namely culture-based school programs, students' attitudes, students' engagement in school activities, and spatial-cultural literacy. Each construct was measured using several indicators derived from theoretical considerations and adapted to the context of Javanese culture in geography learning.

The questionnaire was constructed based on 13 indicators derived from the study variables to ensure that the required research information was adequately captured. The indicators are summarized in Table 1. The questionnaire employed a five-point Likert scale ranging from strongly disagree to strongly agree to allow quantitative measurement of students' perceptions and experiences. The instrument was administered using Google Forms.

Table 1. Questionnaire Indicators

Variable	Indicators
Culture-Based School Program	Context (Culture-Based School Program Objective) Input (Culture-Based School Program Plan) Process (Culture-Based School Program Implementation) Product (Culture-Based School Program Output)
Students' Attitudes	Cognitive Affective Conative
Students' Engagement	Cognitive Engagement Behavioral Engagement Emotional Engagement
Spatial-Cultural Literacy	Spatial Habits of Mind (Describing a place, using spatial aids) Spatial Concept & Thinking Skills (Spatial Concept – Spatial Distribution, Spatial Thinking) Spatial Critical Thinking (Critical Spatial Thinking)

Sources: (Fredricks et al., 2004, 2016; Kim and Bednarz, 2013; Liday, 2025; Stufflebeam, 2003)

The questionnaire data were collected from the main study respondents and subsequently analyzed using SEM-PLS. The same dataset was used to evaluate the measurement model (validity and reliability of indicators) and the structural model (structural relationships among constructs), as SEM-PLS integrates both stages within a single analytical framework.

2.4 Data Analysis

Data analysis in this study was conducted using SEM-PLS to evaluate the structural relationships between culture-based school programs, students' cultural attitudes, students' engagement, and spatial-cultural literacy. The analysis followed two main procedures, namely the evaluation of the measurement model (outer model) and the evaluation of the structural model (inner model). This approach was selected because the study emphasized prediction, involved multidimensional latent constructs, and required analytical flexibility with a moderate sample size.

In the outer model evaluation stage, the analysis focused on assessing the quality of indicators forming each latent construct. The evaluation was conducted using several criteria, including: (1) convergent validity, assessed through factor loading values and Average Variance Extracted (AVE); (2) discriminant validity, evaluated using the Fornell-Larcker criterion and the Heterotrait-Monotrait Ratio (HTMT); and (3) construct reliability, assessed through Cronbach's Alpha and Composite Reliability values. Indicators with factor loadings below 0.50 were considered for removal, while an AVE value of at least 0.50 was used as a construct-level criterion for convergent validity.

Subsequently, the inner model analysis was conducted to assess the strength and significance of the relationships among latent constructs. Path coefficient testing was performed using a bootstrapping procedure to obtain statistical significance values. Model adequacy was evaluated by examining R^2 and Q^2 values. The R^2 value was used to assess the predictive contribution of exogenous variables to spatial-cultural literacy, while the Q^2 value was used to confirm the predictive relevance of the model. SEM-PLS modeling in this study was conducted using SmartPLS 3.0 software to estimate both the measurement (outer) model and the structural (inner) model based on the predefined path model.

Overall, the SEM-PLS procedure enabled the identification of the relative contributions of culture-based school programs, students' cultural attitudes, and students' engagement in explaining the variance in spatial-cultural literacy. This approach strengthened the empirical basis of the conceptual model and provided a systematic framework for interpreting the relationships among the research variables.

2.4.1 Evaluation of the Measurement Model (Outer Model)

The evaluation of the measurement model (outer model) was conducted to assess the indicators associated with each research variable. In this study, all indicators were reflective. The evaluation aimed to determine whether the indicators met the requirements of construct validity and reliability. The outer model of this study is illustrated in Figure 3. As shown in Figure 3, factor loadings were evaluated against a threshold of 0.50. In the first iteration, the loading factor for LSB3 was below 0.50, so the indicator was removed from the outer model. After the second iteration, all remaining indicators had factor loadings above 0.50 and therefore met the loading criterion.

After evaluating indicator reliability, the next step was to assess discriminant validity, convergent validity, and composite reliability. Convergent validity was evaluated using the Average Variance Extracted (AVE) value, with AVE values > 0.50 indicating adequate convergent validity.

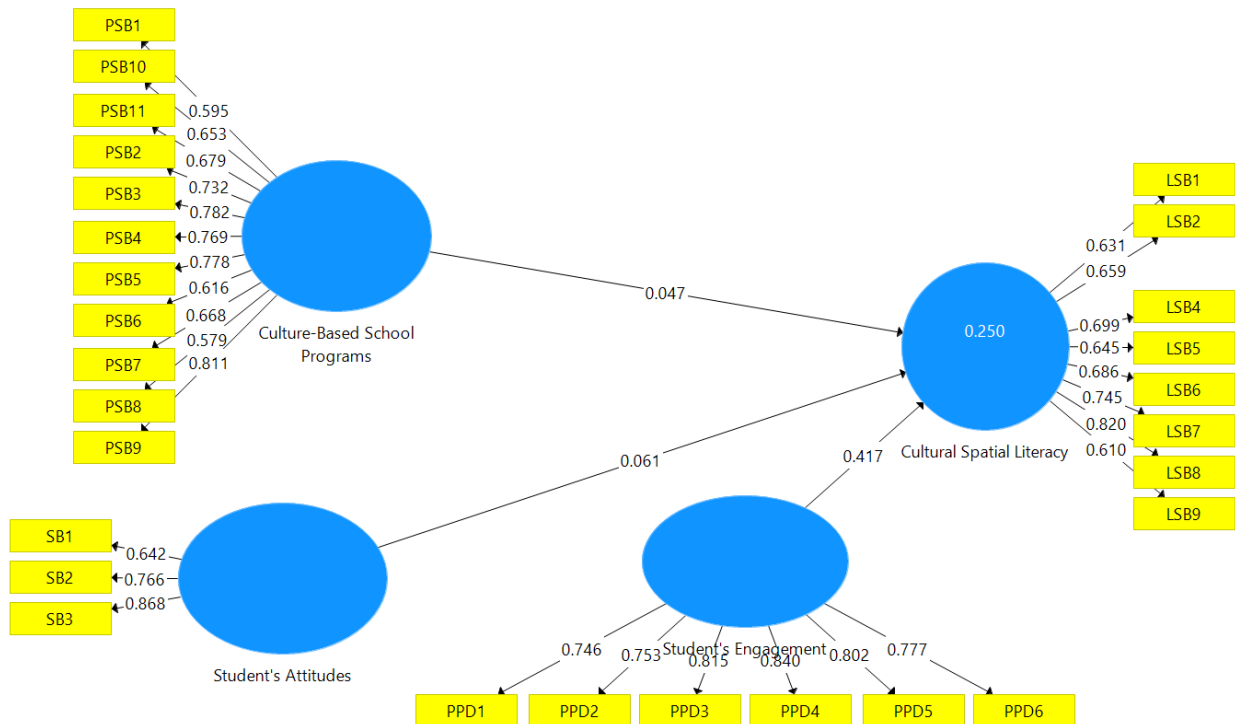


Figure 3. Outer Model

Table 2. AVE Value

Variables	Average Variance Extracted (AVE)
Culture-Based School Program	0.491
Students' Attitudes	0.585
Students' Engagement	0.623
Spatial-Cultural Literacy	0.444

Based on Table 2, the AVE values for the Students' Attitudes and Students' Engagement constructs were 0.585 and 0.623, respectively, and therefore exceeded the conventional 0.50 criterion. In contrast, the AVE values for the Culture-Based School Program (0.491) and Spatial-Cultural Literacy (0.444) were below 0.50. Thus, convergent validity was not fully established for these two constructs under the conventional AVE criterion (Hair et al., 2017). The constructs were nevertheless retained to preserve the pre-specified theoretical model after all remaining indicators met the study's factor-loading criterion and composite reliability exceeded 0.70. This retention should not be interpreted as evidence that the AVE criterion was satisfied; rather, the sub-threshold AVE values are acknowledged as a measurement limitation, and structural relationships involving these constructs should be interpreted cautiously. Discriminant validity was subsequently examined using the Fornell-Larcker criterion and the Heterotrait-Monotrait Ratio (HTMT).

Table 3. Fornell-Larcker criterion

	Culture-Based School Program	Spatial-Cultural Literacy	Students' Engagement	Students' Attitudes
Culture-Based School Program	0.701			
Spatial-Cultural Literacy	0.428	0.690		
Students' Engagement	0.814	0.496	0.789	
Students' Attitudes	0.701	0.377	0.679	0.764

Table 3 presents the Fornell-Larcker criterion using correlations among constructs. Under this criterion, discriminant validity is supported when the square root of each construct's AVE exceeds its correlations with other constructs (Rasoolimanesh, 2022). The criterion was not fully satisfied in this study. For Students' Engagement, the correlation with the Culture-Based School Program (0.814) exceeded the square root of the Students' Engagement AVE (0.789), indicating insufficient empirical separation between these two constructs under the Fornell-Larcker criterion. The remaining construct comparisons satisfied this criterion. Because discriminant validity should not be inferred from a single diagnostic, HTMT was also examined.

Table 4. Heterotrait-Monotrait Ratio

	Culture-Based School Program	Spatial-Cultural Literacy	Students' Engagement	Students' Attitudes
Culture-Based School Program				
Spatial-Cultural Literacy	0.465			
Students' Engagement	0.930	0.550		
Students' Attitudes	0.895	0.468	0.865	

Table 4 presents the HTMT values used to assess discriminant validity. This study adopted 0.90 as the primary decision threshold, while 0.85 was treated as a more conservative benchmark because the constructs are conceptually related (Rasoolimanesh, 2022). Accordingly, HTMT values below 0.90 were interpreted as supporting discriminant validity, whereas values at or above 0.90 were treated as evidence of a discriminant-validity concern.

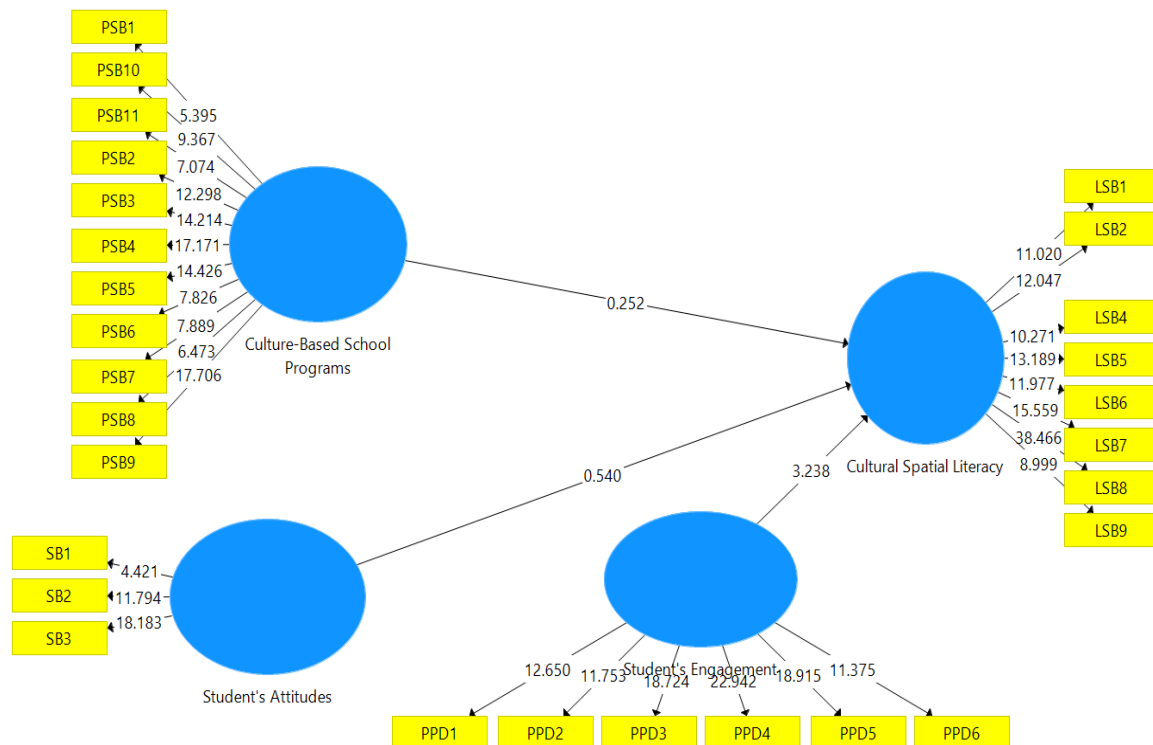
Table 5. Composite Reliability

Variables	Cronbach's Alpha	rho_A	Composite Reliability
Culture-Based School Program	0.896	0.915	0.913
Spatial-Cultural Literacy	0.661	0.736	0.806
Students' Engagement	0.880	0.892	0.908
Students' Attitudes	0.840	0.885	0.876

Based on Table 4, the HTMT value between Students' Engagement and the Culture-Based School Program (0.930) exceeded the adopted 0.90 threshold, indicating that discriminant validity was not fully established between these constructs. The HTMT value between Students' Attitudes and the Culture-Based School Program (0.895) remained below 0.90 but was close to the threshold and exceeded the more conservative 0.85 benchmark. Considered together with the Fornell-Larcker result, these findings indicate substantial overlap particularly between the Culture-Based School Program and Students' Engagement constructs. Structural paths involving these constructs should therefore be interpreted cautiously. Composite reliability was evaluated separately as an indicator of internal consistency. Variables were considered to have adequate internal consistency if their composite reliability values exceeded 0.70. As shown in Table 5, all research variables had composite reliability values above 0.70. Cronbach's alpha and rho_A values also exceeded 0.70; therefore, the constructs demonstrated adequate internal consistency, although this does not substitute for convergent or discriminant validity.

2.4.2 Evaluation of the Structural Model (Inner Model)

After evaluating the measurement model, the next step was to examine the relationships within the structural model (inner model). The results of the path model in the structural model are presented in Figure 4.

**Figure 4.** Inner Model

The inner model evaluation focused on several aspects, including the coefficient of determination (R^2), effect size (f^2), predictive relevance (Q^2), and hypothesis testing, to assess the overall quality of the model.

The R^2 value was used to determine the proportion of variance in the endogenous variable that can be explained by the exogenous variables included in the model.

Table 6. R^2 R^2 Value

	R-Square	R-Square Adjusted
Spatial-Cultural Literacy	0.246	0.232

Based on Table 6, the R^2 value for the model is 0.246, or 24.6%. This indicates that 24.6% of the variance in spatial-cultural literacy can be explained by the variables included in the model, while the remaining 75.4% was not explained by the model. The three exogenous variables—Students' Attitudes, Students' Engagement, and the Culture-Based School Program—jointly explain 24.6% of the variance in Spatial-Cultural Literacy. The relative contributions of these variables can be examined through the effect sizes.

Effect size (f^2) was used to measure the magnitude of the effect of each exogenous latent variable on the endogenous variable included in the model. The criteria used to interpret effect size values were 0.02 (small effect), 0.15 (medium effect), and 0.35 (large effect) (Elvarina & Murhadi, 2023).

Table 7. f^2 f^2 Value

Variables	Spatial-Cultural Literacy
Culture-Based School Program	0.001
Students' Attitudes	0.002
Students' Engagement	0.074

Based on Table 7, the Culture-Based School Program and Students' Attitudes constructs have effect size values below 0.02, indicating effects below the conventional small-effect threshold. The Students' Engagement construct has an effect size value of 0.074. Although this value is still categorized as a small effect, it represents the largest contribution among the exogenous variables in explaining the variance of spatial-cultural literacy. Among the predictors, Students' Engagement made the largest contribution to the model.

The Q^2 value was used to assess the predictive relevance of the model. A model is considered to have good predictive relevance if the Q^2 value is greater than 0 (Febriani et al., 2022). The Q^2 value for the research model is reported below.

$$Q^2 = 1 - (1 - R_1^2) \\ = 1 - (1 - 0.232) = 0.232$$

The Q^2 value obtained in this study is 0.232, which is > 0 . Therefore, it can be concluded that the model has adequate predictive relevance, indicating that the model has predictive relevance for Spatial-Cultural Literacy in this study context.

Structural model evaluation also involved hypothesis testing to examine the structural relationships between the exogenous variables and the endogenous variable. Hypothesis testing was conducted by comparing the p-values obtained from the bootstrapping procedure with a significance level (α) of 5% (0.05). A structural relationship was considered statistically significant when its p-value was lower than the significance level (α).

Table 8. Hypothesis Test

	Original Sample	Standard Deviation	t Statistic	p-Value	Confidence Interval 2.5%	Confidence Interval 97.5%
Culture-Based School Program → Spatial-Cultural Literacy	0.047	0.185	0.252	0.801	-0.363	0.404
Students' Engagement → Spatial-Cultural Literacy	0.417	0.120	3.476	0.001	0.187	0.650
Students' Attitudes → Spatial- Cultural Literacy	0.061	0.109	0.561	0.575	-0.129	0.288

Based on [Table 8](#), the relationship between the Culture-Based School Program and Spatial-Cultural Literacy had a p-value of 0.801. Because this value exceeded the significance level (α) of 0.05, the relationship was not statistically significant; therefore, H1 was not supported. The relationship between Students' Engagement and Spatial-Cultural Literacy had a p-value of 0.001. Because this value was below 0.05, Students' Engagement was significantly and positively associated with Spatial-Cultural Literacy; therefore, H2 was supported. The relationship between Students' Attitudes and Spatial-Cultural Literacy had a p-value of 0.575, which exceeded 0.05; therefore, H3 was not supported.

3. Results and Discussion

3.1 Geography Education, Spatial Literacy, and the Internalization of Cultural Values

Geography commonly approaches problems or phenomena from three main perspectives: spatial, environmental, and regional complexity. When schools aim to instill local cultural values in students, attention should be given to the spatial context in which students and communities live. Culture develops and is practiced within society as a result of continuous interactions between physical and social environments, which are formed through repeated daily practices ([Litaay et al., 2025](#); [Mulyadi et al., 2025](#); [Prihadi & Wibowo, 2025](#)). Based on this perspective, geography learning plays an important role because it directly examines the relationships between humans, space, and their surrounding environment. However, this assumption is often accepted without sufficient conceptual examination. As a result, the relationship between culture as a social construct and spatial literacy as a cognitive construct is frequently treated as a simple and direct relationship, even though it is multidimensional in nature.

In the context of Merdeka Curriculum implementation at SMAN 9 Yogyakarta, which has focused on implementing a culture-based school approach since 2012, geography has been selected as one of the subjects used to integrate the cultural values associated with the special status of Yogyakarta (Field Observation, 2025). This approach is based on the understanding that students live in Yogyakarta, a region with strong Javanese cultural traditions and special cultural values that are expected to be preserved through education. The implementation of this culture-based school program, illustrated in [Figure 5](#), has been developed using the Context, Input, Process, and Product (CIPP) evaluation model ([Stufflebeam, 2003](#); [Aziz et al., 2018](#)). These components are reflected in school uniforms, Javanese language literacy activities, arts-related extracurricular programs, and cultural performances. Nevertheless, the school's cultural development team considers that the culture-based program has not yet achieved optimal outcomes. This condition is influenced by several factors, including students' spatial experiences, patterns of social interaction, pedagogical quality, learning motivation, and the authenticity of cultural representation within the curriculum ([Filgona et al., 2020](#); [Hu et al., 2026](#); [Lo et al., 2022](#)). Students' regional background, parental background, previous junior secondary school, and physical and social environments also shape their spatial knowledge and the internalization of local cultural values. Therefore, this study is relevant because it encourages a more critical examination of how culture is integrated into geography learning and challenges perspectives that overlook the spatial dimensions of cultural education.



Figure 5. From left to right: school vision, mission, and motto; Javanese language program every Thursday; and the use of Yogyakarta batik on Thursday Pahing (Java Calendar System)

Sources: authors' documentation, 2025

Within this context, spatial-cultural literacy is not limited to the ability to read maps, symbols, or spatial representations. It also involves a reflective understanding of how culture shapes individuals' perceptions of space and how space, in turn, influences cultural practices. In a culture-based school environment, students not only learn about culture as informational knowledge but also experience it through daily practices, engagement in school activities, and value-laden social interactions (Grevle, 2025; Harefa, 2024; Wang et al., 2026). This perspective indicates that students' engagement is not merely a supporting activity, but an integral component in shaping students' cognitive structures, behavioral patterns, and learning motivation related to spatial-cultural literacy (Endres et al., 2024; Fredricks et al., 2016).

From another perspective, culture-based school programs have generally emphasized the preservation of traditional values, while the capacity of local culture to interact with developments in modern geospatial technology has not been fully explored. At the time this study was conducted, the educational community at SMAN 9 Yogyakarta had begun to integrate new perspectives by linking culture-based education with techno-geospatial competencies. One example of this integration is the school podcast that discusses educational issues, cultural topics, and contemporary trends using the Javanese language and incorporating local values. This practice demonstrates that culture and technology are not opposing entities, but can complement each other in strengthening students' spatial literacy skills in the digital era (González et al., 2019; Jo & Hong, 2018; Solari et al., 2015).

By applying SEM-PLS analysis, this study examines these relationship pathways more critically, allowing examination of whether cultural factors are associated with cognitive abilities, affective aspects, or a combination of both in the development of spatial-cultural literacy. From a theoretical perspective, the findings point to place identity as a potentially relevant construct for future research examining how local cultural values may relate to geospatial reasoning abilities (Helfenbein, 2021; Marvell & Simm, 2016; Rubáš et al., 2024). Place identity was not included as a construct in the present SEM-PLS model and is therefore discussed only as a conceptual implication. The analysis shows that the Culture-Based School Program is not significantly associated with students' spatial-cultural literacy (p -value > 0.05). This finding suggests that the program has not yet been fully internalized by students. It is also important to note that the respondents were tenth-grade students who had only been exposed to the program for approximately six months (one semester) through geography learning. Given the variation in students' backgrounds and personal characteristics, the extent to which the Culture-Based School Program is understood and internalized is likely to differ across individuals.

The findings also show that students' attitudes are not significantly associated with spatial-cultural literacy (p -value > 0.05). One possible explanation is that, at the level of attitude, students may already believe that spatial-cultural values are important and should be reflected in daily practices. However, the relationship between attitudes and spatial ability does not necessarily operate through a direct pathway. Positive attitudes toward local culture may primarily strengthen students' attachment to their living environment and reinforce place identity. It remains important to examine whether such attachment translates into students' capacity to analytically interpret geospatial phenomena, or whether it more strongly shapes affective outcomes such as environmental concern (Dewantara, 2023; Xu & Han, 2019).

Meanwhile, students' engagement is significantly associated with spatial-cultural literacy (p -value < 0.05). This result is supported by the range of extracurricular activities and geography learning

experiences that encourage active student engagement. Through these activities, students gain direct interaction and firsthand experiences with cultural practices rooted in local wisdom. Importantly, the internalization of these values is not incidental; it is facilitated through teachers' guidance and pedagogical support throughout the learning process. At SMAN 9 Yogyakarta, students are required to choose extracurricular activities, such as theater, dance, or *karawitan* (traditional music), and other activities that are not directly related to cultural preservation. However, based on field observations, students generally believe that Javanese culture should be preserved, particularly among Javanese students living in Yogyakarta, who are expected to be familiar with the cultural values of the Special Region of Yogyakarta. From a spatial perspective, this reflects students' awareness that cultural values and identity are closely connected to the places in which they live and interact. From an empirical perspective, the findings suggest that engagement is more closely associated with spatial-cultural literacy than the culture-based school program or students' attitudes alone. Therefore, this study not only addresses gaps in culture-based geography learning research but also presents a conceptual model relevant to the development of culture-based school programs and culturally responsive curricula oriented toward strengthening spatial-cultural literacy.

Therefore, the implementation of culture-based school programs and the Merdeka Curriculum, which emphasize contextual learning, still lacks evaluation instruments that specifically measure associations involving affective integration and other relevant cultural factors. By positioning spatial-cultural literacy as an empirically measurable indicator within geography learning, this study provides an evaluative basis for schools and policymakers to assess the effectiveness of culture-based school programs more objectively. These findings contribute to discussions on how geography education can develop learning models that are responsive to local cultural contexts while remaining adaptive to students' developmental needs. Such models enable students to apply local cultural wisdom when interacting with physical and social environments, supporting exploratory spatial experiences that foster comprehensive spatial understanding (Amalia & Nursaban, 2023; Mulyadi et al., 2025; Ray, 2009). Future work should develop learning approaches that integrate cultural values, direct experience, and geospatial technology in a more cohesive manner.

3.2 The Importance of Spatial-Cultural Literacy for Spatial Citizenship

From another analytical perspective, geography learning and students' experiences with physical and social environments can contribute to the development of spatial citizenship, particularly when learning connects spatial reasoning with participatory and place-based experiences (Schulze & Kanwischer, 2018). Spatial-cultural literacy can play an important role in fostering spatial citizenship, particularly when space is understood not only as a geographic entity but also as a social construct shaped by values, practices, and cultural experiences (Kim & Bednarz, 2013). This approach leads to a more reflective and multidimensional understanding of space, which is an important foundation for the formation of spatially literate citizens. In Yogyakarta cultural discourse, this idea is reflected in the expression "Mangasah Mingising Budi, Memasuh Malaning Bumi," which may be understood as "sharpening the acuity of the mind and cleansing the earth of calamity." In this context, the expression emphasizes the development and responsible use of knowledge alongside care for the social and physical environment.



Figure 6. From left to right: Javanese philosophy, students wearing batik, and the philosophy of Kawung batik. **Sources:** author's documentation, 2025

Figure 6 presents research findings related to students' engagement in activities oriented toward the preservation of cultural values, such as understanding the meaning of batik and wearing batik as part of school practices. These forms of participation are related to students' spatial-cultural literacy. Such involvement strengthens students' attachment to their learning environment, builds a sense of place, and supports their ability to interpret spatial dynamics from a socio-cultural perspective. In this context, spatial-cultural literacy functions not only as an interpretative skill but also as a reflective tool for understanding how space is negotiated and given meaning by different social groups (Dameria et al., 2020; Kamruzzaman et al., 2025; Marvell & Simm, 2016).

This relationship indicates that students with spatial-cultural competencies have greater potential to become spatial citizens who are able to use geospatial information critically, ethically, and appropriately in spatial decision-making processes. Strong spatial-cultural literacy enables students to engage in public discussions related to spatial planning, sustainability, and environmental protection, while also shaping awareness of the social consequences of spatial actions (Idrees et al., 2018; Setyo et al., 2021; Susetyo et al., 2022). Therefore, this study highlights the importance of integrating cultural values into the geography curriculum as a strategy to develop a generation that is spatially literate and socially responsible toward the spaces in which they live.

4. Conclusion

This study indicates that students' spatial-cultural literacy is associated with multiple factors. Among the variables examined, Students' Engagement showed a significant positive relationship with Spatial-Cultural Literacy, whereas the Culture-Based School Program and Students' Attitudes did not show significant direct associations. The SEM-PLS results suggest that integrating cultural values into geography learning and school programs may be insufficient to strengthen spatial-cultural literacy without active student engagement in classroom and school activities. From a theoretical perspective, these findings highlight the potential relevance of place identity as a construct for future research on the connection between cultural contexts and geospatial competencies; place identity was not directly tested in the present model. From a practical perspective, this study provides reflection and adaptive input for schools and educators in designing geography learning that integrates spatial understanding and cultural values in a locally responsive manner, aligned with the Merdeka Curriculum, and oriented toward strengthening students' spatial-cultural literacy. Overall, this study contributes to bridging the conceptual gap between school programs, geography learning, and students' engagement within culture-based geography education. It also offers strategic implications for the development of pedagogical practices that integrate cultural heritage, spatial reasoning, and character formation to support the development of competent spatial citizenship. The internalization of spatial-cultural literacy within a culture-based school setting needs to be strengthened so that it can more effectively support the program's vision and mission. More broadly, this type of program has value not only for preserving local culture and enhancing students' spatial understanding but also for nurturing individuals with strong spatial competence. From a practical standpoint, geography learning offers a solid foundation for evaluating culture-based school initiatives, because students' interactions with their social and physical environments through spatial, environmental, and regional complexity perspectives can be treated as meaningful learning experiences. Within this process, geography teachers hold a central role in guiding students to interpret these experiences, translate cultural values into spatial understanding, and refine their spatial thinking through well-designed learning activities.

5. Acknowledgments

This study was supported by a fieldwork team comprising Geography Department students, namely Senda Monica, Aisyah Putri, Fitria Nadela Putri, Gadis Renatul Faula, Margareta Henni Purwanti, Maryanti, Muhammad Al Rasyid, Shelvi Oktavia Dwi Putri, Yastika Sari, and Yohana Sinabang. The study was conducted as part of the thematic fieldwork program of the Geography Education Study Program in 2025 in Yogyakarta. The research was also supported through research permits from the Department of Research and Community Service (LPPM) of Universitas Negeri Padang, SMA Negeri 9 Padang, and SMA Negeri 9 Yogyakarta. Funding and cost-sharing support were provided by the Department of Geography, Faculty of Social Sciences, Universitas Negeri Padang.

Funding. This study received no external funding.

Conflict of interest. The authors declare no conflicts of interest related to this publication.

Data availability. The data used in this manuscript are available from the corresponding author upon reasonable request.

AI Use Declaration. The authors used OpenAI's ChatGPT-5.4 for research review, language editing, and outlining assistance. The authors reviewed and edited all AI-assisted output and are fully responsible for its content and any errors.

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