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Integrating Local Wisdom and Technology to Foster Language Competence: A Study on Sasirangan-Based Learning in High Schools

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Abstract
A wide range of strategies in English language teaching has been undertaken, such as the integration of local wisdom. This study aims at exploring the interrelationships between environmental literacy, critical thinking and problem solving, and technology integration within local-wisdom-based English language learning. Six constructs were generated, including Environmental System Interaction, Critical Thinking and Problem-Solving, Value and Pro-Environmental Behavior, Sasirangan

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Value Integration, Technology Integration, and Learning Competence. This study employed a quantitative cross-sectional design. The researchers distributed a 5-point Likert scale questionnaire using Google Forms to 748 senior high school students in South Borneo. The data was analyzed by using partial least squares structural equation modeling version 4. The statistical results supported seven proposed hypotheses, but two hypotheses are not significantly different. The findings indicate that Sasirangan value integration is beneficial towards language competence, and other variables such as critical thinking and problem-solving and pro-environmental behavior provide a substantial influence on technology integration and Sasirangan value integration. The significance of the cultural contextualization of language learning shows that local wisdom is a noteworthy approach to enabling the students to be increasingly engaged, increasingly cultural, and even more likely to enhance their learning experience.

KEYWORDS
Integration, Language Competence, Local Wisdom, Sasirangan, Technology

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Introduction

Digitizing education has its merits and hurdles for the system, and this is applicable to every stakeholder in the education system. The school system should be adequately planned and connected; trained teachers should learn how to introduce the innovation within a short period of time, and motivated students should learn in an experiential way (Flecther et al., 2020; Islam et al., 2024). A number of countries, such as Finland, Singapore, and Norway, externalized the trend to an increasingly digitalized educational framework not only internally but also in the overall course of the globalization of the educational system and the enhancement of the global testing framework, such as PISA (McCarthy, 2023). This transformation requires not only IT skills but also pedagogical innovation to ensure that technology enhances, rather than solely digitizes, the learning experience (Asmayawati et al., 2024; Flecther et al., 2020). It also presents personalized learning.

In Indonesia, the integration of local wisdom into education has emerged as a novel pedagogical approach to enhance the relevance of learning to local contexts and cultures. Local wisdom, as collective knowledge, beliefs, and practices, presents a promising link for such promotion because it reflects community-based knowledge, sustainable practices, and cultural identity (Darmadi, 2018; Fuad et al., 2024; Mulyanah et al., 2025; Ramdiah et al., 2020; Sapta et al., 2025). Among many traditional clothes in Indonesia, Sasirangan, the traditional dyed cloth of South Borneo, is not only widely worn by students from kindergarten to senior high schools, teachers, lecturers, bankers, and other employees in South Borneo as a common uniform every Thursday but also a symbol of harmony with nature and creativity through patterns and colors (Ekawati et al., 2019; Permatasari et al., 2025; Ramdiah et al., 2024).

Sasirangan has been utilized in science, social studies, and mathematics to teach natural dyes, trade history, and geometric patterns. However, its potential as a contextual learning medium in English language classrooms in senior high schools—especially when combined with digital technologies—remains underexplored. This represents a missed opportunity to promote contextualized, culturally grounded language learning and to engage students through authentic materials that connect language, environment, and identity. It investigates the integration of Sasirangan-based local wisdom with technology-enhanced English learning in senior high schools. It examines how environmental system interaction (ESI), critical thinking and problem-solving (CTPS), value and pro-environmental behavior (VPB), and technology integration (TI) interact to foster Sasirangan value integration (SVI) and ultimately improve students' language competence (LC).

The researchers, in this study, investigated senior high school students' perspectives on the integration of Sasirangan cloth in English learning with technology used. They tried to establish how the environmental system interaction, students' critical thinking and problem-solving skills, and value of pro-environmental behavior can be used to assess technology integration and Sasirangan value integration and then predict students' English competence. By doing so, the study contributes to the development of a culturally responsive, technology-supported learning model that prepares students for both local and global challenges. The model is expected to help students to think critically using the learning materials surrounding them and to help teachers understand how to manage their classrooms in creating eco-English to raise students' critical thinking skills, environmental care, and language competence.

Literature Review

Local Wisdom Integration in English Language Teaching

Incorporating local wisdom in education is crucial because it can help preserve cultural heritage, foster educational practices relevant to indigenous knowledge and traditions; and create more contextual learning for students (Hanapi et al., 2025; Mulyanah et al., 2025). Contextualizing learning within students' socio-cultural realities can motivate deeper engagement and improve long-term retention of knowledge. Students can easily construct and understand the concepts, as the topics are relevant and relatable to their lives and draw on their experiences and social activities around them (Tutal, 2023). The link between learning and students' realities brings connection, and it contributes to long-term understanding (Lim et al., 2025; Tutal, 2023).

Integrating local wisdom in language teaching materials and methods has been shown to improve various learning outcomes, including language proficiency, engagement, motivation, and self-directed learning (Sukmawati et al., 2025). When contextual scaffolding and meaningful cultural content are combined with interactive technology tools, such as augmented reality-based interactive e-books featuring local wisdom, the learning process not only becomes more appealing and enjoyable but also can significantly improve students' learning outcomes (Isnaniah et al., 2025; Saputri & Rohiyatussakinah, 2019; Schorr et al., 2024). Moreover, integrating local wisdom, such as Surabaya Zoo, Semanggi, and *Maulud Nabi*, when developing teaching materials of data presentation using local wisdom for preservice teachers can empower preservice teachers' skills in data presentation and cultural understanding (Lutfianto et al., 2020).

In the South Borneo context, research on integrating local wisdom and technology has been conducted by Isnaniah et al. (2025). Instead of relying on general local wisdom, they developed an augmented-reality e-book, Learning English with South Borneo Culture, which features traditional houses, Bubungan Tinggi, river life, floating markets, and local foods such as Soto Banjar. The results of this study showed that technology demonstrated differential effectiveness across student ability levels, with moderate students benefiting most from the culturally embedded content. It improved elementary students' English vocabulary acquisition and contextual use.

Sasirangan cloth, a form of local wisdom in South Borneo that is not well studied, is a cultural heritage and a regional flagship product. It has great potential as a contextual learning resource (Ramdiah et al., 2024; Wahyu, 2021). This aligns with constructivist and experiential learning theories, which emphasize that knowledge is co-constructed through interaction with authentic materials (Holmes, 2019). Thus, Sasirangan is expected to stimulate students' curiosity, prompt critical reflection on cultural and environmental issues, and encourage active use of language. Previous studies have examined Sasirangan as a learning medium for subjects such as biology, chemistry, and social studies (Permatasari et al., 2025; Ramdiah et al., 2024). However, its role in English language learning—especially when supported by digital technologies—has been largely unexplored. This gap is significant given that technology-enhanced cultural learning can simultaneously develop language competence, cultural appreciation, and critical thinking.

Additionally, contemporary research has shown that local wisdom helps strengthen linguistic competence, learning engagement, motivation, cultural cross-awareness, and the preservation of cultural identity in language learning. Nevertheless, most research focuses on positioning local wisdom as a pedagogical context that stands alone yet is explicitly linked to environmental competencies (Darmadi, 2018; Fadli & Irwanto, 2020; Fuad et al., 2024). Relating local wisdom and environmental competence is crucial because traditional cultural practices reflect ecological systems and sustainable values that can be examined and integrated pedagogically when students understand environmental systems, demonstrate critical thinking, and practice pro-environmental behavior oriented toward environmental agency (OECD, 2023). Thus, this study proposes to examine the relationship among local wisdom, Sasirangan, and environmental competencies to determine their influence on students' language development.

Technology Used in English Language Learning
The transformation of education accelerated significantly following the Covid-19 pandemic, introducing numerous digital tools and platforms that support English language learning, including GenAI for L2 writing (Darvin, 2025), digital flashcards (Akmal & Nurjanah, 2024; Zarrati et al., 2024), e-modules (Amelia et al., 2024), and AI-powered applications such as ChatGPT (Mutammimah et al., 2024). Technology has also been found to improve personalization and increase the availability of original input to students, as well as enhance collaborative learning (Kovari, 2025; Tabasi et al., 2024). One promising technology that holds great promise for enhancing language teaching and learning is augmented reality, or AR.

Existing literature shows that AR has significant potential to improve vocabulary retention and comprehension. Through interactive, immersive features in AR applications, students can expand their vocabulary, get a better understanding and practical application, and make their learning more engaging and effective (Kholodniak, 2025; Marrahi-Gomez & Belda-Medina, 2024; Peres-Jorge et al., 2025). Furthermore, AR not only provides interactivity but also gives realistic language practice environments that are effective for improving speaking and writing skills (Kurniawan et al., 2024). Learning with AR was reported to improve students' engagement and performance and reduce their cognitive load by providing visual and interactive aids that simplify complex concepts, making it easier for them to understand and retain information (Vijayakumar et al., 2025). Additionally, personalized learning through AR caters to individual students' needs, enhances their learning outcomes, and boosts their motivation and engagement. Its interactive nature makes learning more enjoyable and increases students' willingness to participate and learn (Di Fuccio et al., 2024; Sreelakshmi et al., 2026).

Despite its effectiveness, adopting AR in the classroom requires addressing challenges. To be effective, integration of AR in language education requires proper teacher training. Teachers need to be qualified and equipped with the skills to use AR technology and integrate it into their teaching practices (Amalia & Rizal, 2025; Marrahi-Gomez & Belda-Medina, 2024). When deciding to integrate AR, high development costs, technical challenges, and the need for adequate infrastructure are high barriers to its widespread adoption in education (Amalia & Rizal, 2025; Kojic et al., 2025).

However, successful AR integration in language teaching does not depend solely on the presence of digital devices; it also depends on teachers' and students' cognitive readiness and affective factors, particularly critical thinking skills, contextual awareness, and a meaning-oriented approach. Those factors will determine whether technology can be used effectively and whether it results in significant development of language competencies (Sukmawati et al., 2025). Much research on technology integration in ELT focuses on the effectiveness of specific media or applications without considering conceptual factors, such as environmental competencies, that enable meaningful use.

Whereas, in sustainable education, the integration of technology should be a medium for reflection, exploration, and decision-making for real problems, not just become information media (Alharbi, 2026; Dhanyamol & Senthunarayanan, 2025; Schorr et al., 2024).

Although technology integration in language teaching has been shown to improve students' motivation, engagement, linguistic performance, and learning outcomes, there is a theoretical gap regarding factors that enable technology to be used reflectively, meaningfully, and contextually. In the context of sustainable education, this study seeks to fill this gap by providing a conceptual approach that positions environmental competencies as driving factors for meaningful technology integration, thereby explaining the correlation among technology, local wisdom, and language competencies comprehensively.

Environmental Competencies and their Impact in Education

Environmental competencies refer to knowledge, skills, attitudes, and values enabling individuals to respond to and address environmental challenges in various contexts (Araujo-Vizuete et al., 2022; Blanco et al., 2024). Because they are crucial, many educational institutions integrate these competencies to prepare and equip students for sustainable learning and to enhance their scientific literacy and environmental understanding. They include methods such as project-based learning and the use of environmental topics in curricula (Bramwell-Lalor et al., 2020; Nazarenko & Kolesnik, 2018). Environmental science competencies in the PISA 2025 science framework also emphasize students as agents of change who can address climate and complex environmental problems (Asgher et al., 2021; OECD, 2023).

This study constructs environmental competencies into three operational dimensions that represent cognitive/knowledge, reflective, and affective sustainable learning; they are environmental system interactions, critical thinking and problem-solving, and pro-environmental values and behaviors (Farooq et al., 2022; Seo et al., 2020). Environmental System Interaction (ESI) is the ability to engage with and adapt to ecological and technological environments in ways that foster sustainability and innovation. In the learning, students are expected to understand the effects of human activities on the environment and recognize local environmental issues. This competency can trigger students' awareness and exploration. Critical Thinking and Problem-Solving (CTPS) captures the capacity to analyze problems, evaluate evidence, and develop solutions in complex situations (Maryam et al., 2025). Mejia & Sargent (2023) argue that critical thinking skills can be reinforced by technology by guiding teachers to select, assess, and evaluate technology tools for their English classroom use. Value and pro-environmental behavior (VPB) that reflects students' ethical orientation and actions toward sustainability and social responsibility (Anggereini & Yelianti, 2023; Raphael & Nandanan, 2024; Seraj, 2024). Derived from this construction, it can be understood that environmental competencies can be pedagogical enablers that relate local wisdom, technology, and language competence within a sustainable educational framework.

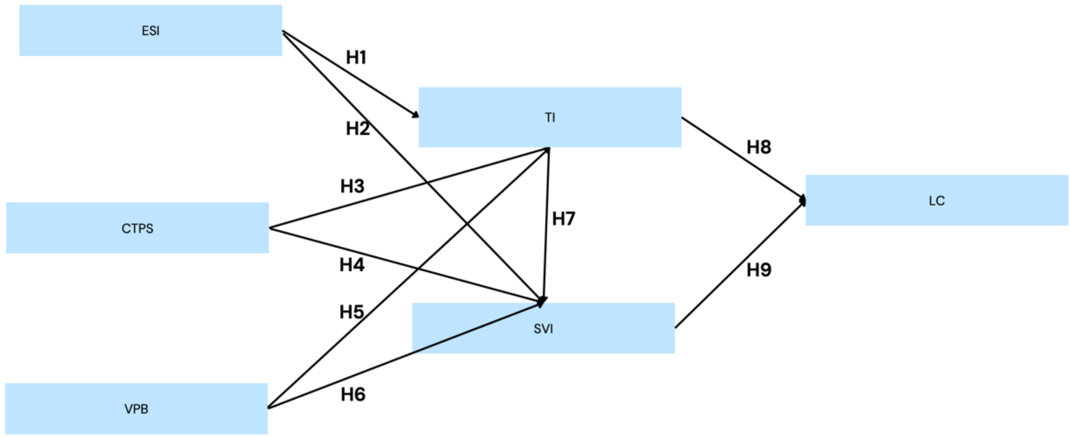
Although various studies have examined the relationship between local wisdom, technology, and language learning, there remain limitations in explaining how students' environmental competence influences the simultaneous integration of these two dimensions. This gap underscores the need for creating a conceptual model. The given current research, in its turn, analyzes a connection between environmental competencies and perception, which is one of the local wisdoms taught within Sasirangan, and the use of AR technology in reference to the learning process and mastery of the English language. It is preceded by a digital transformation that will happen after the pandemic and is responding to the rhetoric in order to make education culturally based and sustainability focused (Asgher et al., 2021; Kayanja et al., 2025; Zhang & Liu, 2023).

Conceptual Framework

This study focused on six interrelated constructs. First, Environmental System Interaction (ESI) is the students' ability to engage with and adapt to ecological and technological environments in ways that foster sustainability and innovation. In the learning, students are expected to comprehend the effect of human activities on the environment and realize the environmental issues locally. This construct can trigger students' awareness and exploration. Second, Critical Thinking and Problem-Solving (CTPS) captures the capacity to analyze problems, evaluate evidence, and develop solutions in complex situations (Maryam et al., 2025). The learning was designed to foster CTPS skills through the lessons designed by the teachers and the researchers. Then, the third is Value and Pro-environmental Behavior (VPB) that reflects students' ethical orientation and actions toward sustainability and social responsibility (Anggereini & Yelianti, 2023; Raphael & Nandanan, 2024; Seraj, 2024). These three constructs were taken from PISA environmental science competences (Eames et al., 2024; Syahmani et al., 2021).

In the framework of this study, these three constructs function as the cognitive and affective inputs. These inputs are mediated through the fourth construct, technology integration (TI), which denotes the effective adoption of digital tools to support English learning processes (Listia et al., 2022; Majitol & Yunus, 2023) and the fifth construct, Sasirangan Value Integration (SVI). In SVI, the local cultural values symbolized in Sasirangan cloth, especially in the patterns such as *naga balimbur, turun dayang, kulat kurikit, kambang kacang, and other patterns,* were included in the reading text in English learning. SVI functions to present meaningful contextualization in the classroom. Finally, the last construct that is language competence (LC) plays a role as the output shaped by critical reflection and cultural meaning-making. The proposed conceptual model of this study is illustrated in Figure 1.

Figure 1
Proposed Conceptual Model



Research Hypotheses

From Figure 1, the hypotheses proposed in this study are: ESI has a significant positive effect on TI (H1), ESI has a significant positive effect on SVI (H2), CTPS has a significant positive effect on TI (H3), CTPS has a significant positive effect on SVI (H4), VPB has a significant positive effect on TI (H5), VPB has a significant positive effect on SVI (H6), TI has a significant positive effect on SVI (H7), TI has a significant positive effect on LC (H8), and SVI has a significant positive effect on LC (H9). The independent variables are ESI, CTPS, and VPB. The mediating variables are TI and SVI; meanwhile, the dependent variable is LC.

Method

Research Design

The researchers employed the PLS-SEM, or Partial Least Squares Structural Equation Modeling. It examined the structural relationship among ESI, CTPS, VPB, TI, SVI, and LC. PLS-SEM is appropriate to predict a model and provide robust predictive power (Sarstedt et al., 2023). It is also an appropriate tool for L2 studies (Sanjaya & Anggraeni, 2026). This study is an initial study as part of a research and development study in developing an instructional medium named SasiVision, which integrated Sasirangan and augmented reality in teaching English to senior high school students in South Borneo, Indonesia. The deep learning approach is used in their curriculum with the pedagogical practices of content-based instruction, critical reading strategy, differentiated learning, guided practice, and sentence starters. English is taught 3 x 45 minutes a week. In this study, the Sasirangan is integrated into the material of argumentative and descriptive texts with the stages of pre-reading, while reading (guided practice, literal, and inferential comprehension), and post-reading. The learning outcome is to evaluate and reflect on explicit and implicit information from narrative, exposition, and discussion on current issues, both national and global, or topics related to other subjects in written or multimodal texts.

Participants

The participants of this study were 748 senior high school students in six public schools from 142 public high schools in Banjarmasin, South Borneo, Indonesia. These schools voluntarily joined the research. Two schools are located in the city, two schools in rural areas, and two schools in coastal areas. These students are in the twelfth grade with various levels from A1 to B1, aged between 16 and 19 years old. They come from various academic majors such as language, science, health, and business. The information of participants in this study, including gender, age, major, schools, technology access, internet access, social media usage, daily online/social media usage, plans to continue to higher education, parents' income, and daily language, is provided in Table 1.

Table 1

Respondent Profile (N= 748)

Question	Categories	N	%
Gender	Female	437	58.42
	Male	311	41.58
Age	16 years old	60	8.02
	17 years old	535	71.52
	18 years old	139	18.58
	19 years old	14	1.87
Major	Science	380	50.80
	Social sciences	164	21.93
	Language	23	3.07
	Business	49	6.55
	Engineering	15	2.01
	Others	117	15.64
Schools	School 1	96	12.84
	School 2	171	22.86
	School 3	39	5.21
	School 4	35	4.68
	School 5	235	31.40
	School 6	172	22.99
Technology Access	I have my own cellphone.	733	97.99
	I do not have my own cellphone.	3	0.40
	I have a laptop.	9	1.20
	I do not have a laptop.	3	0.40
Internet Access	I have internet access at school, e.g., Wi-Fi.	38	5.08
	I do not have internet access at school, e.g., Wi-Fi.	30	4.01
	I have internet access at home, e.g., Wi-Fi.	259	34.63
	I do not have internet access at home, e.g., Wi-Fi.	15	2.01
	I have internet access/data package on my phone.	406	54.28
Social Media Usage	Instagram	292	39.04
	TikTok	364	48.66
	YouTube	52	6.95
	Others	40	5.35
Daily Online/Social Media Usage	> 6 hours per day	175	23.40
	4-6 hours per day	302	40.37
	2-4 hours per day	191	25.53
	1-2 hours per day	64	8.56
	< 1 hour per day	16	2.14
Plan to Continue to Higher Education	Yes, to Diploma 3 (D3)	25	3.34
	Yes, to Diploma 4 (D4)	4	0.53
	Yes, to an undergraduate degree (S1)	395	52.81
	Yes, but later	236	31.55

	No	88	11.76
Parents' Income	< IDR 2,500,000	327	43.72
	IDR 2,500,000 - IDR 3,496,150	165	22.06
	IDR 3,496,151 - IDR 4,000,000	99	13.24
	IDR 4,000,001 - IDR 6,000,000	86	11.50
	IDR 6,000,001 - IDR 10,000,000	44	5.88
	> IDR 10,000,000	27	3.61
Daily Language	Indonesian	131	17.51
	Mother tongue	562	75.13
	Foreign language (e.g., English)	6	0.80
	Others	49	6.55

Instrument

A structured questionnaire comprised six constructs measured on a five-point Likert scale (strongly disagree (1) to strongly agree (5)). Three of the constructs—Environmental System Interaction (ESI), Critical Thinking and Problem-Solving (CTPS), and Value and Pro-environmental Behavior (VPB)—were taken from the PISA 2025 science framework of the environmental science competencies. The researchers proposed three more constructs: Learning Competence (LC), Sasirangan Value Integration (SVI), and Technology Integration (TI) to emphasize the context and purpose of this study. Content validity was ensured through expert review by three lecturers from Universitas Lampung, Universitas Lambung Mangkurat, and Politeknik Negeri Madiun. Revisions were made based on the experts' suggestions. The reliability test showed that nine items were removed, so thirty-one items were used in this study to gather the data. Table 2 presents the list of variables and their items.

Table 2

List of Variables and Their Items

Variable	Item	Statement
Environmental Science Integration	ESI1	I can describe how Earth's physical systems (air, water, soil) interact with living things.
	ESI2	I understand how human activities such as environmental pollution affect natural systems.
	ESI3	I can explain the positive and negative impacts of human actions on the environment over time.
	ESI4	I know how culture influences environmental change.
Critical Thinking and Problem-Solving	CTPS1	I evaluate information from various sources (e.g., science, local knowledge, social media) before forming an opinion about environmental issues.
	CTPS2	I think creatively when looking for solutions to environmental problems, for example, waste from Sasirangan cloth production.
	CTPS3	I collaborate with others (friends, school, or family) to protect the environment.
	CTPS4	I consider the long-term impacts of today's environmental actions.
	CTPS5	I have participated in projects or activities (e.g., clean-ups, tree planting, campaigns) to protect the environment.
Value and Pro-environmental Behavior	VPB1	I believe that all living things, including humans, are part of the environment.

	VPB2	I care about how environmental issues affect people in different communities.
	VPB3	I feel optimistic that we can solve environmental problems together.
	VPB4	I respect other people's opinions even if they have different views on environmental issues.
	VPB5	I believe that young people can make a big difference in protecting the environment.
Language Competence	LC1	I can understand texts in English (articles, websites, social media posts) about environmental issues.
	LC2	I can watch or listen to videos or podcasts in English about the environment and understand the main ideas.
	LC3	I have enough confidence to discuss environmental issues in English.
	LC4	I am able to generate ideas regarding environmental problems and their solutions in English.
		I understand environmental issues, facilitated by my English skills.
	LC5	Every time I need to search for environmental information from worldwide sources, I use English.
	LC6	
Sasirangan Value Integration	SVI1	I have learned about the environmental impacts of the production process of traditional cloth such as Sasirangan.
	SVI2	I am able to explain the process and values of Sasirangan patterns in English.
	SVI3	Learning about Sasirangan helps me understand how local traditions can support environmental sustainability.
	SVI5	I am interested in writing or presenting about Sasirangan in English as part of cultural and environmental education.
	SVI7	I want to learn more about Sasirangan while learning English.
Technology Integration	TI1	Learning media that help me understand the material through visualization are important.
	TI3	I need technology such as Augmented Reality to help me understand English materials.
	TI4	I need a learning approach that makes me think more deeply, understand meaning, and reflect, such as deep learning.
	TI5	I want English lessons to be connected with my local culture.
	TI6	Learning media that incorporate local wisdom such as Sasirangan are necessary.
	TI8	I want to learn English using technology-based media such as Augmented Reality.

Adapted from: The PISA 2025 science framework of the environmental science competencies

Procedure

Data were gathered via online and paper-based surveys conducted during school hours under teacher supervision. Before filling out the questionnaire, the participants were told what the study was about and gave their informed consent. An online survey that was disseminated using Google Forms between August 7th and August 29th, 2025, served as the study's instrument.

Data Analysis

We used SmartPLS 4.0 software to analyze the data. The analysis was made up of two parts: 1. Measurement Model Assessment: This means checking the reliability of indicators (outer loading > 0.6), the internal consistency of reliability (Cronbach's Alpha, composite reliability > 0.7), and the convergent validity (Average Variance Extracted > 0.5). 2. Structural Model Assessment—calculating path coefficients (β), the coefficient of determination (R^2), and conducting significance testing via bootstrapping (5,000 resamples, t-value > 1.64, $p < 0.05$ regarded as significant).

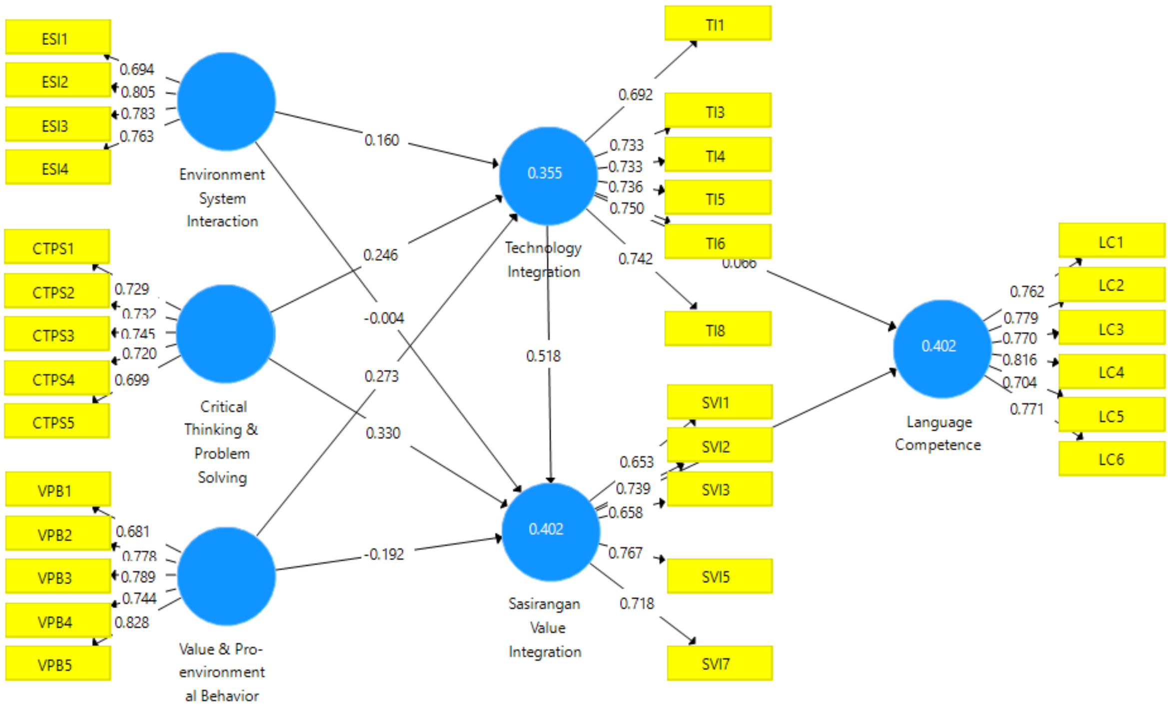
Results

Measurement Model

To begin the analysis, the researchers applied the PLS algorithm, as illustrated in Figure 2. There are four indicators with outer loading values below 0.6. They are TI2, TI7, SVI4, and SVI6. These indicators were subsequently excluded from the model because they failed to meet the validity requirements. After their removal, the remaining indicators demonstrated outer loading values of at least 0.6, with most falling close to or surpassing the recommended threshold of 0.7 (Hair et al., 2021). It means that the retained indicators are sufficiently capable of representing their respective latent constructs.

Figure 2

PLS Algorithm Result



Furthermore, the results in Table 3 confirmed that the construct was reliable, as reflected in Cronbach's Alpha (CA) and Composite Reliability (CR), both of which were above the recommended threshold of 0.7 (Hair et al., 2021).

Table 3
Reliability and Convergent Validity

Factor	Item	Loading	CA	CR	AVE
ESI	ESI1	0.692	0.763	0.850	0.521
	ESI2	0.809			
	ESI3	0.794			
	ESI4	0.764			
CTPS	CTPS1	0.711	0.771	0.845	0.521
	CTPS2	0.740			
	CTPS3	0.751			
	CTPS4	0.708			
	CTPS5	0.699			
VPB	VPB1	0.682	0.821	0.874	0.583
	VPB2	0.775			
	VPB3	0.779			
	VPB4	0.752			
	VPB5	0.823			
TI	TI1	0.700	0.828	0.875	0.538
	TI3	0.728			
	TI4	0.736			
	TI5	0.731			
	TI6	0.751			
	TI8	0.755			
SVI	SVI1	0.664	0.761	0.839	0.510
	SVI2	0.739			
	SVI3	0.677			
	SVI5	0.762			
	SVI7	0.725			
LC	LC1	0.767	0.858	0.894	0.585
	LC2	0.771			
	LC3	0.766			
	LC4	0.804			
	LC5	0.713			
	LC6	0767			

It is seen in Table 4 that most HTMT values are below the conservative threshold of 0.85. It exceeds the level (0.856 and 0.863). However, it still remains under the liberal cut-off of 0.09. These results show evidence of discriminant validity across the constructs.

Table 4

The Heterotrait–Monotrait (HTMT)

	CTPS	ESI	LC	SVI	TI	VPB
CTPS						
ESI	0.856					
LC	0.547	0.483				
SVI	0.597	0.435	0.735			
TI	0.660	0.596	0.488	0.747		
VPB	0.863	0.781	0.337	0.409	0.647	

Structural Model

In the structural model assessment, the hypothesized relationships among constructs were examined through the estimation of path coefficients (β) and the coefficient of determination (R^2).

Figure 3

Bootstrapping result with 5,000 subsamples

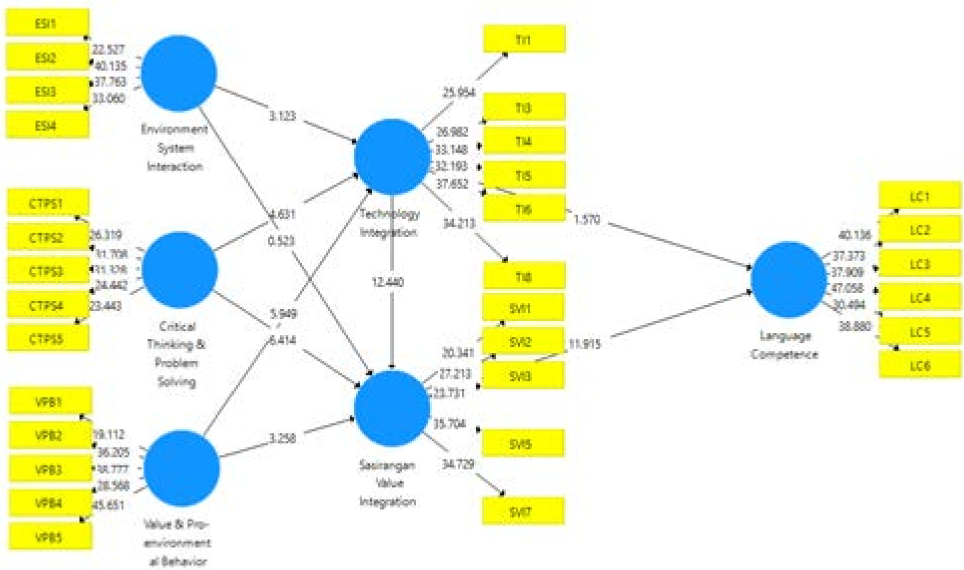


Figure 3 and Table 5 present the structural phase findings from the SmartPLS computation. The structural model was evaluated by examining the path coefficients (β), t-values, and p-values to test the proposed hypotheses. The results indicate that Environmental System Interaction (ESI) has a significant positive effect on Technology Interaction (TI) (β = 0.141, t = 3.123, p = 0.002), thus supporting H1. However, ESI did not significantly influence Sasirangan Value Integration (SVI) (β = -0.023, t = 0.523, p = 0.601), leading to the rejection of H2. Critical Thinking and Problem Solving (CTPS) was found to significantly predict both TI (β = 0.244, t = 4.631, p < 0.001) and SVI (β = 0.303, t = 6.414, p < 0.001), supporting H3 and H4. Similarly, Value and Pro-environmental Behavior (VPB) showed a significant positive effect on TI (β = 0.282, t = 5.949, p < 0.001; H5 supported), while its relationship with SVI was negative yet significant (β = –0.163, t = 3.258, p = 0.001; H6 supported). Moreover, TI strongly and positively influenced SVI (β

= 0.541, t = 12.440, p < 0.001), lending strong support to H7. TI on LC was insignificant (β = 0.070, t = 1.570, p < 0.116), while SVI has a strong positive effect on LC (β = 0.567, t = 11.915, p < 0.001).

Table 5

Path Analysis

Hypothesis: Path	β	t-value	p-value	Supported
H1: ESI - > TI	0.141	3.123	0.002	Yes
H2: ESI - > SVI	-0.023	0.523	0.601	No
H3: CTPS - > TI	0.244	4.631	0.000	Yes
H4: CTPS - > SVI	0.303	6.414	0.000	Yes
H5: VPB- > TI	0.282	5.949	0.000	Yes
H6: VPB - > SVI	-0.163	3.258	0.001	Yes
H7: TI - > SVI	0.541	12.440	0.000	Yes
H8: TI - > LC	0.070	1.570	0.116	No
H9: SVI - > LC	0.567	11.915	0.000	Yes

Notes: The threshold of the t-value is >1.96. The threshold of the p-value is < 0.05 (Al-Hattami, 2023; Hair et al., 2021).

Coefficient of Determination (R^2), Effect Size (f^2), and Predictive Relevance (Q^2)

Table 6 shows how much variance of the dependent variable is explained by its predictor variables in the model. The ranges of the values are weak (0-0.10), modest (0.11-0.30), moderate (0.30-0.50), and strong (>0.50). Technology integration accounted for 34.7% of the variance (R^2 = 0.347), Sasirangan value integration explained 40.6% (R^2 = 0.406), and language competence explained 37.5% (0.375). Collectively, the results highlight the central role of Sasirangan Value Integration and Critical Thinking and Problem Solving in enhancing Language Competence, while the direct impact of Technology Integration was found to be limited.

Table 6

Coefficient Determination (R^2)

	R Square	R Square Adjusted	Consideration
Language Competence	0.375	0.373	Medium
Sasirangan Value Integration	0.406	0.403	Medium
Technology Integration	0.347	0.345	Medium

The effect size (f^2) between the constructs is shown in Table 7. The categories of the effect size are small (0.02), medium (0.15), and large (0.35).

Table 7
Effect Size (f^2)

	CTPS	ESI	LC	SVI	TI	VPB
Critical Thinking and Problem Solving				0.066	0.041	
Environment System Interaction				0.000	0.016	
Language Competence						
Sasirangan Value Integration			0.328			
Technology Integration			0.005	0.322		
Value and Pro-environmental Behavior				0.020	0.059	

	SSO	SSE	Q^2 (=1-SSE/SSO)
Critical Thinking and Problem Solving (CTPS)	3.740.000	3.740.000	
Environment System Interaction (ESI)	2.992.000	2.992.000	
Language Competence (LC)	4.488.000	3.527.513	0.214
Sasirangan Value Integration (SVI)	3.740.000	2.994.478	0.199
Technology Integration (TI)	4.488.000	3.664.863	0.183
Value and Pro-environmental Behavior (VPB)	3.740.000	3.740.000	

Discussion

The present study examined the integration of environmental system interaction, critical thinking and problem solving, value and pro-environmental behavior, and technology integration within the context of local wisdom-based English language learning. Among nine hypotheses, the statistical results supported seven proposed hypotheses. However, two hypotheses are not supported.

Sasirangan Value and Technology Integration Roles to Language Competence

The results show that Sasirangan Value Integration (SVI) is the strongest predictor of Language Competence (LC) (β=0.567). On the other hand, Technology Integration (TI) is insignificant to LC. This effect indicates that culturally embedded innovation directs language competence. In this study, the use of Sasirangan as traditional cloth embedded into reading text and listening activities functions as pedagogical mediators that foster contextual learning. It supports sociocultural learning perspectives. Adam et al. (2024) and Jiang and Zhao (2025) stated that culturally meaningful learning mediated knowledge better than isolated practices and improved comprehension and expressive skills. Likewise, Hanapi et al. (2025) and Alkhudiry (2022) stated that meaningful and contextual learning is in line with experiential learning principles in which students are not solely passive learners but active knowledge co-constructors. Therefore, students can construct their current knowledge of Sasirangan with the lessons they learn in the classroom. Theoretically, this suggests that language competence is most effectively achieved when instructional learning integrates cultural values meaningfully for students (Lim et al., 2025; Tutal, 2023). Two teachers among six teachers in this study have already integrated local wisdom, especially Sasirangan in their English class. This integration came from their initiation. They provide students with relevant activities and exhibition at the end of the semester. This, incorporating local wisdom particularly Sasirangan as learning resources is predicted to support students' language competence. As local wisdom becomes a strategic English learning resource, schools and teachers should maximize the cultural values in learning activities.

Regarding the insignificant result of TI to LC (β=0.070), the finding of this study emphasizes that technology functions as a facilitator. It is able to support innovation when it is integrated with culture. It is in line with Feriyanto and Anjariyah (2024), Jiang and Zhao (2025), and Larsen-Freeman et al. (2024), who stated that technology alone is insufficient to enhance language learning outcomes without meaningful cultural content and task-based engagement. This is different from Gu (2025) who highlights that technology is the fundamental dimension in English learning. Specifically, to many Indonesian and other non-English-speaking countries' students, English is often perceived as distant from their daily communicative realities. Such perceptions may reduce intrinsic motivation and limit meaningful language use, resulting in surface-level engagement despite the presence of technological tools. This proves that merely using TI in the English classroom is not adequate without teachers' contribution to provide the context for learning English and meaningful as well as purposeful interaction. Isnaniah et al. (2025) study, for instance, proved that an AR e-book that features the culture of South Borneo showed effectiveness on students' English ability. In other words, technology must be integrated with culturally relevant materials and cognitively engaging tasks to foster sustained language competence.

Rethinking Technology Integration: Cognitive Activation

The findings partially confirmed the proposed model. ESI, CTPS, and VPB were significant predictors of TI with different effect sizes. VPB (β = 0.282) and CTPS β = 0.244) on TI show a stronger effect than ESI (β = 0.141) that has a weak effect. Interestingly, internal cognitive (VPB and CTPS) is more decisive in technology adoption compared to contextual exposure. Significant effects of VPB and CTPS on TI suggest that adoption of technology is formed when students have constructive beliefs about learning and innovation. They tend to use technology in meaningful and purposeful ways. Anggereini and Yelianti (2023) and Jung and Santos (2022) studies revealed that pro-environmental behavior promotes openness toward technology-supported learning when students perceive digital tools as contributing to sustainability goals. Students' views on the impact of the technology on the environment will determine the ways they choose and use technology in their learning. They tend to exhibit resilience, hope, and efficacy in responding to socio-ecological crises.

It highlights the essential role of belief in forming technology adoption. Similarly, the significant effect of CTPS on TI (β=0.244) shows that higher-order thinking skills foster more purposeful use of technology, as confirmed by Ridho et al. (2021), Susanti et al. (2025), Tusino et al. (2024), and Yin et al. (2024). When students critically think and find technology can help them to preserve their environment, they tend to quickly adapt to its use. On the other hand, if the technology is perceived as complex and harmful to the environment, they may resist adopting it. Also, students need to activate their critical-thinking skills in using the technology, such as apps or websites, effectively during the learning. In addition, whenever students need to analyze and find solutions to problems and challenges, the roles of critical thinking and problem-solving skills are crucial as the input (Addinna & Oktaviani, 2023; Mejia & Sargent, 2023; Xiaomeng et al., 2023). Research studies conducted by Fadli and Irwanto (2020), Malkawi et al. (2019), and Verawati et al. (2022) have similarly found that students who have strong problem-solving skills are more likely to utilize technology for creative projects to value their socio-environmental significance of local wisdom.

Furthermore, as a cultural artifact, Sasirangan cloth symbolizes philosophical meanings and abstract cultural values that extend beyond its aesthetic function. The motifs reflect moral principles and belief systems that have historically shaped the daily practices of the Banjar community (Permatasari et al., 2025). Understanding these symbolic and philosophical dimensions requires interpretive and analytical engagement rather than surface-level recognition. In this regard, critical thinking enables students to examine multiple perspectives, contextualize cultural meanings, and evaluate their relevance within contemporary social and environmental contexts (Atmojo et al., 2025; Mejia & Sargent, 2023; Peng, 2024). All in all, competency in digital technology needs not only technical skills but also thinking skills (Rahmawati et al., 2025). Thus, teachers must address environmental impacts openly, stimulate critical thinking and problem-solving, and invite students to examine more sustainable and environmentally friendly ways to produce Sasirangan cloth in South Borneo, Indonesia.

Different from the two strong significant effects above, environmental system integration (ESI), which refers to the condition in which students can explain what they know about the environment and how they interact with each other, shows a weaker significant result. This suggests that students' awareness of ecological systems may encourage the adoption of technology for learning (Tabuenca et al., 2023). Although students are able to relate how to integrate technology into their English learning, coming from their own learning experiences, environmental interaction has a small impact without critical thinking and beliefs. It is also true that the integration of environmental systems creates the application of technology (Tabuenca et al., 2023; Ricoy & Sanchez-Martinez, 2022), but the extent is not the same as cognitive activation (VPB and CTPS). Context can make opportunity, but it is activated by the cognition. Therefore, this finding puts TI as the process construct that is affected strongly by internal factors or cognitive activation rather than environmental exposure.

Local Wisdom in Action: Sasirangan Value Integration

As the innovation proposed in this study, Sasirangan Value Integration (SVI) was supported by CTPS, VPB, and TI. TI ($\beta = 0.541$) has the strongest effect on SVI in the model and becomes the key driver. This finding reinforces prior evidence that technological integration can act as a bridge between local cultural heritage and language competence, making traditional knowledge more accessible and engaging (Hu & Ødemotland, 2021; Peng, 2024; Shin et al., 2022), including Sasirangan cloth values in this study. As a Banjarese cultural artifact, Sasirangan is widely used in everyday life; however, it is rarely incorporated into English learning materials as structured local content. Its commodification may gradually hide its philosophical meanings, leading students to recognize it superficially rather than interpretively. Therefore, the integration of augmented reality (AR) functioned as a recontextualizing tool that transformed this familiarity into inquiry (Akmal & Nurjannah, 2024). By visualizing motifs and embedding cultural narratives, AR mediated students' interpretive engagement, which may explain why technology integration significantly predicted Sasirangan Value Integration. Moreover, in a post-COVID-19 context where mobile phone use is increasingly regulated, legitimizing smartphones as learning tools bridged students' digital practices with curricular goals, thereby initiating curiosity and engagement (Vijayakumar et al., 2025; Zarrati et al., 2024). In this sense, technology did not merely function as a delivery tool but as a pedagogical bridge that connected environmental understanding, cognitive processing, and pro-environmental orientation with the internalization of cultural values.

Then, CTPS to SVI ($\beta = 0.303$) shows a moderate positive effect. CTPS directly improves SVI. As culture is made of concrete and abstract concepts, critical thinking is needed in comprehending the values and principles in Sasirangan patterns in Banjar society, South Borneo. The pattern of *kangkung kaumbakan* depicts values of temptations and the feeling of never giving up, and the pattern of *tampuk manggis* symbolizes honesty and hard work (Permatasari et al., 2025). Every pattern of Sasirangan contains Banjar people's moral values in life. Students' critical thinking skills are required to evaluate diverse viewpoints within a social and cultural context, fostering inclusivity and respect (Atmojo et al., 2025; Mejia & Sargent, 2023; Peng, 2024). In addition, the material of Sasirangan cloth in English learning is not only used to introduce its values depicted from the patterns and how to preserve Sasirangan, but also how environmentally supportive it is—such as reducing material waste or promoting awareness—so students are more likely to engage with it proactively. Conversely, when cultural practices are perceived as environmentally harmful, students may exhibit resistance. This evaluative process helps explain the cognitive tension observed in the integration of Sasirangan values. While Sasirangan represents cultural heritage and philosophical meaning, its traditional production involving chemical dyes may conflict with students' environmental commitments (Permatasari et al., 2025). Because pro-environmental behavior reflects deeply internalized value systems, students may critically reassess cultural artifacts through a sustainability lens rather than accepting them uncritically. Thus, the divergent effect of VPB reflects not inconsistency but value-driven judgment. This suggests that higher critical thinking skills support stronger cultural value integration. Therefore, it is necessary to integrate CTPS as the input to SVI in English learning.

Finally, the finding of VPB to SVI (β = -0.163) shows a negative significant effect. As the English learning in most of the schools in South Borneo is rarely integrated to Sasirangan, students prefer to follow common methods utilized by their teachers. Meanwhile, Sasirangan value integration needs a teaching style for cultural innovation. With VPB to TI effect and TI to SVI effect are positive, the negative path of VPB to SVI established in this study shows a complex role of students' beliefs. The offered instructional learning designs challenge students' expectations of current English instructional learning. It reduces their openness to innovative approaches. In fact, belief flexibility is required in innovation. Teachers' role is needed to link culture and real life by showing how cultural integration and the value of pro-environmental behavior are meaningful to our lives. This practice is expected to boost students' openness to innovation.

Limited Role of Environmental System Interaction

The results indicate that Environment System Interaction (ESI) had a significant positive effect on Technology Integration (TI) (β = 0.141, t = 3.123, p = 0.002), thus supporting H1. However, ESI did not significantly influence Sasirangan Value Integration (SVI) (β = –0.023, t = 0.523, p = 0.601), leading to the rejection of H2. Environmental System Interaction (ESI) has a weak effect on TI, and it did not directly influence Sasirangan Value Integration (SVI). ESI influence on cultural value internalization is more indirect, potentially mediated through other constructs such as TI or CTPS (Lee et al., 2022; Ou et al., 2021; Satvati et al., 2025). Students' ability to articulate their understanding of environmental systems and human–environment interactions appears to strengthen their readiness to adopt and utilize technology in learning. This readiness may stem from their prior experiences engaging with digital platforms, particularly during the COVID-19 pandemic, which normalized technology as an adaptive learning tool. However, technological engagement alone is not adequate to foster the internalization of culturally embedded values. Without this cognitive mediation, environmental awareness remains more conceptual rather. Although the results are in contrast with Kovari (2025) and Tabasi (2024) who stated that technology enhances learning. However, these findings align with arguments contending that environmental knowledge provides a foundation for digital adaptability but requires pedagogical scaffolds to transform into culturally meaningful practices (Haleem et al., 2022; Ostiz-Blanco et al., 2021). Unfortunately, despite its contextualized characteristics for deep learning, the materials of local content are scarcely covered within the teaching and learning process in high schools. To include the local content in their teaching, teachers need to modify the content or, not to mention, make it from scratch, and this becomes the reason why local contents are not covered.

Regarding the size effect analysis (f^2), the results show that Sasirangan Value Integration (SVI) has a medium effect on Technology Integration (TI) (f^2 = 0.322), It indicates that cultural values play a role as the foundation in instructional technology. In other words, technology does not stand alone as a tool (Feriyanto & Anjariyah, 2024; Jiang & Zhao, 2025). It gains pedagogical meaning when integrated into context and local wisdom

(Atmojo et al., 2025; Peng, 2024). Thus, the integration of technology in the classroom is not merely determined by the availability of the tools but also by how the technology is in line with students' cultural identity and values. Theoretically, this finding strengthens the argument that culture-based education successfully enhances the use of technology in educational contexts.

On the other hand, the weak effect of SVI (f^2 = 0.020) and TI (f^2 = 0.059) on VPB shows a gap between internalized value and actualization. Even though cultural values have been integrated into technology and have been utilized contextually, both of them do not insignificantly drive the change of pro-environmental behavior. It indicates that the pro-environmental behavior change does not take place linearly from knowledge or values to action. There may be other mediating variables such as affective and behavioral components. Affective components include a person evaluation of a person's objects or events (Bakanauskas et al., 2020). It is consistent with the value-behavior gap concept in environmental education literature, which emphasizes that value internalization cannot guarantee the action.

Further, R^2 value is in the category of moderate (0.347 – 0.406), showing that the model can explain some variation in endogenous constructs, although it cannot cover all relevant determinants. The Q^2 value also shows a moderate category (0.183-0.214) indicating that the model has adequate predictive relevance, but there is still room for conceptual improvement. These findings highlight the need to expand the model by considering psychological, cognitive, and social constructs in order to strengthen the pathway from value integration to behavioral change.

Limitations and Future Directions

The limitations of this study lie in the expansion of the model to include mediating variables such as learning motivation and digital literacy of the teachers to improve its predictive power. In addition, it is seen in the demographic data that while almost all students own a cell phone, only 5.08% have internet access at schools. This uneven access to stable internet may have influenced students' experience with technology-enhanced learning and could partly explain why TI did not have a significant direct effect on LC. Students who rely on limited data plans may engage less frequently or less deeply with interactive, media-rich content (such as augmented reality), thus reducing the potential benefits of technology on language outcomes. Future studies are expected to address students' learning motivation, ensure good facilities to include technological use, and provide a strong foundation in the form of training to English teachers.

Conclusion

In a nutshell, this study partially confirmed the model proposed in this study and offered some insights of how environmental science interaction, critical thinking and problem-solving skills, values of pro-environmental as the input to technology and Sasirangan value integration as the process, and language competence as the output. Within the context of senior high school English language learning, it is revealed that meaningful local content that is contextualized in English learning facilitates students' English competence. Then, technology integration direct contribution to language competence was not significant, even though it potentially mediated the relationship between the input variables and SVI. In this regard, cultural contextualization in language learning is highlighted, and local wisdom, such as Sasirangan cloth, can serve as a powerful pedagogical tool to strengthen students' engagement, cultural identity, and language outcomes. Meanwhile, Critical Thinking and Problem-Solving and Value and Pro-environmental Behavior are the key drivers of Technology Integration and Sasirangan Value Integration. This study demonstrates that purposeful integration of technology, culture, and environment is able to create captivating English learning. The presence of local wisdom in the form of Sasirangan cloth integrated in English learning foster students' language competence.

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Rizky Amelia: Conceptualization, Funding Acquisition, Supervision, and Original Draft
Siti Kustini: Methodology, Original Draft, Review, and Editing
Novita Triana: Investigation, Resources, Validation, and Original Draft
Heldiansyah Heldiansyah: Data Curation and Software
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Generative AI Use Disclosure Statement

The authors declare that ChatGPT was used for brainstorming ideas at the beginning of drafting the discussion. The final manuscript was reviewed and revised by the authors.

Ethics Declarations

World Medical Association (WMA) Declaration of Helsinki–Ethical Principles for Medical Research Involving Human Participants

We hereby confirm that our study was conducted in accordance with the ethical principles outlined in the World Medical Association (WMA) Declaration of Helsinki. We sent a permission letter to the South Borneo Provincial Office of Education and Culture, Indonesia, to conduct the study, and we also sent the letter to each headmaster in the schools involved in this study. In the instrument, we included the informed consent so that they were fully informed of the objectives, procedures, risks, and benefits of the research. We affirm that the rights, dignity, and well-being of the participants were respected in the processes of this present study.

Competing Interests

No, there are no conflicting interests.

Data Availability

Data are available upon request from the corresponding author.

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