Pertanika J. Soc. Sci. & Hum. 34 (1): 415 - 447 (2026)

PERTANIKA JOURNALS

SOCIAL SCIENCES & HUMANITIES

Journal homepage: http://www.pertanika.upm.edu.my/

Digitally Mediated Problem-based Learning Integrating Aneuk Jamee Cultural Values to Enhance Computational Thinking and Cultural Identity in Primary Education

Mardhatillah[1,2,3,4], Khusnul Khotimah[1,2,3,4], Zihan Novita Sari[1,2,3,4], Nurzatulshima Kamarudin[4]*, Novrian Dony[5], Cempa Huzaimah[1,2], and Ilfi Nur Diana[1,2]

[1]*Department of Elementary Education, State University of Malang, 65145 Malang, Indonesia*
[2]*Department of Elementary School Teacher Education, State University of Malang, 65145 Malang, Indonesia*
[3]*Department of Physical Education, Health, and Recreation, State University of Malang, 65145 Malang, Indonesia*
[4]*Department of Science and Technical Education, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia*
[5]*Department of Chemistry Education, Islamic University of Kalimantan Muhammad Arsyad Al Banjari Banjarmasin, 70123 Banjarmasin, Indonesia*

ABSTRACT

This study aimed to develop a problem-based learning model that integrates Aneuk Jamee cultural values through the use of digital platforms to improve the quality of learning in elementary schools. The method used is research and development (R&D) based on the Plomp approach, which includes the stages of initial investigation, design, development, formative evaluation, implementation, and dissemination of the product. The participants were thirty fourth-grade students (N=30; aged 9-11 years) in a public elementary school in Malang, Indonesia. The research instruments included learning tools, student books, activity sheets, and computational thinking ability tests. The results show that integrating local culture into learning increases motivation, active participation, and students' understanding of the material and cultural values. This model has also been proven to support the development of 21st century skills such as critical thinking, creativity, and collaboration. Expert validation indicated that the developed tools were highly feasible for use, and trial results showed a significant improvement in students' computational thinking abilities. This research makes a tangible

ARTICLE INFO

Article history:
Received: 01 December 2025
Accepted: 31 January 2026
Published: 27 February 2026

DOI: https://doi.org/10.47836/pjssh.34.1.21

E-mail addresses:
mardhatillah.pasca@um.ac.id (Mardhatillah)
khusnul.khotimah.fip@um.ac.id (Khusnul Khatimah)
zihan.novita.fik@um.ac.id (Zihan Novita Sari)
nzshima@upm.edu.my (Nurzatulshima Kamarudin)
n.dony@uniska-bjm.ac.id (Novrian Dony)
cempa.huzaimah.2521038@students.um.ac.id (Cempa Huzaimah)
ilfi.nur.2521038@students.um.ac.id (Ilfi Nur Diana)
* Corresponding author

e-ISSN: 2231-8534

contribution to innovation in culturally based and contextually relevant digital technology learning while strengthening students' cultural identity in the global era.

Keywords: 21st century skills, Aneuk Jamee, digital platform, elementary school, local culture, problem-based learning

INTRODUCTION

Digital transformation in education has fundamentally revolutionised the way students learn and teachers teach. Digital platforms such as learning management systems, interactive applications, and multimedia learning resources are increasingly used to enhance the effectiveness of learning and student engagement at various educational levels. According to UNESCO (2022), more than 1.6 billion students worldwide were affected by school closures during the COVID-19 pandemic, which accelerated the adoption of digital technology in over 190 countries worldwide (Kasmini, et al., 2024). The OECD (2023) also reported that more than 70% of member countries have integrated digital skills into their basic education curriculum. In this context, technology serves as a strategic tool for shaping collaborative, personalised, and contextual learning environments in line with the demands of 21st-century education. (Voogt et al., 2013). Competencies such as critical thinking, creativity, collaboration, and digital literacy have become essential skills that students must possess to face future global challenges (Forum, 2020; Zhao & Watterston, 2021).

Along with technological advancements, attention to the importance of integrating local cultural values into education has increased. Multicultural and culture-based education is now considered a strategic approach to shaping students' character to be adaptive and strongly rooted in identity (J. Banks & C. Banks, 2019; Gay, 2013). Local culture has great potential as a contextual learning resource, capable of connecting learning materials with students' everyday realities. However, learning approaches in elementary schools remain largely conventional and have yet to fully utilise local culture optimally. This disparity contributes to low student engagement and weakens students’ connection to their cultural identity (Paris & Alim, 2014).

One of the cultural communities rich in educational values is Aneuk Jamee, an ethnic group resulting from the acculturation between the Minangkabau people and the local inhabitants of the West Coast of Aceh. Aneuk Jamee culture embodies social values such as cooperation, respect for elders, collective responsibility, and local wisdom in preserving the environment. (Ansari & Mardhatillah, 2020; Mardhatillah & Adisaputera, 2021). These values have great potential to be contextualised in basic education that emphasises character building, social responsibility, and sensitivity to cultural diversity. Unfortunately, to this day, there are still few learning models that explicitly integrate Aneuk Jamee culture into innovative, technology-based instructional design. Integrating local wisdom with pedagogical approaches such as digital-based Problem-based Learning (PBL) has significant potential to improve the quality of learning, strengthen cultural values, and synergistically foster 21st-century skills. (Hmelo-Silver, 2004; Hung, 2011). Aneuk Jamee communities are primarily located along the west and southwest coast of Aceh, and they commonly use the Jamee language alongside Indonesian in daily communication. This cultural-linguistic background is important for understanding the local narratives and values embedded in the learning tasks.

Various studies have shown that problem-based learning is effective in enhancing students' critical thinking, collaboration, and problem-solving skills at various educational levels (Dolmans et al., 2005; Hmelo-Silver, 2004). Meanwhile, culture-based learning contributes positively to strengthening local identity and students' motivation to learn (Chen et al., 2021; Gay, 2019; He et al., 2021; Sung et al., 2020; Wang & Torrisi-Steele, 2019). However, most of these studies remain partial and have not yet comprehensively combined both approaches. The development of instructional models that integrate problem-based pedagogy with local cultural content into a single, cohesive design is still limited in literature.

Furthermore, very few studies have adopted an instructional design approach that integrates specific local cultural values, such as Aneuk Jamee, into problem-based learning (PBL) supported by digital technology. Digitalisation offers a great opportunity to revitalise local culture through interactive media and contextual digital content that is easily accessible and adaptive (Belland et al., 2020; Kim & Reeves, 2021; Lai & Hwang, 2019; Looi et al., 2021; Marty & Jones, 2020). Approaches such as curriculum-based ecosystems also emphasise the importance of the connection between learning and students' sociocultural ecology (Bang & Vossoughi, 2019; Erickson & Shultz, 2019; Kim et al., 2021; Roth & Lee, 2019; Voogt et al., 2020). The absence of a learning model that synergises local culture and technology within a structured pedagogical framework represents a significant gap in developing value-based contextual learning innovations.

This gap indicates an urgent need to design and develop a learning model that is not only responsive to 21st-century skill demands but also adaptive to the local context and relevant to strengthening students' cultural identities. This study aims to address these challenges by formulating and developing a problem-based learning model that integrates Aneuk Jamee cultural values using digital platforms, as an effort to bridge the gap between theory and practice in primary education in Indonesia.

The original contribution of this research lies in its integrative approach, which brings together three main components: the local cultural wisdom of Aneuk Jamee, innovative problem-based pedagogy, and digital technology as a learning medium. This approach not only offers a comprehensive solution to the challenges of contextual learning in the modern era but also strengthens the discourse on multicultural education grounded in values relevant to local needs. This study is expected to make a practical contribution to the development of technology-based local curricula and enrich the conceptual framework of primary education in regions rich in cultural resources.

Unlike previous studies that separately examined digital problem-based learning or culturally responsive pedagogy, this study offers a distinct contribution by integrating Aneuk Jamee cultural epistemology within a digitally mediated PBL framework specifically designed to develop computational thinking and cultural identity simultaneously at the primary education level. This research does not merely embed local culture as contextual content but structurally aligns cultural values with problem-solving processes and digital learning design, resulting in a cohesive instructional model that bridges cognitive, technological, and cultural dimensions. To the best of our knowledge, such an integrative model focusing on Aneuk Jamee culture in digital PBL for computational thinking development has not been systematically explored in prior literature.

The integration of local culture in learning holds strategic significance in shaping students' character to be inclusive, environmentally conscious, and possess a strong sense of cultural identity. In the context of Aneuk Jamee, values such as cooperation, social responsibility, and respect for the environment serve as important foundations that can be transformed into meaningful learning experiences in elementary education. This study offers an innovative learning model that combines PBL strategies with local cultural values through the support of digital technology to create contextual, interactive, and transformative learning.

Through the development of a problem-based learning model specifically designed to accommodate the cultural values of Aneuk Jamee and supported by a digital platform, this study aims to increase student engagement, strengthen conceptual understanding, and foster a love for the local culture. In addition, this approach is expected to reinforce 21st century competencies that serve as benchmarks for successful learning in the digital age. The results of this study are relevant for teachers, curriculum developers, and educational institutions looking to adopt a value- and technology-based learning model in a contextual manner.

More broadly, this study contributes to the development of critical pedagogy discourse and digital-based multicultural education. The research findings not only enrich the literature in the fields of elementary education and contextual curriculum development but also serve as a practical reference for other regions with rich cultural diversity seeking to integrate it into modern learning. Thus, this study has a significant impact both theoretically and practically in strengthening education based on local wisdom that is globally relevant.

The main objective of this study is to develop and evaluate a problem-based learning model integrated with Aneuk Jamee cultural values through digital technology support, in order to improve the quality of learning and 21st-century competencies of elementary school students. Specifically, this research aims to design digital learning tools that contextually incorporate local cultural content, as well as test the validity, practicality, and effectiveness of the developed model in relation to student engagement and understanding. In addition, this study also analyses the model's impact on students' computational thinking skills and the strengthening of their cultural identity. By addressing gaps in current educational practice and literature, this study is expected to produce innovative learning solutions that are adaptive to local needs and aligned with global developments.

LITERATURE REVIEW

Digitally Mediated Learning

Digital transformation has reshaped contemporary educational practices by enabling learning environments that are interactive, accessible, and personalised. Digital platforms, including learning management systems, multimedia resources, and interactive applications, support students' engagement and facilitate more comprehensive knowledge construction (Reid et al., 2022; Veluvali & Surisetti, 2021). Within primary education, the use of digital tools provides multimodal representations that help students visualise abstract concepts and engage in exploratory learning aligned with 21st century competencies (Moon et al., 2024; Tang et al., 2024).

Digital mediation also enables scaffolding, where learning tasks are structured with guided feedback, improving cognitive accessibility for younger learners (Chang & Yang, 2023). In the context of culturally embedded education, digital environments offer opportunities to revitalise local wisdom by transforming cultural values into interactive, visual, and contextually relevant learning content (Kumi-Yeboah et al., 2020; Mcdaniel, 2024). This aligns with global trends highlighted in digital education reports that emphasize the fusion of technological innovation with contextual learning to promote holistic student development (Tan et al., 2024). Through digitally mediated instruction, learners can engage with real-world problems and cultural narratives in meaningful ways, bridging local identity and global digital literacy demands.

Problem-based Learning (PBL)

Problem-based Learning is an instructional approach grounded in constructivist principles that situates students in authentic problem scenarios requiring inquiry, collaboration, and critical thinking (Gaviria Alzate et al., 2024). Research consistently shows that PBL enhances learners' higher-order thinking skills, including critical analysis, problem-solving, and reflective reasoning (Dias-Oliveira et al., 2024). At the primary school level, PBL supports the development of self-directed learning habits and encourages students to construct knowledge through exploration rather than rote instruction (Varadarajan & Ladage, 2022). When integrated with digital tools, PBL becomes more dynamic: students can simulate solutions, test hypotheses, and create digital artefacts that represent their thinking processes.

The recursive cycle of problem analysis, information gathering, solution planning, and reflection aligns strongly with the core principles of computational thinking. Moreover, embedding PBL in learners' cultural contexts strengthens authenticity and ensures that learning tasks resonate with students lived experiences (Crespi et al., 2022). This is consistent with research asserting that PBL must evolve beyond generic problem contexts towards culturally meaningful, community-rooted inquiry tasks (Saad & Zainudin, 2024). In this study, the fusion of PBL with Aneuk Jamee cultural values represents an effort to contextualise learning in social realities familiar to students while retaining the cognitive rigour of the PBL model.

Aneuk Jamee Cultural Values

Aneuk Jamee represents a distinctive ethnocultural group formed through acculturation between Minangkabau migrants and communities along the West Coast of Aceh. The culture embodies values of cooperation, respect for elders, social responsibility, and environmental stewardship. These cultural concepts carry pedagogical significance because they foster moral development, social awareness, and strong identity grounding among children (Pham et al., 2021). Cultural values also serve as contextual anchors for problem formulation, allowing learners to engage with tasks that are meaningful and connected to community life. Nevertheless, existing educational practices rarely integrate Aneuk Jamee wisdom into structured pedagogical models, despite its potential to enrich character education and contextual relevance.

Digitally mediated instruction expands the possibilities for integrating these cultural values by presenting them through stories, scenarios, images, and multimedia-based problem tasks. Prior work on culturally relevant pedagogy argues that students demonstrate stronger engagement and motivation when learning materials reflect their cultural backgrounds. By embedding Aneuk Jamee narratives and values within digital PBL contexts, learners not only deepen their understanding of academic content but also foster pride and connectivity to their heritage (Orphanidou et al., 2024). This is particularly important in culturally diverse regions where local identities risk being overshadowed by standardised curricula.

Computational Thinking (CT)

Computational thinking has emerged as a foundational skill for 21st century learners, extending beyond computer science into general problem-solving and reasoning development. CT encompasses several core components: decomposition, pattern recognition, abstraction, and algorithmic thinking (Ballard & Haroldson, 2021). Primary school learners benefit significantly from early exposure to CT-oriented tasks, as these experiences shape structured thinking habits crucial for future learning (Molina-Ayuso et al., 2023). Research highlights that CT can be effectively developed through model-based tasks, inquiry cycles, and scaffolded problem-solving features inherent in PBL (Lee, 2024).

Digital platforms further enhance CT development by enabling students to interact with dynamic representations, model algorithms visually, and manipulate data in exploratory ways (Yuan et al., 2021). Assessments of CT also align with performance-based tasks that evaluate students' abilities to break down problems, identify relationships, and plan logical steps. In the context of this study, students' CT abilities improved significantly when exposed to a digitally mediated PBL model enriched with local cultural values, demonstrating that contextual relevance enhances both engagement and cognitive outcomes (Amanda et al., 2023; Rehman et al., 2023). Thus, CT serves as both a cognitive target and an evaluative measure for the effectiveness of the instructional model developed.

Cultural Identity

Cultural identity refers to an individual's sense of belonging to a cultural group, shaped by shared values, traditions, language, and practices. In childhood, cultural identity is formed through exposure to community norms, family practices, and social interactions. Education plays a crucial role in reinforcing or diminishing this identity, depending on the extent to which cultural elements are represented within learning environments. Literature on culturally sustaining pedagogy contends that embedding cultural knowledge in instruction promotes positive identity formation, enhances motivation, and validates students' sociocultural backgrounds (Dunham et al., 2011; Steketee et al., 2021).

In primary education, culturally grounded learning activities can foster emotional connection and intrinsic motivation, especially when students see their traditions reflected in classroom content (Suarta et al., 2022; Yüksel et al., 2024). Digital media further strengthens cultural identity formation by allowing learners to engage with cultural narratives in immersive and interactive formats (Sun et al., 2023). In this study, the integration of Aneuk Jamee values supported by digital platforms provided students with opportunities to explore and appreciate their heritage while engaging in academic inquiry. This dual development of cultural awareness and academic skills exemplifies a holistic approach to education that reconciles local wisdom with global digital competencies.

This study is grounded in an integrated theoretical framework that connects digitally mediated Problem-based Learning, computational thinking, and cultural identity within a culturally responsive pedagogy paradigm. Digitally mediated PBL serves as the core instructional strategy that situates learners in authentic, culturally contextualised problem scenarios derived from Aneuk Jamee values. Through iterative cycles of problem analysis, information seeking, solution design, and reflection, students engage in structured cognitive processes that foster core elements of computational thinking, including decomposition, pattern recognition, abstraction, and algorithmic reasoning.

Simultaneously, embedding Aneuk Jamee cultural narratives and values within problem contexts facilitates the internalisation of local wisdom, promoting students' cultural identity and socio-cultural awareness. Digital platforms function as mediating tools that visualise cultural content, support interaction, and scaffold learning, thereby bridging local cultural knowledge with global digital competencies. This framework positions learning as a synergistic interaction between cognition, culture, and technology, ensuring that computational skill development is inseparable from cultural grounding and identity formation.

In this study, learning is conceptualised as a dual developmental process encompassing both cognitive transformation and socio-cultural formation. Cognitively, learning is reflected in the development of students' computational thinking skills, including problem decomposition, abstraction, and algorithmic reasoning. Socio-culturally, learning is manifested in the strengthening of students' cultural identity through engagement with culturally contextualised problems rooted in Aneuk Jamee values. Thus, learning is not viewed merely as knowledge acquisition, but as a holistic process integrating thinking skills, cultural internalisation, and identity formation through meaningful digital learning experiences.

METHODOLOGY

This study uses a research and development (R&D) approach based on the Design-based Research (DBR) model by Plomp (2013), which includes five main stages: initial investigation, design, construction (realisation), formative and summative evaluation, as well as implementation and dissemination. This approach was chosen to develop a problem-based learning model integrated with Anak Jamee cultural values through the utilisation of a digital platform that is contextual, valid, practical, and effective for application among elementary school students.

The subjects of this study were fourth-grade students at a public elementary school in Malang City, totalling 30 individuals, consisting of both boys and girls aged 9-11 years. The selection of subjects was purposive, considering the representation of students' cognitive characteristics and the classroom teacher's readiness to implement the learning model. The research was conducted during the odd semester of the 2023/2024 academic year. Here, "cognitive characteristics" refer to age-related learning needs (9-11 years, concrete-operational reasoning), readiness to engage in digitally mediated tasks, and suitability for collaborative PBL processes.

In the initial investigation stage, the researcher conducted a literature review, classroom observations, and interviews with teachers and local cultural experts to identify learning needs, challenges faced by students, and the potential cultural values of Aneuk Jamee that could be contextualised in learning English. The results of this analysis served as the basis for preparing the initial design of the learning materials.

The design phase is carried out by developing an initial prototype (Draft A) consisting of a complete set of learning materials, namely the Lesson Implementation Plan, Teacher's Handbook, Student Book, Student Activity Sheets, and a computational thinking skills test instrument (Mardhatillah et al., 2019). The learning design refers to Bruner's theory (enactive, iconic, symbolic) and the Problem-Based Learning (PBL) approach, which is connected to the local cultural context of Aneuk Jamee. Draft A is then validated by five experts using validation instruments that assess content, language, and visual appearance aspects.

After revisions were made based on expert validation results, the materials were developed into a digital prototype (Draft-B) and then tested for readability and practicality with 12 students. The test results showed that the materials were deemed practical, only requiring minor revisions. The refined materials were used in two stages of trials: the first trial was a simulation conducted by the researcher, and the second trial was carried out by the classroom teacher involving students in actual learning. Data was collected through observation of student activities, assessment of teachers' ability to manage learning, and student questionnaires regarding the materials and the learning process.

The research instruments included validation sheets for the materials and test instruments, observation sheets, student response questionnaires, and computational thinking ability tests. The test was administered before and after the intervention (pre and post-test) to measure students' improvement. Test blueprints, assessment rubrics, and answer keys were developed and validated to ensure the quality of the instruments. Validation results showed that all materials and instruments were in the "highly valid" category, with inter-rater reliability ranging from moderate to high (r = 0.41-0.55).

Quantitative data analysis was conducted using descriptive statistics (mean and standard deviation) and inferential statistics in the form of independent t-tests with the assistance of SPSS software version 17.0 to examine the differences in learning outcomes between the experimental group and the control group. Meanwhile, qualitative data from observations and interviews were analysed thematically to provide an in-depth overview of the students' engagement processes and the effectiveness of the developed model.

This study has received approval from the Ethics Committee of the State University of Malang. Informed consent was obtained from the students' parents or guardians, and official permission from the school was secured prior to data collection. All participants' confidentiality was protected, and they were given the right to withdraw from the study at any time without any consequences.

RESULTS

Description of the Definition Stage (Define)

Initial Analysis

Based on the observations and conversations between the researcher and several teachers at a public elementary school in Malang City, student participation has not yet become part of the learning process. Teachers still use standard teaching strategies, such as giving practice questions, providing example problems, and summarising ideas or processes through a series of questions and answers. As a result, students are not accustomed to creating their own knowledge or problem-solving strategies.

The problem-based learning model is one of the teaching strategies that can prioritise students' work outcomes by emphasising the importance of using contextual problems. Therefore, creating high-quality learning tools becomes very important. The learning resources created for this research consist of:

1. Lesson Plan

   The lesson plan, which consists of four sessions, outlines the core competencies, basic competencies, indicators, learning objectives, main materials, teaching models, methodologies and techniques, required resources, and stages of the learning activities. The five phases of the learning activities, or the learning scenario, are as follows: sharing goals and students' motives sets the stage for learning, which is then followed by information presentation, group organisation, group guidance, evaluation, and giving rewards.

2. Teacher’s Guidebook

   Lesson plans and contextual problems relevant to the topic are included in the teacher's guidebook. Four (4) meetings on the subject are scheduled, each featuring contextual problems. Bruner's learning theory, which comprises three different modes of presentation-enactive (through action), iconic (internal imagery), and symbolic (using words or language) - is used in designing the content presented in the teacher's book. In addition to the fact that students play a dominant role in the process of constructing knowledge, the problems presented are real difficulties related to the students' environment.

3. Student Handbook

   The narrative about my field was chosen with the understanding that elementary school students should be taught this subject because of its importance and based on observations by elementary school teachers that students struggle with the material when faced with real-world problems. This textbook is intended to serve as a guide for students. Bruner's learning theory, which consists of three methods of presentation-enactive (through actions), iconic (internal mental images), and symbolic (using words or language)-is used in the design of the content presented in this book. The issues raised are current topics related to the learning environment, and students also have a significant influence on the process of knowledge creation.

4. Student Activity Sheet

   With the help of the teacher, students must formulate concepts, principles, and methods from the material discussed in structured learning activities developed for this subject. Four sets of reinforcement challenges and problem-solving exercises make up the developed LAS.

5. Students' Computational Thinking Ability Test

The instrument for assessing computational thinking skills, the computational thinking test questions before and after the test, the scoring guidelines, and the answer key are all included in the test blueprint for learning outcome assessment.

Student Analysis

This study focuses on three main features of fourth-grade students in the 2023-2024 academic year: cognitive development, academic aptitude, and socioeconomic background. Students in fourth grade at elementary school are typically between 9 and 11 years old. Fourth-grade students are in the concrete operational stage if Piaget's stages of cognitive development are to be trusted. Students at this age still need concrete materials to learn, even in the form of everyday occurrences. Therefore, the application of Bruner's learning theory in mathematics education is very sensible. There are three (3) ways to present Bruner's theory: the enactive mode (through action), the iconic approach (in the mind), and the symbolic mode (using words or language), in which challenges are drawn from their real-life experiences. Learning materials are organised from more concrete to more abstract concepts to facilitate students' understanding of the subject matter.

Based on the academic achievements of fourth-grade elementary students, it appears that they have never been involved in a learning approach based on local culture. For students, this means that such a learning model is still relatively new. In terms of socioeconomic background, students' parents work in a variety of fields, such as traders, entrepreneurs, civil servants, and others. The school and the students' parents or guardians have established a good relationship. In addition, parents provide a lot of support for their children's school activities.

Description of the Planning (Design) Stage

The results of each activity in the planning stage can be described as follows:

Media Selection Results

At this stage, suitable instructional media are produced for use in implementing the problem-based learning model based on the culture of the Aneuk Jamee ethnic group for 4th grade students at SDN, as shown in the following Table 1.

Selection Results Format

The format of learning support tools is selected by considering the process, attributes, and guiding principles of the Problem Based Learning model. Core competencies, basic competencies, indicators, learning objectives, main materials, models, approaches, and learning techniques, as well as the necessary materials and stages of learning activities (learning scenarios), are all included in the lesson implementation plan. There is an introduction, three main activities, and a conclusion in the learning scenario. To spark students' interest and encourage them to keep learning, color is used throughout the teacher's guidebook, student book, and Student Activity Sheets.

Table 1
Learning media for the PBL learning model based on Aneuk Jamee ethnic culture

No.	Lesson Plan	Media
1.	Lesson Plan I	Lesson plan I, student worksheet I, student worksheet, teacher management sheet, and student book are all used in the learning process
2.	Lesson Plan II	Lesson plan II, student activity sheet II, student handbook, student book, teacher management sheet, and student activity sheet in the learning process
3.	Lesson Plan III	Lesson plan III, student worksheet III, teacher management sheet, student book, and instructor handbook in the learning process
4.	Lesson Plan IV	Lesson plan IV, student activity sheet IV, instructor management sheet, student handbook, and student book in the learning process

[1] Tables may have a footer

Initial Design Results

At this stage, a computational thinking skills test, assessment criteria, answer key, teacher's guidebook, student book, and lesson plans for four meetings were developed. All outputs from this design stage are referred to as draft-A.

Development Stage Results (Develop)

The following is the display of the learning device development results from each activity in this development stage:

Expert Validation Results

The validator or expert validates Draft-A. Validation is now carried out on the learning materials by examining the graphics, language, content, format, and compatibility with the problem-based learning approach. The Lesson Plan (RPP), the problem-based learning model, and the Student Activity Sheet (LAS), which adhere to Bruner's theory of learning, are the learning materials evaluated by the validator. The revised materials are referred to as draft-B. Draft-B is the name given to the learning materials considered valid by the validator. The following is an overview of the validation results from the experts:

1. Validation Results of the Lesson Plan (RPP) (Table 2)

Table 2
Learning media for the PBL learning model based on Aneuk Jamee ethnic culture

No.	Aspect Assessed	Validators who gave Grades						
		1	2	3	4	5	Criterion Average	Aspect Average
1.	Format							
	Clarity of material division	0	0	1	2	2	4.2	4.35
	Clarity of the numbering system	0	0	0	2	3	4.6	
	Layout and spacing	0	0	1	3	1	4.0	
	Size and font suitability	0	0	0	2	3	4.6	

Table 2 *(continued)*

No.	Aspect Assessed	Validators who gave Grades						
		1	2	3	4	5	Criterion Average	Aspect Average
2.	Language							
	The sentence must be grammatically correct	0	0	0	5	0	4.0	3.96
	According to the age and level of reading ability of the students	0	0	1	4	0	3.8	
	Sentences should be simple in structure	0	0	0	5	0	4.0	
	A phrase must not have two meanings	0	0	0	5	0	4.0	
	The sentence must be grammatically correct	0	0	1	3	1	4.0	
3.	Content							
	Logically, the truth of the content of the material is divided into parts	0	0	0	2	3	4.6	4.32
	Activities designed for instructors and students are formulated in a straightforward and practical way, making it easier for teachers to incorporate them into the classroom learning process	0	0	1	3	1	4.0	
	In accordance with the PBL learning model	0	0	0	3	2	4.4	
	In accordance with the state curriculum (independence)	0	0	0	1	4	4.8	
	Adequacy of material arrangement	0	0	1	4	0	3.8	
	Sum						58.8	12.63
	Total Average						4.21	
	Validation Results						Excellent	

[1] Tables may have a footer.

Information:

1: means "not good" 4: means "good"

2: means "not good" 5: means "very good"

3: means "good enough"

Average score = $\frac{jumla\ h\ skor\ \ yang\ \ diperole\ h}{banyak\ \ aspek\ \ pengamatan}$

The validity criteria for learning tools are:

$4 \leq RTV\ _{PP} \leq 5$	Very valid
$3 \leq RTV\ _{PP} < 4$	Valid
$2 \leq RTV\ _{PP} < 3$	Less Valid
$1 \leq RTV\ _{PP} < 2$	Invalid

The components of the learning implementation plan are considered quite good, good, or very good based on the results of expert validation calculations conducted by five experts on the Learning Implementation Plan (RPP) in Table 2. Thus, a total average of 4.21 was obtained from the calculation results. The results of the validation of the learning implementation plan are included in the "Excellent" category. The validator's response to the lesson plan has the following reliability levels:

$$JK_b = \frac{1}{k\sum X(i)} 2 - \frac{(\sum X\ldots)^2}{n_t} = 7.20$$

$$JK_k = \frac{1}{k\sum X(j)} 2 - \frac{(\sum X\ldots)^2}{n_t} = 2.62$$

$$JK_t = \frac{1}{k\sum X(ij)} 2 - \frac{(\sum X\ldots)^2}{n_t} = 23.20$$

$$JK_e = JK_t - JK_k - JK_b = 13.37$$

$$RJK_b = \frac{JK_b}{db_b} = 0{,}55$$

$$RJK_e = \frac{JK_e}{db_e} = 0{,}25$$

$$r = \frac{RJK_b - Rjk_e}{RJK_b} = 0.53$$

The level of suitability of the learning implementation plan must be 0.53 in the medium category to meet the validator assessment criteria. Corrections, criticisms, and suggestions are collected from validator assessments and considered when the learning implementation plan is revised.

2. Results of Teacher Handbook Validation (Table 3)

The components of the teacher's handbook received a good, good, and very good assessment based on the results of expert validation calculations carried out by five experts on the Teacher's Handbook in Table 3. Thus, an average total of 4.65 was obtained from the calculation results. "Very Good" is the classification given to the results of the teacher's handbook validation. The following is the validity of the validator's response to the teacher's handbook (BPG):

$$JK_b = \frac{1}{k\sum X(i)} 2 - \frac{(\sum X\ldots)^2}{n_t} = 7.68$$

$$JK_k = \frac{1}{k\sum X(j)} 2 - \frac{(\sum X\ldots)^2}{n_t} = 8.67$$

$$JK_t = \frac{1}{k\sum X(ij)} 2 - \frac{(\sum X\ldots)^2}{n_t} = 34.48$$

$$JK_e = JK_t - JK_k - JK_b = 18.12$$

$$RJK_b = \frac{JK_b}{db_b} = 0{,}51$$

$$RJK_e = \frac{JK_e}{db_e} = 0{,}30$$

$$r = \frac{RJK_b - Rjk_e}{RJK_b} = 0.41$$

Table 3
Results of Teacher Handbook Validation (BPG)

No.	Aspects Assesed	Validators who gave Grades						
		1	2	3	4	5	Average Criteria	Aspect Average
1.	Format							
	Clarity of material division	0	0	0	1	4	4.8	4.80
	Clarity of the numbering system	0	0	1	0	4	4.6	
	Layout and spacing	0	0	0	0	5	5.0	
	Size and font suitability	0	0	0	1	4	4.8	

Table 3 (*continued*)

No.	Aspects Assesed	Validators who gave Grades 1	2	3	4	5	Average Criteria	Aspect Average
2.	Language							
	Correct grammar	0	0	0	1	4	4.8	4.48
	Sentences that are appropriate for the age and cognitive level of the student	0	0	1	2	2	4.2	
	Simple structured sentences	0	0	1	3	1	4.0	
	Ambiguity-free sentences	0	0	0	0	5	5.0	
	Clear instructions and instructions	0	0	1	1	3	4.4	
3.	Content							
	Logically, the truth of the content of the material is divided into parts	0	0	1	0	4	4.6	4.60
	Activities designed for students and instructors are structured in a clear and practical way, making it easy for teachers to incorporate them into classroom lesson plans	0	0	1	1	3	4.4	
	In line with the PBL learning paradigm	0	0	0	1	4	4.8	
	In accordance with the state curriculum (independence)	0	0	0	2	3	4.6	
4.	Illustration							
	Support the concept with illustrations	0	0	0	0	5	5.0	4.73
	Provide visual stimulation	0	0	0	0	5	5.0	
	Easy to understand	0	0	2	0	3	4.2	
	Sum						74.2	18.61
	Total Average						4.65	
	Validation Result						Excellent	

[1] Tables may have a footer.

Information:

1: means "not good" 4: means "good"

2: means "not good" 5: means "very good"

3: means "good enough"

Average score = $\frac{jumlah\ skor\ yang\ diperoleh}{banyak\ aspek\ pengamatan}$

The validity criteria for learning tools are:

$4 \leq RTV_{PP} \leq 5$	Very valid
$3 \leq RTV_{PP} < 4$	Valid
$2 \leq RTV_{PP} < 3$	Less Valid
$1 \leq RTV_{PP} < 2$	Invalid

The teacher handbook conformity rate is 0.41 with a medium category, according to validator assessment standards.

Corrections, criticisms, and suggestions are collected from validator assessments and considered when the teacher handbook is revised.

3. Student Handbook Validation Results (Table 4).

Based on Table 4, which shows the results of expert validation calculations carried out by five experts on Student Books (BS), the components of the student book are considered quite good, good, or very good. Thus, a total average of 4.41 was obtained from the calculation results. The student's book was rated "Excellent" in the validation process. The validator's response to the student's book (BS) has the following levels of reliability:

$$JK_b = \frac{1}{k\sum X(i)} 2 - \frac{(\sum X\dots)^2}{n_t} = 8.18$$

$$JK_k = \frac{1}{k\sum X(j)} 2 - \frac{(\sum X\dots)^2}{n_t} = 32.17$$

$$JK_t = \frac{1}{k\sum X(ij)} 2 - \frac{(\sum X\dots)^2}{n_t} = 54.98$$

$$JK_e = JK_t - JK_k - JK_b = 14.62$$

Table 4
Student Book Validation Results

No.	Aspects Assesed	Validators who gave Grades						
		1	2	3	4	5	Average Criteria	Aspect Average
1.	Format							
	Clarity of material division	0	0	1	0	4	4.6	4.60
	Clarity of the numbering system	0	0	1	0	4	4.6	
	Layout and spacing	0	0	1	0	4	4.6	
	Size and font suitability	0	0	1	0	4	4.6	
2.	Language							
	Correct grammar	0	0	2	3	0	3.6	4.04
	Sentences that are appropriate for the age and cognitive level of the student	0	0	1	2	2	4.2	
	Simple structured sentences	0	0	1	4	0	3.8	
	Ambiguity-free sentences	0	0	1	0	4	4.6	
	Clear instructions and instructions	0	0	1	3	1	4.0	
3.	Content							
	Logically, the truth of the content of the material is divided into parts	0	0	1	0	4	4.6	4.55
	Activities designed for students and instructors are structured in a clear and practical way, making it easy for teachers to incorporate them into classroom lesson plans	0	0	1	0	4	4.6	
	In line with the PBL learning paradigm	0	0	1	0	4	4.6	
	In accordance with the state curriculum (independence)	0	0	1	1	3	4.4	

Table 4 (*continued*)

No.	Aspects Assesed	Validators who gave Grades						
		1	2	3	4	5	Average Criteria	Aspect Average
4.	Illustration							
	Support the concept with illustrations	0	0	1	0	4	4.6	4.47
	Provide visual stimulation	0	0	1	0	4	4.6	
	Easy to understand	0	0	2	0	3	4.2	
	Sum						70.2	17.66
	Total Average						4.41	
	Validation Result						Excellent	

[1] Tables may have a footer

Information:

1: means "not good"
4: means "good"
2: means "not good"
5: means "very good"
3: means "good enough"

Average score = $\frac{jumlah\ skor\ yang\ diperoleh}{banyak\ aspek\ pengamatan}$

The validity criteria for learning tools are:

$4 \leq RTV_{PP} \leq 5$ Very valid

$3 \leq RTV_{PP} < 4$ Valid

$2 \leq RTV_{PP} < 3$ Less Valid

$1 \leq RTV_{PP} < 2$ Invalid

$$\text{RJK}_b = \frac{JK_b}{db_b} = 0{,}54$$

$$\text{RJK}_e = \frac{JK_e}{db_e} = 0{,}24$$

$$r = \frac{RJK_b - Rjk_e}{RJK_b} = 0.55$$

The student book (BS) has a conformity rate of 0.55 with a medium category, according to the validator's assessment criteria.

Revisions, criticisms, and recommendations are received from validator evaluations and incorporated into the student's book.

4. Results of Validation of Student Activity Sheet (LAS) (Table 5).

The student activity sheet component obtained a good, good, and excellent rating based on the results of expert validation calculations conducted by five experts on the Student Activity Sheet (LAS) in Table 5.

Table 5
Results of Validation of Student Activity Sheet (LAS)

No.	Rated Aspect	Validator who gave the Scores						
		1	2	3	4	5	Criteria Average	Average Aspect
1.	Format							
	Clarity of material division	0	0	0	1	4	4.8	4.40
	Clarity of the numbering system	0	0	1	3	1	4.0	
	Layout and spacing	0	0	1	1	3	4.4	
	Appropriateness of font size and type	0	0	1	1	3	4.4	
2.	Language							
	The sentence must be grammatically correct	0	0	0	5	0	3.8	4.24
	Appropriate for the age and reading level of the students	0	0	1	4	0	4.2	
	Sentences should be simple in structure	0	0	0	5	0	4.2	
	A phrase must not have two meanings	0	0	0	5	0	5.0	
	The sentence must be grammatically correct	0	0	1	3	1	4.0	
3.	Content							
	Truthful information divided into logical parts	0	0	0	2	3	4.6	4.60
	Bruner's learning theory states that the following criteria must be met: enactive, iconic, and symbolic Appropriateness of material order	0	0	1	3	1	5.0	
	The truth of the information is divided into logical parts	0	0	0	3	2	4.2	
	Sum						52,6	13,24
	Total Average						4,41	
	Validation Results						Very Good	

[1] Tables may have a footer

Information:

1: means "not good"
2: means "not good"
3: means "good enough"
4: means "good"
5: means "very good"

Average score = $\frac{jumlah\ skor\ yang\ diperoleh}{banyak\ aspek\ pengamatan}$

The validity criteria for learning tools are:

$4 \leq RTV_{PP} \leq 5$	Very valid
$3 \leq RTV_{PP} < 4$	Valid
$2 \leq RTV_{PP} < 3$	Less Valid
$1 \leq RTV_{PP} < 2$	Invalid

Thus, a total average of 4.41 was obtained from the calculation results. The results of the validation of student activity sheets are included in the "Very Good" category.

Corrections, criticisms, and recommendations are received from the results of the validator's evaluation and are considered when the student activity sheet is revised.

Results of Expert Validation of Research Instruments

The Pre and Post Cultural Value Ability Test is an instrument that will be validated by qualified validators. The suitability of the question content with the ability indicator will determine the validity of the question.

Results of Validation of Computational and Differentiated Thinking Ability Tests

The computational thinking ability *pre-test* component obtained good and excellent ratings, according to the expert validation calculations conducted by five experts on the computational thinking ability *pre-test* and differentiation in the table above. As a result, a total average of 4.27 was determined from the calculation results. "**Very Good**" was the classification given to the computational thinking ability pre-test validation results (Table 6).

Computational Thinking Ability Test Validation Results

The components of the computational thinking post-test were rated as good or excellent based on the expert validation calculations conducted by five experts, as shown in Table 7. Thus, a cumulative average of 4.40 was determined by the calculation results. "Very Good" was the classification given for the post-test validation results of computational thinking ability.

Readability and Practicality Test

Before the pilot test, the readability test of draft-B was first conducted to 12 fourth grade students and to the predetermined validators. The results of the readability test analysis and the validation results by validators were used to revise the draft-B. It turned out that the device that was prepared did not undergo any changes, only a few revisions occurred. Based on the information in chapter III, the device is said to be practical if the learning device developed can be applied and used in the field with little or no revision. So, the draft-B that has been declared valid is called draft-C, which will be used for the trial.

Trial 1

The first trial or simulation of learning devices was conducted by researchers in this initial trial. We conducted this trial/simulation in class IV. Researchers conducted this trial/simulation directly, acting as teachers to practice the use of learning devices. The first trial was conducted for four meetings in accordance with the lesson plan that had been prepared.

Based on the results of the first trial, the LAS did not undergo any changes, but the lesson plan underwent changes, especially

Table 6
Validation results of computational and differentiated thinking ability tests

No.	Aspect Assessed	Validator who gave the Scores						
		1	2	3	4	5	Criteria Average	Average Aspect
1.	Instructional Clarity							
	Guidelines for conducting the proficiency test	0	0	0	5	0	4.00	4.00
2.	Content							
	The content of the proficiency test is aligned with the achievement indicators	0	0	0	4	1	4.20	4.20
3.	Language							
	Grammar appropriate for students' age, reading level, and cognitive capacity	0	0	0	1	4	4.80	4.60
	Simplicity of sentence structure	0	0	0	4	1	4.20	
	The language used is communicative	0	0	0	1	4	4.80	
	Total						22	12.80
	Total Average						4.27	
	Validation Result						Very Good	

[1] Tables may have a footer

Information:

1: means "not good"
2: means "not good"
3: means "good enough"
4: means "good"
5: means "very good"

$$\text{Average score} = \frac{jumlah\ skor\ yang\ diperoleh}{banyak\ aspek\ pengamatan}$$

The validity criteria for learning tools are:

$4 \leq RTV_{PP} \leq 5$	Very valid
$3 \leq RTV_{PP} < 4$	Valid
$2 \leq RTV_{PP} < 3$	Less Valid
$1 \leq RTV_{PP} < 2$	Invalid

regarding the information to be discussed at the first meeting and changes in time allocation.

The second trial of the learning tools was subsequently analysed to finalise Draft-C and inform minor revisions prior to implementation.

The lesson plan that has been created requires four meetings to conduct the second trial, in addition to two meetings for pre- and post-tests. You can see the trial schedule in Appendix 9. Class IV was the selected class. In this exercise, the

Table 7
Computational thinking ability test validation results

No.	Aspect Assessed	Validator who gave the Scores						
		1	**2**	**3**	**4**	**5**	**Criteria Average**	**Average Aspect**
1.	Instructional Clarity							
	Guidelines for conducting the proficiency test	0	0	0	5	0	4.00	4.00
2.	Content							
	The content of the proficiency test is aligned with the achievement indicators	0	0	0	2	3	4.60	4.60
3.	Language							
	Grammar appropriate for students' age, reading level, and cognitive capacity	0	0	0	1	4	4.8	4.60
	Simplicity of sentence structure	0	0	0	4	1	4.2	
	The language used is communicative	0	0	0	1	4	4.8	
	Total						22.40	13.20
	Total Average						4.40	
	Validation Result						Very Good	

[1] Tables may have a footer

Information:

1: means "not good"
2: means "not good"
3: means "good enough"
4: means "good"
5: means "very good"

Average score = $\frac{jumlah\ skor\ yang\ diperoleh}{banyak\ aspek\ pengamatan}$

The validity criteria for learning tools are:

$4 \leq RTV_{PP} \leq 5$	Very valid
$3 \leq RTV_{PP} < 4$	Valid
$2 \leq RTV_{PP} < 3$	Less Valid
$1 \leq RTV_{PP} < 2$	Invalid

researcher used the created device as a tool and acted as the teacher. Two observers who had separate tasks attended the trial. Two observers observed the students' actions and the teacher's capacity to supervise the instruction.

Students were divided into 5 groups during the learning process: 2 students were in the middle group, 2 students were in the lower group, and 1 student was in the upper group. Based on odd semester grades and interviews or meetings with relevant teachers, students were grouped into upper, middle, and lower grades. Thus, it can be concluded that the average competence of students in each group is comparable.

Group selection has a significant impact on how well LAS is completed. In this study, the groups used are problem-based groups. The LAS problems tailored to the topic will be worked on by the students. Students with group number 1, for example, worked on the LAS according to their number, that is, they only worked on problem 1 or problem number 1, and so on. When students' ability determined the difficulty level of the problems, the problem numbers were modified to match the sequential numbers of the students in the initial group, so that the expert group discussion could proceed as planned.

Only one group of students was observed as they were engaged in their activities. This observation covered four meetings (4 lesson plans). This was done for the following reasons:

1. Since the average skills of each group were relatively similar, one group could represent the other groups.
2. It is impossible for a single observer to thoroughly document several groups.
3. During the learning process, observations were made constantly every four minutes (plus one additional minute for notetaking).

Draft-C was revised into the final device after the data from the second trial was examined and the results were considered. Statistics on students' responses before, after, and after were included in the data collected from the pilot test, along with information on students' activities and teachers' capacity to supervise learning.

Results of Observations of Student Activity During Learning

Student activities were observed by an observer. Of the six groups formed, the observer only saw one group of five students. During the learning process, observations were made and the results are shown in Table 8.

With the exception of the first meeting (lesson plan I), where the percentage of student activity exceeded the activity cut-off criteria - that is, actively paying attention and listening to the teacher's or friends' explanations - it is clear from the table above that, on average, student activity was within the parameters of the learning effectiveness cut-off as described in chapter III.

This makes sense as regular learning continues to impact educators and students as they adapt to the new learning model. Thus, most of the students' work was still listening to the teacher explain things. To prepare for this, the researcher encouraged students to participate more actively in the learning process on the second meeting. For example, the researcher in this case provides questions that encourage the emergence of students' ideas for solutions to the given contextual difficulties. It is expected that the predetermined aspects will be at the threshold of learning effectiveness at the next meeting. The learning device was not revised based on the findings of the student activity observations because in general the proportion of student activity was at the threshold of the limitations of learning efficacy.

Table 8
Percentage of student activity during learning

No.	Observation Category	Percentage of Student Activity in Learning				Criteria Limit Activity (%)
		Lesson Plan I	Lesson Plan II	Lesson Plan III	Lesson Plan IV	
1.	Attending/listening to teacher/ friend explanation actively	19.667	14.333	10.667	10.333	9 - 19
2.	Reading/understanding the contextual problem on the student LAS	9.000	13	12.333	12.667	6 - 16
3.	Solving problems/finding answers and ways to answer contextual problems	33.333	35.000	35.333	36.333	33 - 43
4.	Discussion/questioning between students and teacher	20.000	21.000	24.667	25.000	19 - 29
5.	Draw conclusions of a procedure/concept	13.333	14.667	15.333	14.333	8 - 18
6.	Behaviour that is not relevant to the KBM	4.667	2.000	1.667	1.333	0 - 5

[1] Tables may have a footer

Assessment Result of Teacher's Ability to Manage Learning

The results of the assessment of teachers' ability to manage learning are presented in the Table 9.

Results of Student Response Questionnaire

After following the Aneuk Jamee culture-based problem-based learning model, thirty students were given a student response questionnaire. The results are shown in detail in the Table 10.

The table above shows that, overall, and particularly about learning devices, student responses are above 80%. This includes their evaluation of the learning component, which includes student books, student activity sheets (LAS), and computational thinking skills assessments. This indicates that all elements received good feedback from students, preventing any revisions to the learning tools based on student feedback.

Research Results on Students' Computational Thinking Ability Test

The entire learning process during the research, both in the experimental class and the control class, was obtained to determine the learning output on computational thinking skills.

Description of Students' Computational Thinking Skills

The output findings of the use of SPSS 17 software to handle post-test data regarding

Table 9
Teacher's ability to manage learning

No.	Activity/Aspect Observed	Lesson Plan I	Lesson Plan II	Lesson Plan III	Lesson Plan IV
		Average	Average	Average	Average
1.	The introduction consists of				
	Conveying learning objectives	4	4.5	4	4
	Motivating students	4	4.5	4	4
2.	Core activities consist of				
	Presenting information	4	4	5	5
	Organizing into learning groups	3.5	5	5	5
	Guiding group work and learning	3	5	5	5
	Providing evaluation	3	4	4	4
	Giving awards	3	4	4	4
3.	The cover consists of				
	Reaffirm the conclusion of the material	4	5	5	5
	Gave some questions as independent assignments	4	4	4	4
4.	Learning time management	4	5	4	4
5.	The atmosphere in the classroom consists of				
	Students' enthusiasm for learning	3	4	4.5	4
	Teachers' enthusiasm in managing learning.	3.5	5	5	4
	Number	43	54	53.5	52
	Average	3.58333	4.5	4.45833	4.33333

[1] Tables may have a footer

students' computational thinking skills are shown in Table 11.

The Tables and Figure 1 show that the experimental-class highest score for computational thinking skills is 50 higher than the control class score, which is 45, while the experimental class's minimum score of 39 is much lower than the control class score, which is 28. The average score of the experimental class on the computational thinking ability test, which was 44.00, was higher than the control class score of only 37.60. In terms of achievement scores, the experimental class obtained an average of 88% of the ideal score, compared to 75.2% for the control group.

Table 12 shows the results of the calculation of the mean difference test for the post-test computational thinking ability test:

As can be seen from the previous table, the calculation yields tcount = 9.50 ttable = 1.701, which means that or is accepted. As a result, children who learned using Aneuk Jamee's culture-based problem-based learning model had higher computational thinking skills than students who received normal learning. These results indicate that students in the experimental class

Table 10
Results of student response questionnaire to the device and implementation of problem-based learning model

No.	Aspect Observed	Percentage	
		Happy	**Not Happy**
1.	How do you feel about the:		
	Course Content	100 %	0 %
	Student Book	93.33 %	6.67 %
	Student Activity Sheet (LAS)	90 %	10 %
	Classroom Learning Atmosphere	96.67 %	3.33 %
	The way the teacher teaches	93.33 %	6.67 %
		New	**Not New**
2.	How do you feel about the components?		
	Course Content	90 %	10 %
	Student Book	93.33 %	6.67 %
	Student Activity Sheet (LAS)	100 %	0 %
	Classroom Learning Atmosphere	100 %	0 %
	The way the teacher teaches	100 %	0 %
		Interested	**Not Interested**
3.	Are you interested in participating in further learning activities like the one you have participated in now?	93.33%	6.67%
		Yes	**No**
4.	What do you think about the student book and the Student Activity Sheet (SAS)?		
	Were you able to understand the language used in the student book/LAS?	96.67%	3.33%
	Are you interested in the appearance (writing, illustrations, pictures, and the location of the pictures) contained in the student book/LAS?	96.67%	3.33%

[1] Tables may have a footer

Table 11
Data of students' computational skills test results

	N	Minimum	Maximum	Mean	Std. deviation
Experiment	30	39	50	44.00	4.000
Control	30	28	45	37.60	6.157
Valid N (listwise)	30				

[1] Tables may have a footer

outperformed the control class on the computational thinking post-test, supporting the effectiveness of the digitally mediated PBL model integrating Aneuk Jamee values.

DISCUSSION

The results of this study highlight the significant impact of integrating Aneuk Jamee cultural values into digital problem-

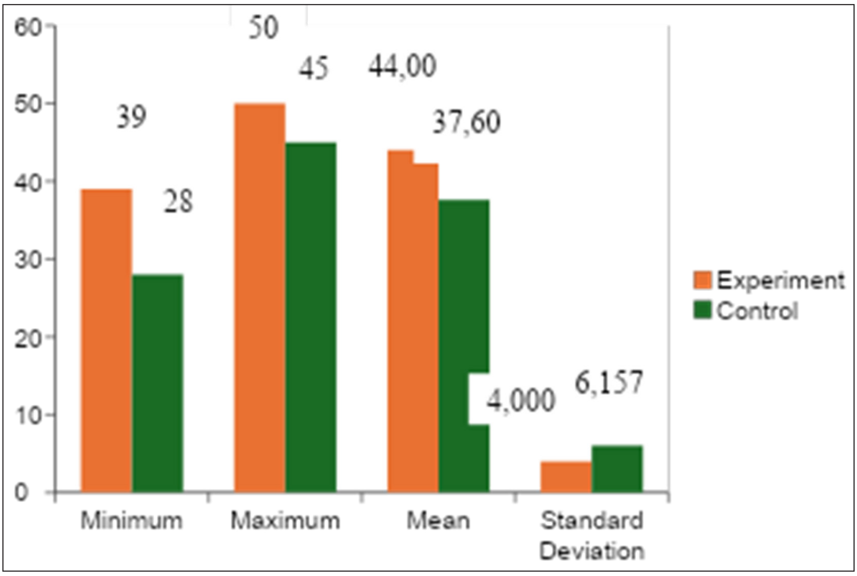

Figure 1. Mastery of students' computational thinking ability post-test in experimental and control classes

based learning (PBL) on students' learning outcomes, engagement, and cultural awareness. The improvement in students' computational thinking skills, observed through statistically significant differences between experimental and control groups, confirms the hypothesis that culturally contextualised digital learning can enhance not only cognitive development but also socio-cultural competence in elementary education.

The magnitude of improvement in computational thinking observed in the experimental group is not only statistically significant but also pedagogically meaningful. An average achievement of 88% compared to 75.2% in the control group indicates that the developed model substantially enhanced students' problem-solving capabilities and logical reasoning in authentic classroom settings. This level of improvement suggests that the integration of culturally grounded problem contexts within a digital PBL framework provides learners with cognitively rich and emotionally engaging learning experiences that exceed conventional instructional approaches. From a classroom practice perspective, this finding demonstrates that culturally contextualised digital learning can effectively translate abstract computational concepts into concrete learning actions suitable for primary learners.

The integration of Aneuk Jamee values-such as cooperation, respect for elders, and environmental stewardship-provided a meaningful learning context that fostered greater student motivation and active participation. This is consistent with Gay (2013), who emphasises that culturally responsive teaching creates relevance between students' cultural experiences and

Table 12
Test the difference in average points test students' computational thinking ability

Aspects		t			Conclusion				Conclusion
	$\overline{X_e}$		S2e	$\overline{X_k}$	Cs	S2k			
Computational Thinking Ability	44.00	2.45	6	37.60	2.75	7.6	9.50	1.701	Better

H_0:Aneuk Jamee's culture-based problem-based learning paradigm does not change the computational thinking skills of students who receive regular instruction from those who learn using learning devices.

academic content, resulting in improved learning engagement. Furthermore, the digital delivery of these values through student-centered materials enabled students to visualise, manipulate, and internalise abstract cultural and academic concepts in a more interactive and intuitive manner.

The application of the Bruner learning theory-enactive, iconic, and symbolic representation-proved to be an effective framework for structuring instructional materials that align with the cognitive development stage of 9-11-year-old learners. This aligns with Hung (2011), who asserts that the cognitive scaffolding inherent in PBL can be optimised through concrete and localised problem contexts, which in this study were derived from Aneuk Jamee culture. The LAS (Student Activity Sheets), textbooks, and digital materials provided layered cognitive support that facilitated gradual abstraction of knowledge, supporting Piaget's operational concrete stage of development theory.

Notably, positive feedback from students, with over 90% indicating enjoyment, novelty, and interest, suggests that the model resonates with learners' psychological and emotional dimensions. This supports Voogt, Fisser, et al. (2013) and Zhao (2022), who argue that 21st century education must incorporate affective dimensions of learning, including cultural identity and student agency.

This study's findings also extend the discourse on the synergy between local culture and digital pedagogy. While previous studies (Dolmans et al., 2005; Hmelo-Silver, 2004) explored the effectiveness of PBL, few have examined its implementation through a digital cultural framework in elementary school settings. The digital contextualisation of local values in this study demonstrates how technology can revitalise indigenous knowledge systems and promote inclusive, multicultural learning experiences. This is particularly relevant in post-pandemic educational transformation, where hybrid learning models and localised content are crucial (OECD, 2023).

Nevertheless, this study has limitations. The research was conducted in a single elementary school with a relatively small sample size, which may affect the generalisability of findings. Moreover, the long-term retention of cultural knowledge and computational thinking skills was not assessed. Future studies are encouraged to implement longitudinal designs and explore comparative cultural frameworks across different ethnic groups and geographical regions in Indonesia.

In conclusion, the discussion underscores that integrating culturally rich, digitally mediated PBL models into elementary education not only enhances core academic skills but also strengthens students' cultural rootedness and global readiness. The study contributes a novel instructional design that bridges local wisdom and global competencies, making it a relevant and scalable model for future curriculum development in multicultural contexts.

Despite the promising findings, this study has several limitations that should be acknowledged. First, the research was conducted in a single elementary school with a relatively small sample size, which may limit the generalisability of the results to broader educational contexts. Second, the cultural specificity of Aneuk Jamee values means that the instructional model may require contextual adaptation before being applied in other cultural settings. Third, this study did not examine long-term retention of computational thinking skills or cultural identity development, focussing instead on short-term learning outcomes. Future research is therefore encouraged to employ longitudinal designs, larger and more diverse samples, and cross-cultural comparisons to further validate and extend the applicability of the proposed model.

From a practical perspective, this study offers concrete guidance for teachers and schools seeking to implement culturally responsive digital learning: teachers can adapt the digitally mediated PBL model by designing problem scenarios rooted in local cultural contexts relevant to their students to enhance engagement and contextual understanding, while schools and curriculum developers can integrate local wisdom systematically into digital learning platforms as part of culturally grounded curriculum innovation. From a research perspective, the study also opens pathways for further investigation into integrating diverse local cultures within digital pedagogical models, including examining scalability across regions, integration with emerging technologies such as artificial intelligence or virtual reality, and assessing long-term impacts on both cognitive and identity-related learning outcomes.

ACKNOWLEDGEMENT

This research was funded by the Institute for Research and Community Service (LPPM), Universitas Negeri Malang, through the Centre for Education Scheme (Skema Pusat Pendidikan) for the fiscal year 2024. The authors gratefully acknowledge this support, which enabled the successful implementation of the study.

REFERENCES

Amanda, F. F., Ibrohim, I., Lestari, S. R., & Sumitro, S. B. (2023). Enhancing critical thinking and problem solving skills by complexity science problem-based learning model. *Multidisciplinary Journal of Educational Research*, 1-19. https://doi.org/10.17583/remie.9409

Ananda, R., Rafida, T., & Mardhatillah, M. (2023). Turnitin the guidance website: Internet strategy implementation at the university in Industrial 4.0 content. *International Journal of Innovative Research and Scientific Studies, 6*(2), 227-234. https://doi.org/10.53894/ijirss.v6i2.1242

Ansari, K., & Mardhatillah, M. (2020). The role of Aneuk Jamee culture in the forming of millenary characters in the Industrial Revolution 4.0. In *Proceedings of the International Conference on Language and Literature (IC2LC)* (pp. 1-5).

Ballard, E. D., & Haroldson, R. (2021). Analysis of computational thinking in children's literature for K-6 students: Literature as a non-programming unplugged resource. *Journal of Educational Computing Research*, *59*(8), 1487-1516. https://doi.org/10.1177/07356331211004048

Bang, M., & Vossoughi, S. (2019). Participatory design research and educational justice: Studying learning and relations within social change making. *Cognition and Instruction*, *37*(3), 281-290. https://doi.org/10.1080/07370008.2019.1624543

Banks, J. A., & Banks, C. A. M. (Eds.). (2019). *Multicultural education: Issues and perspectives* (10th ed.). Wiley.

Belland, B. R., Kim, C., & Hannafin, M. J. (2020). A framework for designing scaffolds that improve motivation and cognition. *Educational Psychologist*, *55*(1), 1-22. https://doi.org/10.1080/00461520.2019.1659796

Chang, C.-C., & Yang, S.-T. (2023). Interactive effects of scaffolding digital game-based learning and cognitive style on adult learners' emotion, cognitive load, and learning performance. *International Journal of Educational Technology in Higher Education*, *20*(1). https://doi.org/10.1186/s41239-023-00385-7

Chen, J.-S., Chiu, M.-H., & Wang, T.-I. (2021). Effects of culture-integrated project-based learning on students' learning motivation and cultural identity. *Educational Technology Research and Development*, *69*(4), 2071-2093. https://doi.org/10.1007/s11423-021-09999-4

Crespi, P., García-Ramos, J. M., & Queiruga-Dios, M. (2022). Project-based learning (PBL) and its impact on the development of interpersonal competences in higher education. *Journal of New Approaches in Educational Research*, *11*(2), 259-276. https://doi.org/10.7821/naer.2022.7.993

Dias-Oliveira, E., Pasion, R., Vieira da Cunha, R., & Lima Coelho, S. (2024). The development of critical thinking, team working, and communication skills in a business school-a project-based learning approach. *Thinking Skills and Creativity*, *54*, Article 101680. https://doi.org/10.1016/j.tsc.2024.101680

Dolmans, D. H. J. M., De Grave, W., Wolfhagen, I. H. A. P., & van der Vleuten, C. P. M. (2005). Problem-based learning: Future challenges for educational practice and research. *Medical Education*, *39*(7), 732-741. https://doi.org/10.1111/j.1365-2929.2005.02205.x

Dunham, Y., Baron, A. S., & Carey, S. (2011). Consequences of "minimal" group affiliations in children. *Child Development*, *82*(3), 793-811. https://doi.org/10.1111/j.1467-8624.2011.01577.x

Erickson, F., & Shultz, J. (2019). Sociocultural perspectives on learning. *Review of Research in Education*, *43*(1), 1-30. https://doi.org/10.3102/0091732X18821111

World Economic Forum. (2020). *The future of jobs report 2020*. https://www.weforum.org/reports/the-future-of-jobs-report-2020

Gaviria Alzate, S. J., Valencia-Sánchez, W. G., Espinal, F. E., Bustamante, J. L., & Arias-Arias, E. (2024). Tactical critical thinking program on the tactical efficiency index, declarative and procedural knowledge in male soccer players: A case study. *Frontiers in Sports and Active Living*, *6*, Article 1469347. https://doi.org/10.3389/fspor.2024.1469347

Gay, G. (2013). Teaching to and through cultural diversity. *Curriculum Inquiry*, *43*(1), 48-70. https://doi.org/10.1111/curi.12002

Gay, G. (2019). *Culturally responsive teaching: Theory, research, and practice* (2nd ed.). Teachers College Press.

He, W., Zhu, C., & Deneen, C. (2021). Cultural identity and learning engagement: A study of ethnic minority students in blended learning environments. *Computers & Education*, *168*, Article 104211. https://doi.org/10.1016/j.compedu.2021.104211

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, *16*(3), 235-266. https://doi.org/10.1023/B:EDPR.0000034022.16470.f3

Hung, W. (2011). Theory to reality: A few issues in implementing problem-based learning. *Educational Technology Research and Development*, *59*(4), 529-552. https://doi.org/10.1007/s11423-011-9208-1

Jalaluddin, M., Silaban, P. J., Sari, S. M., & Setiawan, D. E. N. Y. (2020). The effect of emotional intelligence on the results of learning mathematics in students elementary school. *Advances in Mathematics: Scientific Journal*, *9*(12), Article 42. https://doi.org/10.37418/amsj.9.12.42

Kasmini, L., Mardhatillah, M., & Prayudi, S. (2024). The impact of a gender mainstreaming-based blended learning flipped classroom model on the solidarity values and problem-solving abilities of students. *International Journal of Innovative Research and Scientific Studies*, *7*(1), 226-239. https://doi.org/10.53894/ijirss.v7i1.2604

Kim, H., & Reeves, T. C. (2021). Reframing research on learning with technology: In search of the meaning of learning in the 21st century. *Educational Technology Research and Development*, *69*(1), 1-14. https://doi.org/10.1007/s11423-020-09831-4

Kim, H., Tan, C., & Lee, J. C.-K. (2021). Curriculum leadership and sociocultural responsiveness in Asian schools. *Asia Pacific Journal of Education*, *41*(2), 221-236. https://doi.org/10.1080/02188791.2020.1867934

Kumi-Yeboah, A., Sallar, A., Kim, Y., & Kiramba, L. K. (2020). Exploring the use of digital technologies from the perspective of diverse learners in online learning environments. *Online Learning*, *24*(4). https://doi.org/10.24059/olj.v24i4.2323

Lai, C.-L., & Hwang, G.-J. (2019). A self-regulated flipped classroom approach to improving students' learning performance in a mathematics course. *Computers & Education*, *130*, 105-121. https://doi.org/10.1016/j.compedu.2018.11.012

Lee, Y.-C. (2024). Changes in learning outcomes of students participating in problem-based learning for the first time: A case study of a financial management course. *The Asia-Pacific Education Researcher*, *34*(1), 511-530.

Looi, C.-K., Wong, L.-H., & Song, Y. (2021). Harnessing technology for effective and culturally responsive learning in Asia: Research and practice. *Computers & Education*, *165*, Article 104145. https://doi.org/10.1016/j.compedu.2021.104145

Mardhatillah, M., Kasmini, L., Yusrizal, Fatmawati, Rambe, T., & Yasrizal. (2020). The influence of information technology and communication technology (ICT)-based learning media on student learning outcomes in mathematics learning in elementary school. *Advances in Mathematics: Scientific Journal*, *9*(12), 10569-10576. https://doi.org/10.37418/amsj.9.12.42

Mardhatillah, K. A., & Adisaputera, A. (2021). The effectiveness of thematic learning model based on the Aneuk Jamee tribe integrated higher order thinking skills (HOTS) in basic school students. *Elementary Education Online*, *20*(5), 6788-6794.

Mardhatillah, S. M. S., Surjono, H., & Muhtadi, A. (2019). Development of teacher and student thematic learning books based on gender and diversity for elementary school students in district of Aceh Barat. *International Journal of Scientific & Technology Research*, *3*(3), 3-6.

Marty, P. F., & Jones, R. S. (2020). Cultural heritage learning in the age of digital transformation. *Museum Management and Curatorship*, *35*(5), 499-514. https://doi.org/10.1080/09647775.2020.1790022

McDaniel, D. S. (2024). Toward culturally digitised pedagogy: Informing theory, research, and practice. *Reading Research Quarterly*, *59*(2), 193-210. https://doi.org/10.1002/rrq.534

Molina-Ayuso, Á., Adamuz-Povedano, N., Torralbo-Rodríguez, M., & Bracho-López, R. (2023). Computational thinking with Scratch: A tool to work on geometry in the fifth grade of primary education. *Sustainability*, *16*(1), Article 110. https://doi.org/10.3390/su16010110

Moon, J., Yeo, S., Banihashem, S. K., & Noroozi, O. (2024). Using multimodal learning analytics as a formative assessment tool: Exploring collaborative dynamics in mathematics teacher education. *Journal of Computer Assisted Learning*, *40*(6), 2753-2771. https://doi.org/10.1111/jcal.13028

OECD. (2023). *Education at a glance 2023: OECD indicators*. OECD Publishing. https://doi.org/10.1787/69096873-en

Orphanidou, Y., Efthymiou, L., & Panayiotou, G. (2024). Cultural heritage for sustainable education amidst digitalisation. *Sustainability*, *16*(4), Article 1540. https://doi.org/10.3390/su16041540

Paris, D., & Alim, H. S. (2014). What are we seeking to sustain through culturally sustaining pedagogy? A loving critique forward. *Harvard Educational Review*, *84*(1), 85-100. https://doi.org/10.17763/haer.84.1.982l873k2ht16m77

Pham, T. H. T., & Renshaw, P. (2021). Moral education in culturally diverse contexts: The role of cultural values in identity formation. *Journal of Moral Education, 50*(3), 345-360.

Rehman, N., Zhang, W., Mahmood, A., Fareed, M. Z., & Batool, S. (2023). Fostering twenty-first century skills among primary school students through math project-based learning. *Humanities and Social Sciences Communications*, *10*(1). https://doi.org/10.1057/s41599-023-01914-5

Reid, J. W., Cole, R., Rushton, G. T., Syed, A., Fatima, A., States, N. E., Fateh, S., Kirbulut Gunes, Z. D., Shah, L., Talanquer, V., Quintanilla, F., Nennig, H. T., & Macrie-Shuck, M. (2022). Investigating patterns of student engagement during collaborative activities in undergraduate chemistry courses. *Chemistry Education Research and Practice*, *23*(1), 173-188. https://doi.org/10.1039/d1rp00227a

Roth, W.-M., & Lee, Y.-J. (2019). Vygotsky's neglected legacy: Cultural-historical activity theory.

Review of Educational Research, *89*(1), 56-98. https://doi.org/10.3102/0034654318822293

Saad, A., & Zainudin, S. (2024). A review of teaching and learning approach in implementing project-based learning (PBL) with computational thinking (CT). *Interactive Learning Environments*, *32*(10), 7622-7646. https://doi.org/10.1080/10494820.2024.2328280

Steketee, A., Williams, M. T., Printz, D., Hooper, L. M., & Valencia, B. T. (2021). Racial and language microaggressions in the school ecology. *Perspectives on Psychological Science*, *16*(5), 1075-1098. https://doi.org/10.1177/1745691621995740

Suarta, I. M., Yarsama, K., Adhiti, I. A. I., & Noortyani, R. (2022). The role of teachers' Indigenous knowledge and cultural competencies in enhancing students' engagement and learning outcomes. *Journal of Ethnic and Cultural Studies*, *9*(1), 244-264. https://doi.org/10.29333/ejecs/1025

Sun, T., Jin, T., Huang, Y., Li, M., Wang, Y., Jia, Z., & Fu, X. (2023). Restoring Dunhuang murals: Crafting cultural heritage preservation knowledge into immersive virtual reality experience design. *International Journal of Human-Computer Interaction*, *40*(8), 2019-2040. https://doi.org/10.1080/10447318.2023.2232976

Sung, Y.-T., Chang, K.-E., & Liu, T.-C. (2020). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. *Computers & Education*, *144*, Article 103709. https://doi.org/10.1016/j.compedu.2019.103709

UNESCO. (2022) Global monitoring of school closures caused by COVID-19. United Nations Educational, Scientific and Cultural Organisation. https://en.unesco.org/covid19/educationresponse

Tan, X., Lin, X., & Zhuang, R. (2024). Development and validation of a secondary vocational school students' digital learning competence scale. *Smart Learning Environments*, *11*(1). https://doi.org/10.1186/s40561-024-00325-6

Tang, K.-S., Murcia, K., Brown, J., Cross, E., Mennell, S., Seitz, J., Phillips, S. R. P., & Sabatino, D. (2024). Exploring the multimodal affordances of digital coding devices in fostering creative thinking in early childhood education. *Thinking Skills and Creativity*, *53*, Article 101602. https://doi.org/10.1016/j.tsc.2024.101602

Varadarajan, S., & Ladage, S. (2022). Exploring the role of scaffolds in problem-based learning (PBL) in an undergraduate chemistry laboratory. *Chemistry Education Research and Practice*, *23*(1), 159-172. https://doi.org/10.1039/d1rp00180a

Veluvali, P., & Surisetti, J. (2021). Learning management system for greater learner engagement in higher education—A review. *Higher Education for the Future*, *9*(1), 107-121. https://doi.org/10.1177/23476311211049855

Voogt, J., Erstad, O., Dede, C., & Mishra, P. (2013). 21st century skills: What research and practice tell us. *Journal of Computer Assisted Learning*, *29*(5), 403-413. https://doi.org/10.1111/jcal.12029

Voogt, J., Fisser, P., Good, J., Mishra, P., & Yadav, A. (2013). Computational thinking in compulsory education: Towards an agenda for research and practice. *Education and Information Technologies*, *20*(4), 715-728. https://doi.org/10.1007/s10639-015-9412-6

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & van Braak, J. (2020). Technological pedagogical content knowledge—A review of the literature. *Journal of Computer Assisted Learning*, *36*(3), 261-272. https://doi.org/10.1111/jcal.12402

Wang, F., & Torrisi-Steele, G. (2019). An empirical study on the impact of culturally responsive teaching on students' engagement and identity development. *Teaching and Teacher Education*, *84*, 27-39. https://doi.org/10.1016/j.tate.2019.04.010

Yuan, Y.-H., Liu, C.-H., & Kuang, S.-S. (2021). An innovative and interactive teaching model for cultivating talent's digital literacy in decision making, sustainability, and computational thinking. *Sustainability*, *13*(9), Article 5117. https://doi.org/10.3390/su13095117

Yüksel, H. G., Solhi, M., Özcan, E., & Giritlioğlu, N. B. (2024). The associations between EFL learners' L2 class belongingness, emotion regulation strategies, and perceived L2 proficiency in an online learning context. *The Language Learning Journal*, *53*(3), 306-322. https://doi.org/10.1080/09571736.2024.2403463

Zhao, Y. (2022). Teaching traditional Yao dance in the digital environment: Forms of managing subcultural forms of cultural capital in the practice of local creative industries. *Technology in Society*, *69*, Article 101943. https://doi.org/10.1016/j.techsoc.2022.101943

Zhao, Y., & Watterston, J. (2021). The changes we need: Education post COVID-19. *Journal of Educational Change*, *22*(1), 3-12. https://doi.org/10.1007/s10833-020-09417-3