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Artificial intelligence-supported cultural values education for ethnic minority students in Vietnam

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ABSTRACT

Cultural value education plays an important role in strengthening the cultural identity and heritage awareness of ethnic minority high school students. However, conventional educational evaluations rely mainly on manual analysis and often fail to reveal hidden patterns in students' perceptions. This study proposes an artificial intelligence (AI)-assisted analytical framework that integrates natural language processing (NLP), text mining, unsupervised clustering, and expert validation to analyze cultural value education in Thai Nguyen Province, Vietnam. The framework was applied to survey data collected from 50 teachers and 147 students. The proposed AI-assisted framework automatically identified semantic patterns in students' responses and classified them into three groups with different levels of cultural awareness, providing insights that were difficult to obtain through conventional qualitative analysis. Based on these findings, the study proposes AI-supported educational strategies for strengthening cultural value education and preserving ethnic minority cultural heritage. The results demonstrate that AI-assisted text analytics can enhance educational decision-making by providing scalable, objective, and evidence-based analysis for culturally responsive education.

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1. INTRODUCTION

Cultural value education plays an important role in preserving cultural identity and strengthening the social development of ethnic minority students. However, evaluating students' perceptions of cultural values remains challenging because conventional educational approaches rely largely on manual analysis and qualitative interpretation of survey data. Recent advances in artificial intelligence (AI), particularly natural language processing (NLP) and machine learning (ML), provide effective approaches for analyzing large-scale educational data, identifying hidden semantic patterns, and supporting evidence-based educational decision-making [1], [2]. These developments enable AI to contribute not only to personalized learning but also to intelligent educational analytics for cultural value education.

Recent studies have demonstrated that AI is transforming educational research through intelligent data analysis, personalized learning, and automated decision support. Beyond conventional educational applications, AI has increasingly been applied to cultural heritage preservation and cultural education. Kumar *et al.* [3] reviewed the rapid development of AI-assisted educational technologies for cultural heritage, while Gîrbacia [4] highlighted the application of AI in heritage classification, computer vision, recommendation systems, and digital reconstruction. Harisanty *et al.* [5] further emphasized that AI supports cultural heritage preservation through automated documentation, intelligent data management, and predictive

analysis. Recent studies in Vietnam have also highlighted both the opportunities and challenges of AI-assisted digital preservation [6]–[8]. Together, these studies suggest that AI can facilitate both cultural heritage preservation and educational decision-making.

Vietnam is a culturally diverse country with 54 officially recognized ethnic groups, each contributing distinctive traditions, languages, and cultural practices. Thai Nguyen Province, located in Northern Vietnam, is home to several ethnic minority communities, including the Tay, Nung, Dao, San Diu, Hmong, and Thai. Preserving these cultural values through education is increasingly important in the context of digital transformation. Motivated by this challenge, the present study proposes an AI-assisted analytical framework that integrates NLP, text mining, and unsupervised clustering to analyze students' perceptions of cultural values. The proposed framework supports the automatic identification of semantic patterns from survey responses while assisting educators in designing more evidence-based cultural education strategies [9].

Although previous studies have investigated AI in education and digital heritage preservation, limited research has applied AI-assisted text analytics to cultural value education for ethnic minority students. Most existing studies focus on educational applications of AI rather than its capability to extract knowledge from educational data and support educational decision-making. Therefore, this study addresses this gap by proposing an AI-assisted analytical framework that combines NLP, text mining, unsupervised clustering, and expert validation to provide a scalable and data-driven approach for cultural value education.

2. LITERATURE REVIEW

In today's knowledge-based society, education is widely recognized as a key driver of social and economic development. Cultural values play an important role in preparing younger generations for personal growth and social participation. Recent studies suggest that AI can support cultural heritage preservation and cultural education [4], while its effectiveness depends on ethnic and cultural contexts [5], [10]. The integration of AI into cultural heritage management also requires careful attention to ethical issues to ensure that technology supports rather than undermines cultural values and collective memory.

Culture consists of values, traditions, and beliefs passed from one generation to another. Cultural value education helps ethnic minority students understand and appreciate their heritage, contributing to the preservation of their communities' cultural values [11]. It also strengthens students' cultural identity, self-confidence, and sense of belonging. In addition, cultural education promotes respect for diversity and encourages mutual understanding among communities [12].

At the same time, the rapid advancement of digital technologies has transformed the field of education. In recent years, AI and ML have emerged as powerful tools for personalized learning, data analysis, and curriculum design. Romero and Ventura [1] highlighted the role of educational data mining and learning analytics, where AI-based models were used to predict student performance, identify learning difficulties, and design adaptive interventions. Similarly, Richter *et al*. [2] conducted a systematic review of AI applications in higher education, emphasizing their impact on automated assessment, intelligent tutoring systems, and personalized feedback mechanisms. Chen *et al.* [13] further demonstrated the rapid expansion of AI research in education across academic publications, software tools, institutions, and research communities. More recently, Parker *et al.* [14] showed that large language models can effectively support the analysis of educational survey feedback, enabling the extraction of meaningful insights from large volumes of textual data. Likewise, Maphosa and Maphosa [15] identified a rapid growth of research on AI in higher education, highlighting the increasing use of data-driven analytical approaches and topic modeling techniques to explore educational trends and learning-related issues.

Cultural value education supports the development of students' critical thinking, communication, and social skills while encouraging respect for cultural diversity. Hutchison and Shields [16] emphasized that culturally responsive teaching promotes inclusive learning by recognizing students' cultural backgrounds. In Vietnam, Nam and Minh [17] argued that value education contributes to preserving cultural heritage while fostering personal development and social integration. In addition, culture is recognized as an important dimension of sustainable development [18]. Heritage education also enriches learning by connecting students with cultural traditions and collective memory, helping them develop a broader understanding of society and culture [19].

Therefore, cultural value education contributes not only to preserving traditional values but also to personal development, social integration, and sustainable development in the context of globalization. Previous studies have highlighted the importance of culture and cultural identity in supporting students' development and educational participation. Luces and Cantero [20] emphasized that culturally responsive and intercultural approaches are essential for meeting the needs of ethnically diverse learners and promoting inclusive education. Likewise, Snyder *et al*. [11] argued that culturally responsive education is fundamental to multicultural education and noted ethnic minority families' concerns about the influence of dominant cultural values on their children. They further suggested that cultural value education provides students with

valuable "funds of knowledge." Moll *et al.* [12] described culture as a resource that shapes everyday life, while Isa *et al.* [21] emphasized the importance of integrating students' cultural backgrounds into science education. In addition, technology has been increasingly incorporated into heritage education to support cultural value education [19]. Overall, traditional cultural values remain closely linked to education and contribute to learners' holistic development in a globalized society [11].

Recent studies have increasingly explored the integration of AI with the preservation and transmission of ethnic cultural heritage. Yao [22] argued that AI technologies can support the inheritance and integration of ethnic cultural knowledge through digital preservation, intelligent dissemination, and innovative approaches to cultural education. Building on this trend, Chen *et al.* [23] developed an AI-based ethnic music dataset and demonstrated its potential for the documentation, preservation, and transmission of traditional cultural knowledge. The digital preservation of cultural heritage has also become an important strategy for safeguarding cultural identity and enhancing public access to traditional cultural resources [6]. These studies suggest that AI can play an important role not only in safeguarding cultural heritage but also in enhancing cultural learning and intergenerational knowledge transfer. Nam and Minh [17] emphasized that, in the context of globalization and rapid technological development, cultural value education has become increasingly important. Although technological achievements significantly influence younger generations, cultural values remain an indispensable foundation for personal and social development. Through cultural value education, cultural heritage can be preserved while simultaneously promoting sustainable community development [17].

Applying AI and ML to cultural values education is a relatively new direction. While traditional approaches emphasize curriculum development, cultural exchange, and teacher-led interventions, AI enables a data-driven perspective that can reveal deeper insights into student perceptions and support the design of adaptive educational solutions. This integration aligns with global trends in using intelligent systems to support multicultural education, promote inclusivity, and contribute to sustainable development. Recent scholarship has increasingly explored the intersection between AI and cultural heritage education. Harisanty *et al.* [5] demonstrated that AI technologies can support heritage preservation through automated documentation, digital archiving, and predictive analysis. Similarly, Pérez [18] argued that AI-enhanced heritage education provides new opportunities for interactive learning and cultural engagement. The incorporation of AI into education is increasingly shifting from purely technological applications toward culturally responsive approaches that emphasize local identities, cultural values, and learner diversity [24]. At the same time, the application of AI in cultural and educational contexts raises important ethical considerations related to transparency, cultural representation, and responsible technology use [25]. These studies suggest that AI-based educational approaches can support cultural value education by making traditional knowledge more accessible, interactive, and relevant to younger generations.

Despite these advances, limited research has examined the application of AI-assisted analytical methods to cultural value education among ethnic minority students in developing countries, particularly in Vietnam. This study addresses that gap by integrating AI-based text mining and clustering techniques into research on cultural value education. The study specifically focuses on ethnic minority students in Thai Nguyen Province.

3. METHOD

3.1. Research design and data collection

To achieve the research objectives, this study employed a mixed-method design combining qualitative investigation with AI-assisted quantitative text analysis. The dataset consisted of responses from 50 teachers and 147 high school students in Thai Nguyen Province, Vietnam. Data were collected through questionnaires, interviews, and classroom observations. Closed-ended responses were analyzed using descriptive statistics, whereas open-ended responses were processed through an AI-assisted analytical framework integrating NLP, text mining, and unsupervised clustering. This framework enabled the automatic extraction of semantic patterns from textual responses and the classification of students into different cultural awareness groups. Compared with conventional manual coding, the proposed approach provides a more systematic, objective, and scalable analysis of educational data [1], [3].

3.2. Artificial intelligence-assisted data analysis procedure

To improve the transparency and reproducibility of qualitative data analysis, this study developed an AI-assisted analytical procedure for processing students' open-ended responses. Instead of relying exclusively on manual coding, the proposed framework combines NLP, text mining, unsupervised clustering, and expert validation to identify semantic patterns and support educational interpretation. The complete analytical workflow consists of three sequential phases, as illustrated in Figure 1.

i) Phase 1: data preprocessing. All textual responses were digitized and cleaned before analysis. The preprocessing procedure included removing duplicate records, correcting typographical inconsistencies, eliminating punctuation and irrelevant symbols, and standardizing the text format. Keywords related to cultural values (e.g., "language," "festival," "custom," and "heritage") were extracted to generate a structured textual dataset suitable for AI-based analysis.
ii) Phase 2: pattern recognition and unsupervised clustering. The preprocessed textual data were analyzed using NLP and text mining techniques to identify semantic similarities among students' responses. An unsupervised clustering approach was then applied to group responses according to shared cultural themes without predefined labels. The resulting clusters represented different levels of cultural awareness and enabled the automatic identification of latent patterns that were difficult to detect through conventional qualitative analysis.
iii) Phase 3: human-in-the-loop validation. The clustering results were independently reviewed by the research team to verify their consistency with the educational context and local cultural characteristics. Expert validation was incorporated to reduce potential bias in AI-generated classifications and to ensure that the analytical results were both technically reliable and culturally meaningful. The proposed workflow improves the transparency and reproducibility of AI-assisted educational data analysis by combining automated text processing with expert validation. This hybrid framework enables scalable analysis while maintaining the contextual interpretation required for cultural value education. The complete workflow is presented in Figure 1.

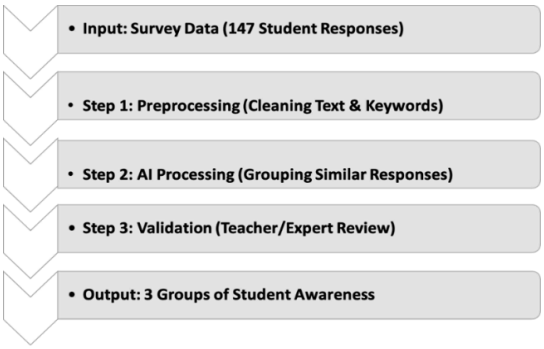

Figure 1. Proposed AI-assisted analytical framework for cultural value education

4. RESULTS AND DISCUSSION

4.1. Results

The proposed AI-assisted analytical framework was applied to analyze the survey data collected from teachers and students. Field observations and questionnaire responses showed that some students preferred using Vietnamese or English instead of their native languages. Some were also unwilling to wear traditional clothing during school activities or participate in community cultural events. In addition, many students showed limited understanding of their ethnic cultural values, partly because they lacked awareness of the importance of preserving cultural heritage. Teachers also paid insufficient attention to cultural value education through integrated teaching activities. The detailed evaluation results are presented in Figure 2.

The survey results indicate that traditional cultural values have been integrated into curriculum content, teaching methods, and learning activities. These values are reinforced through classroom interaction and learning assessment, reflecting their important role in the educational process. AI-assisted semantic clustering further identified three groups of students with different levels of cultural awareness: i) students with a strong cultural identity and active participation in heritage-related activities; ii) students with moderate cultural awareness but limited engagement in cultural practices; and iii) students with low cultural awareness and little interest in traditional activities. Unlike conventional manual interpretation, the proposed AI framework automatically detected these latent semantic patterns from students' responses, providing a more objective basis for educational analysis and intervention.

The survey results reveal three main patterns in teachers' evaluations of traditional cultural values. First, patriotism, national resilience, solidarity, kindness, tolerance, eagerness for learning, and respect for righteousness and peace received the highest ratings, with 100% of teachers evaluating these values as good or fair. This indicates strong agreement on their importance in cultural value education. Second, diligence and creativity in labor (94%) and sophistication in behavior and simplicity in lifestyle (86%) also received positive evaluations, although a small proportion of teachers rated them as average, suggesting that these

values require greater emphasis in teaching. Third, the values of upland cultivation culture (56%), wet rice civilization (30%), festival beliefs (28%), and cultural heritage (18%) received relatively higher average ratings, indicating greater challenges in teaching and transmitting these cultural values. Overall, teachers in Thai Nguyen place high importance on core traditional values, while culture-specific values require more effective educational approaches, particularly for ethnic minority students. For the student group, the survey results are shown in Figure 3.

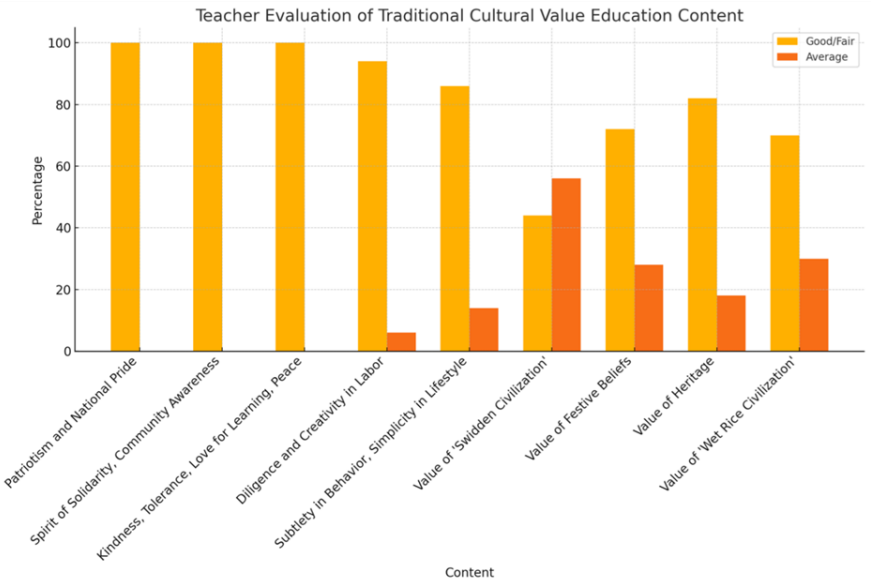

Figure 2. Teachers' evaluation of traditional cultural values education content (n = 50)

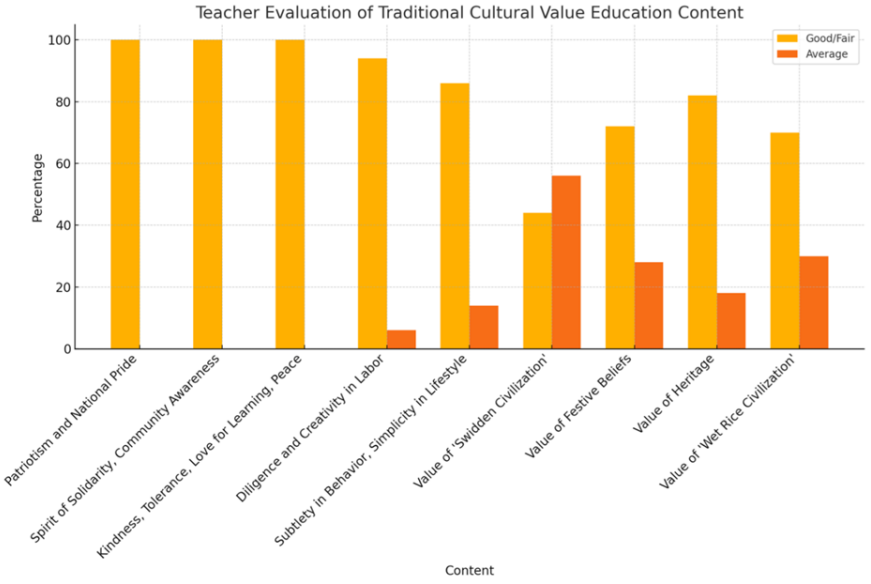

Figure 3. Students' evaluation of traditional cultural values education content (n = 147)

Figure 3 summarizes students' evaluations of educational content on traditional cultural values. Overall, students expressed positive perceptions across most categories, with positive ratings ranging from 79.6% to 96.6%. Patriotism and national spirit received the highest level of approval (96.6%), followed by solidarity, kindness, community responsibility, cultural behavior, and cultural values in learning, all of which achieved positive ratings above 94%. Diligence, creativity, compassion, and optimism were also evaluated positively, with approval rates between 87.8% and 93.9%.

Lower ratings were observed for traffic safety awareness (79.6%), participation in labor activities (82.3%), and national religious cultural values (86.4%). These findings suggest that these areas require greater attention in educational practice. Overall, students highly value core traditional cultural values, whereas practical and context-specific values require more effective educational strategies.

4.2. Discussion

It is important to emphasize that AI does not replace teachers but serves as a decision-support tool for educational data analysis and evidence-based decision-making [1], [2]. The proposed AI-assisted framework identified latent semantic patterns in students' cultural awareness and supported the development of targeted educational strategies for different learner groups, with potential integration approaches summarized in Table 1. Compared with conventional manual analysis, AI-assisted text analytics improved the consistency and scalability of educational data analysis while reducing subjective interpretation. In the long term, AI applications may include personalized learning systems for ethnic minority students, intelligent chatbots for cultural and educational support, and AI-enhanced digital repositories for preserving ethnic cultural heritage [2], [5], [26].

These applications could complement existing educational practices by making cultural value education more adaptive, inclusive, and sustainable. Looking ahead, Harisanty *et al.* [5] suggested that the future of heritage preservation lies in extended reality (XR), integrating virtual restoration and IoT for monitoring historical sites. However, the integration of these technologies must be approached with caution. Pérez [18] warned of the digital divide and ethical challenges in heritage education, stressing the need for inclusive strategies that do not marginalize students with limited access to technology. These concerns are also consistent with UNESCO's view that technology should support equitable and inclusive education rather than widen existing educational gaps [8]. Therefore, the proposed framework emphasizes not only technological innovation but also accessibility, expert validation, and ethical implementation [25]. Overall, these findings demonstrate that AI-assisted educational analytics can support multicultural understanding and cultural value education through scalable, context-sensitive, and evidence-based learning environments [10], [27].

Table 1. AI-assisted framework for integrating ethnic minority cultural values into high school education

Content	Integration	Experiential	Project
Love your homeland and country; love your family, neighbors, and friends	✓	✓	
Solidarity, diligence, honesty, discipline, responsibility, courage, and cooperation	✓	✓	
Culinary culture	✓	✓	
Clothing culture		✓	✓
Language and script	✓	✓	
Traditional festivals		✓	✓
Social customs		✓	✓
Production customs		✓	✓
Traditional crafts	✓	✓	✓
Folk knowledge	✓		✓
Folk beliefs	✓	✓	
Folk games; literature; and arts	✓	✓	✓
Folk performing arts			✓
Historical and cultural relics		✓	✓

To strengthen cultural value education for ethnic minority high school students, schools should create an inclusive learning environment that respects their cultural heritage. The proposed roadmap includes developing the curriculum: i) collaborating with experts, ii) community leaders, and iii) representatives of ethnic minority groups to develop a curriculum that reflects the traditions, values, and history of ethnic minority communities. This curriculum should be integrated into existing subjects such as history, culture, and the arts [21].

i) Cultural exchange programs: organize cultural exchange activities where students from different ethnic groups share their traditions, languages, music, and customs, promoting mutual respect, and cultural understanding.
ii) Guest speakers and community involvement: invite community members from ethnic minority groups to share their experiences and cultural knowledge with students.
iii) Language preservation: provide language classes or workshops to preserve ethnic minority languages, helping students maintain their cultural identity and heritage.
iv) Mentorship programs: establish mentorship programs that connect ethnic minority students with successful community members who can provide guidance, share experiences, and encourage pride in their cultural values.

v) Celebrations and cultural festivals: organize cultural festivals that showcase the traditions, cuisine, arts, and performances of ethnic minority groups, creating opportunities for learning and appreciation of cultural diversity [28].
vi) Clubs and multicultural activities: encourage multicultural clubs and student organizations to organize activities and projects that promote awareness and appreciation of ethnic minority cultures and traditions [12].
vii) Parent and community involvement: encourage parents and local communities to participate in school cultural activities and events, strengthening support for traditional cultural value education [29].
viii) Progress assessment: regularly assess the effectiveness of cultural values education initiatives by gathering feedback from students, parents, and educators. This feedback can be used to improve and refine educational programs and activities to better meet students' needs.

It is essential to adapt these approaches to the specific cultural contexts, needs, and characteristics of different ethnic minority groups. Collaboration, open communication, and a genuine commitment to inclusion are key factors in successfully implementing traditional cultural values education for ethnic minority high school students. Such efforts are also consistent with Vietnam's policies on ethnic affairs and educational inclusion for ethnic minority communities [30]. Each ethnic minority student represents the cultural heritage of a particular community within the broader multicultural landscape of Vietnam. Through cultural value education, students not only experience the traditional cultural values of their own ethnic group but also gain opportunities to learn about the cultural traditions of other communities, thereby fostering intercultural understanding and cultural continuity [17]. According to Ngô [31], Vietnamese cultural values constitute a system of moral, social, and spiritual norms that continue to influence individual behavior, community cohesion, and educational practices in contemporary society.

Therefore, the primary goal of educating ethnic minority students about traditional cultural values is to help them understand, appreciate, and preserve the cultural heritage of their communities. Such education also contributes to the development of cognitive abilities, intercultural understanding, communication and cooperation skills, social responsibility, cultural tolerance, and respect for diversity, while reducing prejudice and discrimination against ethnic minority groups [20]. In addition, the digitization of cultural heritage has created new opportunities for preserving indigenous knowledge and enhancing educational accessibility, thereby strengthening the transmission of cultural values to younger generations [32].

At all educational levels, traditional cultural values education in a multicultural environment can significantly influence students' attitudes, perceptions, and behaviors. Through these educational experiences, students become more aware of the value of culture and develop a stronger commitment to preserving and promoting their communities' traditional cultural heritage. Heritage education has also been recognized as an effective means of fostering social and civic competence by connecting cultural identity, historical memory, and active citizenship [33]. Introducing cultural values education into general education is therefore important not only for transmitting knowledge but also for strengthening students' understanding of their cultural roots and national identity. Furthermore, it contributes to the development of an advanced Vietnamese culture enriched by national identity and cultural diversity in the context of globalization and international integration. These objectives are consistent with national initiatives promoting cultural heritage awareness and preservation, including the establishment of Vietnam Cultural Heritage Day [34]. To achieve these goals, teachers need to understand both the theoretical and practical dimensions of cultural values and ethnic cultures to design appropriate educational activities for different student groups and local contexts.

5. CONCLUSION

This study proposed and applied an AI-assisted analytical framework integrating NLP, text mining, and unsupervised clustering to support cultural value education for ethnic minority students in Thai Nguyen Province. The framework successfully identified three groups of students with different levels of cultural awareness and engagement while complementing conventional educational analysis with automated semantic pattern identification. The findings demonstrate that AI-assisted educational analytics can complement conventional educational research by revealing latent semantic patterns in students' perceptions of cultural values. These insights provide a more objective and evidence-based foundation for designing culturally responsive educational programs and targeted interventions for ethnic minority students. The study also highlights the importance of collaboration among schools, families, local communities, and cultural institutions in strengthening cultural value education. Future research should further evaluate AI-assisted educational systems in larger and more diverse datasets and investigate their long-term effectiveness in supporting cultural heritage education. Rather than replacing teachers, AI should be regarded as a decision-support tool that enhances educational analysis, supports culturally responsive teaching, and contributes to more inclusive, adaptive, and evidence-based learning environments.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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Ngo Thu Thuy	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	
Ngo Thi Thanh Quy		✓				✓		✓	✓	✓	✓	✓		

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

ETHICAL APPROVAL

The study complied with institutional ethical guidelines and informed consent was obtained from all participants.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [NTTQ], upon reasonable request.

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