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Teaching integrated with cultural and social contexts for sustainable development goals

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Abstract

In the context of globalization and the current environmental crisis, education for sustainable development has become a central priority for the international community. Modern educational goals now emphasize fostering student awareness of resource conservation, addressing social challenges, and preserving cultural heritage. The unique cultural and social contexts of each locality play an essential role in implementing sustainable development education, providing students with opportunities to connect with their communities and cultivate a sense of responsibility toward their environment. This paper presents a theoretical study on culturally and socially contextualized teaching, alongside a case study involving the instruction of physics to 10th and 11th-grade students in Vietnam's Central Highlands. The study successfully developed instructional frameworks for two main topics: (1) Designing a solar energy model and (2) Crafting and preserving the traditional musical instrument ChingKram, used by the indigenous peoples of the Central Highlands. These topics not only foster student responsibility for renewable energy usage but also contribute to the preservation of cultural heritage through engagement with traditional musical instruments. The findings underscore the importance of integrating science education with social and cultural contexts as a pathway to sustainable development, enhancing student responsibility toward cultural and social issues. The teaching framework established in this study offers a valuable resource for educators implementing Vietnam's 2018 national education program, reinforcing the alignment of theory with practice to advance sustainable development goals.

Keywords: cultural and social contexts, education for sustainable development, the central highlands, students' awareness

Teaching integrated with cultural and social contexts for sustainable development goals

1. Introduction

In the current era of globalization and escalating environmental challenges, the international community is increasingly focused on advancing Education for Sustainable Development (ESD). Modern education now aspires not only to convey knowledge but also to cultivate students' awareness and sense of responsibility regarding resource conservation, environmental stewardship, and socio-cultural issues (Heath, 1992; Pedretti, 1996). This goal is particularly pressing in developing countries, where resource protection and cultural preservation are vital and must be deeply embedded within educational programs. Culturally and socially contextualized teaching plays a critical role in educating students about environmental conservation and the preservation of traditional culture (Beatty & Schweingruber, 2018; Radwan, 2022; Javed et al., 2021). This approach not only reinforces the connection between knowledge and real-world practice but also enhances students' sense of responsibility toward community values (Teshager et al., 2021). When students learn through authentic, culturally relevant experiences linked to their local communities, they gain a foundation in sustainable development, meeting educational goals that emphasize individual and community responsibility (Amsudin et al., 2023). This method shows significant promise for cultivating environmental and cultural responsibility among students.

The Central Highlands of Vietnam is a region distinguished by its unique cultural heritage and renewable energy potential. Home to various ethnic minorities, this region preserves a rich cultural legacy, including folk music traditions and unique musical instruments like the ChingKram, gongs, and Đinh Tut (Nguyen Tien Thanh, 2024). Additionally, the Central Highlands has substantial potential for renewable energy development, especially in solar energy. Integrating science education with local cultural heritage not only contributes to the preservation of valuable cultural assets but also enhances students' awareness of sustainable energy practices. This rich cultural and social landscape offers an ideal context for educators to integrate into the Physics curriculum for 11th and 12th-grade students, in alignment with Vietnam's 2018 national education program. Drawing on this context and these educational imperatives, this paper seeks to address the following questions: What instructional processes are required for the topics "Designing a solar Energy Model" and "Crafting the ChingKram musical instrument"? Additionally, does the proposed instructional process foster students' sense of responsibility toward cultural and social issues?

2. Related Literature

2.1 Teaching within Cultural and Social Contexts

Context-based teaching, a method extensively researched and developed by various scholars with differing perspectives, focuses on embedding concepts and skills within real-world situations closely tied to students' lives (Acar & Yaman, 2011; Peşman & Özdemir, 2012). This approach typically initiates with the presentation of a relevant everyday scenario or issue, which in turn makes learning both necessary and meaningful. Here, curriculum content is utilized as a tool for addressing the scenario or problem, enabling students to connect academic concepts with their lived experiences (Acar & Yaman, 2011). Empirical studies indicate that context-based teaching can enhance scientific education by improving students' learning outcomes and preparedness through varied real-world contexts (Nail Ilhan et al., 2016). According to Whitelegg and Parry (1999), this approach can be understood at two levels: broadly, it encompasses the entire cultural and social environment in which students and teachers interact; more narrowly, it focuses on specific applications of scientific concepts that require development and reinforcement. Sutman and Bruce (1992) propose that context-based teaching utilizes real-life materials and resources, such as pertinent social issues, as foundational elements for the teaching and learning process. Teacher-student dialogues play a critical role in facilitating the linkage between academic concepts and practical contexts. Aikenhead (2006) highlights that context-based teaching emphasizes the application of scientific knowledge as a tool for fostering understanding of the natural world and enhancing student competencies.

The social constructivist theories of John Dewey and Lev Vygotsky, as well as Albert Bandura's cultural-social learning theories, endorse context-based teaching. Dewey (1930) underscored that students are active constructors of knowledge, with learning occurring in a collaborative setting where information emerges from problem-solving. Context-based learning is thus viewed not merely as a process of information acquisition but as one of knowledge transformation and restructuring to fit the realities in which it is applied. In Vietnam, Phuong et al. (2023) define context-based teaching as the application of real-life situations to facilitate learning activities aimed at achieving objectives related to knowledge, skills, and attitudes. This process, in turn, fosters essential competencies and personal development in students. These perspectives reveal diverse approaches to context-based teaching, contingent upon the characteristics of each subject and situation. In this study, we adopt a social constructivist approach to context-based teaching, emphasizing that the context should be situated within the cultural and social environments relevant to students' lives. Teaching within cultural and social contexts, therefore, involves leveraging events, issues, or situations rooted in local cultural and social practices that embed scientific knowledge and can be developed into educational scenarios. This process aims to equip students with not only knowledge but also the skills and attitudes necessary to engage with cultural and social issues in real-life contexts.

2.2 The Effect of Context-Based Teaching within Cultural and Social Environments on Student Responsibility Development

Research has consistently shown that context-based teaching positively influences students' self-esteem and fulfills their social needs. Maslow argued that integrating relevant contexts into teaching reduces the authoritarian nature of the learning process, allowing students to feel respected and thereby enhancing their confidence and active participation in learning (Whitelegg & Parry, 1999). Notably, Whitelegg and Parry (1999) emphasize that employing contexts tied to cultural and social issues not only elevates students' awareness but also fosters their social responsibility toward community matters. Murphy and Whitelegg (2006) further support that real-life contexts increase student motivation, confidence, and enthusiasm by connecting curriculum content with the social issues that matter to. This approach is crucial for cultivating and advancing students' cultural and social responsibilities.

2.3 The Framework for Context-Based Teaching in Cultural and Social Contexts to Enhance Student Responsibility toward Cultural and Social Issues

The development of a framework for context-based teaching in cultural and social contexts is grounded in the following theoretical perspectives: Firstly, this approach draws from constructivist theory as presented by Finkelstein (2005) and the social constructivist framework of Vygotsky (Jaramillo & James A, 1996). In Finkelstein's social constructivist model, context is continuously integrated within the learning process, embedded in every phase of instruction. Here, students build upon prior knowledge and experience to actively construct new understanding through a problem-solving instructional model. Social constructivist theory, on the other hand, stresses that students' cognitive processes and the environment in which they learn are inseparable, meaning that the learning context should stem from students' familiar environments or from the local communities where they live and study.

Secondly, this framework utilizes Aikenhead's (1996) Science-Technology-Society (STS) teaching model. Aikenhead asserts that the STS model aims to explore and understand the complex interactions between science, technology, and society. STS emphasizes analyzing the ways social, cultural, and political factors influence the development and application of science and technology and, conversely, how science and technology affect society. Research suggests that the STS components are optimally organized in a sequence as illustrated in Figure 1.

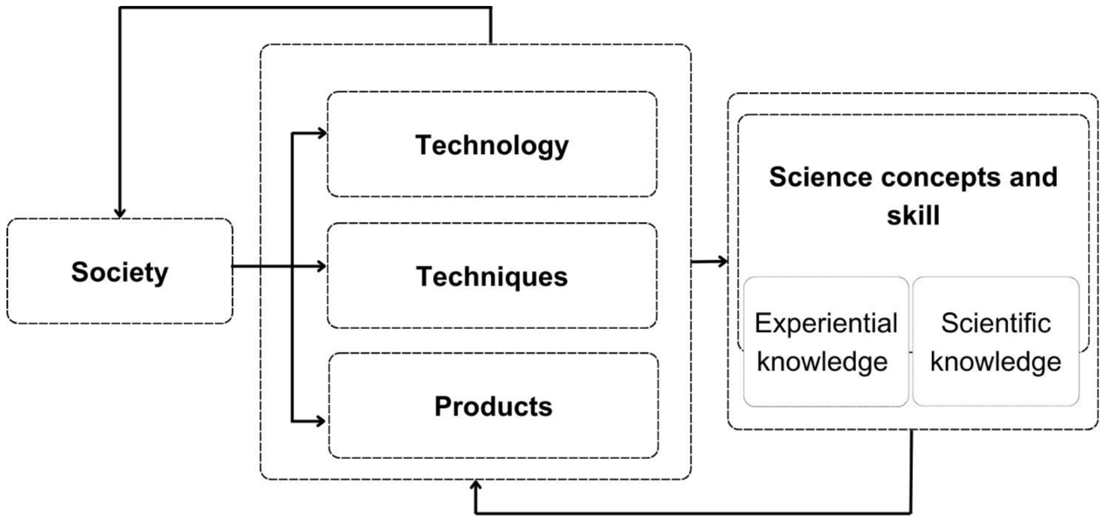

Figure 1. Guidelines for Applying the STS Approach in Teaching by Aikenhead (1996)

Drawing from the theoretical foundations outlined above, we developed a context-based instructional process for cultural and social contexts, comprising five primary stages:

Stage 1: Identifying the learning context and defining - The Issue Through experiential activities, investigations, and surveys, students identify relevant cultural and social issues occurring within their local community that require resolution, thereby pinpointing the specific issue to be addressed.

Stage 2: Proposing solutions - Addressing cultural and social issues demands both theoretical knowledge (S) (encompassing experiential and scientific knowledge) and technological solutions (T). With guidance from the teacher, students select the most feasible solution aligned with the instructional content.

Stage 3: Solution implementation - This phase involves implementing the chosen solution, which includes exploring knowledge and developing products according to proposed design plans.

Stage 4: Solution evaluation - Students test their products and analyze their impact on society (by examining STS factors), allowing them to critically evaluate their approach to addressing local cultural and social issues and draw essential conclusions.

Stage 5: Decontextualization - Upon acquiring the relevant scientific knowledge, students transition from the original context, applying their scientific understanding and experiences to similar cultural and social situations or explaining related scientific phenomena.

3. Methodology

Research Design - This study proceeded in two primary phases:

Phase 1: Building on the theoretical foundation outlined in Section 2, the study developed specific instructional procedures for two topics: (1) Solar energy model design, targeting 10th-grade students; (2) Crafting and preserving traditional ChingKram musical instruments of the Central Highlands' indigenous ethnic groups, aimed at 11th-grade students.

Phase 2: The designed instructional procedures were applied through pedagogical experiments with the selected student sample (see Section 3.2). Following implementation, a questionnaire was administered to evaluate students' development of responsibility towards cultural and social issues (see Section 3.3).

Research Subjects - The study sample comprised students residing and studying in Dak Lak Province, selected to ensure consistency in living and educational conditions, thus minimizing external bias. Specifically, the sample included students from two grade levels with similar academic profiles: Class 10A (45 students) from Viet Duc High School, Cu Kuin District, and Class 11A3 (47 students) from Tran Dai Nghia High School, Buon Don District, Dak Lak Province. The selection of these groups ensures representativeness and enables a feasible comparison of the instructional methods' impact on the development of students' sense of responsibility within the local cultural and social context.

Assessment Tool and Reliability - In this study, we applied the responsibility scale model structure (Figure 2) proposed by Conrad and Hedein (1985) to develop our questionnaire (Conrad & Hedein, 1985). The questionnaire includes 14 items rated on a 4-point Likert scale with response options: 1 = Completely untrue for me; 2 = Untrue for me; 3 = Mostly true for me; 4 = Completely true for me.

Figure 2: Social Responsibility Model Structure by Conrad and Hedein (1985)

To evaluate the reliability of the questionnaire, we conducted a pilot survey with 97 tenth-grade students at Buon Ma Thuot High School in Dak Lak Province. The survey yielded a Cronbach's Alpha of 0.899, indicating high reliability within the acceptable range of 0.8 to 1. This suggests that the questionnaire reliably measures students' sense of responsibility toward cultural and social issues. Additionally, no item demonstrated a Cronbach's Alpha if Item Deleted higher than the overall Cronbach's Alpha, and all Corrected Item–Total Correlation values were acceptable (all above 0.3). These findings confirm that the questionnaire items are strongly interrelated and jointly measure a single latent variable—students' responsibility regarding cultural and social issues. Consequently, no items were removed from the final questionnaire.

Data Analysis Method - The questionnaire was administered to students both before and after the pedagogical intervention. Data from the questionnaire was analyzed using SPSS (version 26), a widely recognized software for statistical analysis. Descriptive statistical techniques, including calculations of means and standard deviations, were employed to quantify the data. To assess the growth in students' responsibility regarding cultural and social issues, a T-Test was conducted to compare the mean scores from the pre- and post-intervention questionnaires. The hypotheses tested were as follows:

- H0 (Null Hypothesis): The instructional approach for Topic 1 (or Topic 2) does not significantly enhance students' responsibility toward cultural and social issues.
- H1 (Alternative Hypothesis): The instructional approach for Topic 1 (or Topic 2) significantly enhances students' responsibility toward cultural and social issues.

4. Results and Discussion

4.1 Proposed Teaching Process

The specific instructional process for the two topics, "Designing a Solar Energy Model" and "Crafting and Preserving the Traditional ChingKram Instrument of Indigenous Ethnic Groups in the Central Highlands," was developed following the teaching process proposed in Section 2.3 and is presented in Table 1.

Table 1
Specific instructional process for the two topics

Stages	Topic 1: Designing a solar energy model	Topic 2: Crafting and preserving the traditional musical instrument ChingKram, used by the indigenous peoples of the Central Highlands.
Stage 1	Teachers organize experiential, investigative, and survey activities to help students recognize local energy and environmental issues. Through these activities, students will identify problems such as reliance on traditional energy sources, their environmental impact, and the need for renewable energy development.	eachers organize field trips or experiential activities to local cultural sites where students can observe and learn about traditional musical instruments, particularly the ChingKram—a unique instrument of the Central Highlands' indigenous communities. Through these activities, students realize the growing importance of preserving these traditional instruments as local cultural values gradually fade.
Stage 2	Students are guided to study the theory of solar energy, the operating principles of solar panels, the process of converting solar energy into electricity, and some basic applications. They are encouraged to propose measures and ideas for building a solar energy conversion model.	Students study the physics principles related to sound, frequency, resonance, and the materials of the ChingKram, thereby learning how this traditional instrument produces its unique sound. Under the teacher's guidance, students discuss and propose solutions for recreating the instrument and suggest preservation methods to maintain its sound quality over time.
Stage 3	Students proceed to construct the solar energy model according to the proposed plan and design. This process includes selecting materials, assembling, and adjusting the model to optimize energy conversion efficiency. The teacher provides support and guidance throughout the implementation.	Students proceed to craft the ChingKram instrument according to proposed plans, including selecting suitable materials, assembling, and testing to ensure accurate sound production. The teacher provides technical support and guides students through each step, from crafting to testing.
Stage 4	Students test the constructed solar energy model and analyze its efficiency. They then assess the model's environmental and social impact, comparing it with traditional energy sources. The teacher guides students in using the STS model to understand the interconnections between science, technology, and society.	Students test the crafted ChingKram instrument, analyzing sound quality and the effectiveness of each crafting step. They then evaluate the impact of preserving this instrument on society and the community, using the STS model to understand the connections between science, technology, and cultural values.
Stage 5	Students discuss and apply the knowledge they have learned to other contexts. They are encouraged to think about how scientific knowledge and experiences from the solar energy model can be used to explain or address similar issues, such as utilizing solar energy in other regions or exploring additional forms of renewable energy.	Students are encouraged to consider how they can apply their scientific knowledge and skills to preserve other musical instruments or to delve deeper into traditional cultural forms.

4.2 Results of the Pedagogical Experiment

After conducting surveys using questionnaires before and after the pedagogical experiment on 44 students in Class 10A (Topic 1) and 47 students in Class 11A3 (Topic 2), we obtained the data presented in Table 2 below:

Table 2
Data from the Pre-test and Post-test Questionnaires for Both Classes

Value	Class: 10A (N=44)		Class: 11A3 (N= 47)	
	Pre-test	Post-test	Pre-test	Post-test
Mean	36.27	41.16	33.68	36
Standard deviation	4.09	3.23	4.42	4.11

Based on the data in the above table, the average scores of students in Classes 10A and 11A3 in the pre-test and post-test questionnaires show a difference after the pedagogical experiment. The results of the hypothesis tests for H1 and H0 (as presented in section 3.4) are shown in Table 3.

Table 3
T-Test Data Results

Class	T-test	p-value
10A	Pre-test with Pro-test	$9.9.10^{-8}$
11A3	Pre-test with Pro-test	0.0117

Based on the analysis results in Tables 2 and 3, we reject the null hypothesis (H0), indicating a statistically significant difference in the mean questionnaire scores before and after the pedagogical experiment following the designed instructional processes ($p < 0.05$). This demonstrates that the two instructional processes had an impact on developing students' responsibility toward cultural and social issues.

5. Discussion

The findings indicate that the instructional processes designed for the topics "Designing Solar Energy Models" and "Crafting and Preserving the Traditional ChingKram Instruments of Indigenous Peoples in the Central Highlands" effectively engaged students with cultural and social issues through a scientific perspective. These processes not only fostered students' responsibility towards renewable energy use but also enhanced their awareness of cultural heritage preservation. These results align with prior research on the benefits of context-based learning, particularly when applied to local cultural and social concerns (Arroyave et al., 2021; Theila Smith et al., 2022). Compared with previous studies, this research underscores that integrating science education with cultural contexts extends beyond improving scientific understanding; it actively involves students in cultural preservation efforts (Bellocchi et al., 2016; Mustafaoğlu & Yücel, 2022). The solar energy model project heightened awareness of renewable energy's significance, while the traditional instrument crafting activity deepened students' appreciation for cultural heritage. These findings further support the argument that socially and culturally integrated teaching can be an effective approach for developing student responsibility in the context of sustainable development (Hutchison & McAlister-Shields, 2020; Nail ilhan et al., 2016).

Additionally, the results demonstrate that engaging students in real-world problems through targeted activities enables them to apply scientific knowledge practically while fostering social responsibility. This is increasingly relevant in modern education, where global issues like environmental conservation and cultural preservation demand urgent attention. The outcomes indicate that context-based learning is a powerful strategy for building student responsibility and community engagement with practical issues (Kuhn & Müller, 2014; Bennett et al., 2007). However, this study has limitations. The sample was restricted to selected schools in Dak Lak Province, limiting the generalizability of the results to other regions. The short study duration also constrained a comprehensive evaluation of students' long-term responsibility development. Future research should explore the application of this instructional approach across different locations to assess its efficacy in diverse cultural contexts. Extending the study period would enable a more thorough evaluation of the method's impact on student responsibility development, providing more robust evidence for the benefits of incorporating cultural and social contexts in education to promote sustainable development.

6. Conclusion

This study successfully designed and implemented instructional processes for two topics, "Designing Solar Energy Models" and "Crafting and Preserving the Traditional ChingKram Instruments of Indigenous Peoples in the Central Highlands," with the aim of developing students' responsibility towards cultural and social issues. These topics not only deepen students' awareness of the importance of renewable energy and environmental protection but also enhance their consciousness about preserving local cultural heritage. The research findings demonstrate that integrating social and cultural contexts into science education can be highly effective in fostering student responsibility, encouraging them to engage with practical community issues. This approach aligns with sustainable development goals, helping to cultivate younger generations who are environmentally conscious and appreciative of cultural heritage. However, the study also identified some limitations, such as its focus on a specific area and the short research duration. For more comprehensive development, future research should consider expanding the application of this instructional approach to other regions and extending the follow-up period to assess its long-term impact on students.

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