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Research Article

Institutional Readiness and Faculty Awareness for Ethno-STEM and Augmented Reality Pedagogy: A Descriptive-Correlational Study in Masbate, Philippines

Alvin M. Mahawan[1]*, John Rey B. Quiñones[2]

[1]Graduate Student, Nueva Ecija University of Science and Technology, Philippines
[2]Faculty, Nueva Ecija University of Science and Technology, Philippines

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**Corresponding author:*
E-mail:
ammahawan@debesmscat.edu.ph

ABSTRACT

This descriptive–correlational study examined institutional readiness for integrating Augmented Reality (AR) in teaching and faculty awareness of Ethno-STEM pedagogy in a state college in Masbate Province, Philippines. Institutional readiness was assessed in terms of technological infrastructure, technical and administrative support, faculty digital competence, and organizational culture, while faculty awareness of Ethno-STEM was examined through conceptual understanding, perceived pedagogical value, and contextual application. Data were gathered from thirty-five (35) full-time faculty members using a validated survey instrument and analyzed using descriptive statistics and Pearson's product–moment correlation through Jamovi. Results indicated that institutional readiness for AR integration (M = 3.02) and faculty awareness of Ethno-STEM pedagogy (M = 3.18) were both at a moderate level. While technological infrastructure and organizational culture were generally adequate, technical and administrative support emerged as a key area needing improvement. Faculty members demonstrated greater appreciation of the pedagogical value of Ethno-STEM than their capacity to apply it effectively in culturally contextualized instruction. Correlation analysis revealed that faculty digital competence ($r = .482$, $p = .004$) and organizational culture ($r = .356$, $p = .041$) were significantly associated with Ethno-STEM awareness, whereas technological infrastructure and technical support were not. These findings suggest that human and cultural dimensions of institutional readiness play a more decisive role than material resources in advancing culturally responsive, technology-enhanced pedagogy. The study provides empirical evidence to inform capacity-building initiatives that emphasize faculty professional development, supportive organizational cultures, and enabling institutional policies for effective AR and Ethno-STEM integration in teacher education.

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Introduction

The imperative to reform science education in the Philippines is deeply intertwined with the capacity of its teacher education institutions to embrace and model pedagogical innovation. Global educational discourse increasingly advocates for pedagogies that are both technologically immersive and culturally sustaining, aiming to develop the critical 21st-century competencies required in a complex world (Voogt et al., 2013).

In this context, the confluence of Augmented Reality (AR) and Ethno-STEM (Ethnoscience, Technology, Engineering, and Mathematics) presents a compelling paradigm. AR, by overlaying digital information onto the physical world, offers powerful tools for visualizing abstract scientific concepts, thereby enhancing spatial understanding and student engagement (Akçayır & Akçayır, 2017). Ethno-STEM, conversely, emphasizes the integration of local cultural contexts, indigenous knowledge systems, and community-based practices into STEM curricula, fostering relevance, identity, and deeper cognitive connections (Gonzalez-Howard & McNeill, 2019). Given the statuses of the Philippine Basic Education System, this finding align with the mandates of incorporating technology enhance and informed instructional materials particularly those being developed scientifically and empirically.

The Teacher Education Programs, which serve as the primary incubators for future science teachers, adopting such integrative pedagogies is not merely an option but a strategic necessity. Pre-service teachers must be equipped not only with content knowledge but also with the pedagogical repertoires to design learning experiences that are meaningful within the diverse cultural landscapes of the Philippine archipelago (De la Cruz, 2020). However, the successful adoption of any educational innovation is rarely a function of its inherent merits alone; it is critically dependent on the readiness of the institution to support it and the awareness of the faculty who must implement it (Ertmer & Ottenbreit-Leftwich, 2010). Institutional readiness encompasses tangible assets like technological infrastructure and intangible enablers like organizational culture and support systems. Faculty awareness extends beyond mere familiarity with terminology to include a nuanced understanding of pedagogical principles, practical application skills, and belief in the innovation's value (Rogers, 2003).

While a growing body of international literature examines the effects of AR or culturally relevant pedagogy on student outcomes, there is a pronounced scarcity of research investigating the antecedent conditions within teacher education institutions themselves, particularly in the Global South. This gap is significant, as faculty members act as the crucial change agents, and institutional structures provide the enabling, or constraining, environment for innovation. A diagnostic understanding of these pre-conditions is essential to move from aspirational advocacy to effective, sustainable implementation. Therefore, this study was conceived not as an impact assessment but as foundational research. It seeks to map the current situation of capacity within a specific setting, identifying strengths to build upon and gaps to address.

Objectives of the Study

This study aims to assess the readiness of Masbate State College's College of Education to implement an integrated Ethno-STEM and Augmented Reality pedagogy. It will evaluate the institution's technological preparedness and the faculty's awareness of culturally contextualized teaching methods to establish a strategic, evidence-based plan for future capacity building. Specifically, the study was guided with the following objectives:

1. To assess the level of institutional readiness for the integration of Augmented Reality (AR) in teaching along:

   a. Technological infrastructure
   b. Technical and administrative support
   c. Faculty digital competence
   d. Organizational culture
2. To evaluate the level of faculty awareness regarding Ethno-STEM pedagogy in terms of:
   a. conceptual understanding
   b. perceived pedagogical value, and knowledge
   c. contextual application
3. To determine the relationship between faculty members' self-reported readiness and awareness of Ethno-STEM pedagogical principles.
4. To synthesize the findings into evidence-based recommendations for strategic capacity-building initiatives.

Methods

This study employed a descriptive–correlational research design to determine the level of institutional readiness for Augmented Reality (AR) integration and the level of faculty awareness of Ethno-STEM pedagogy, as well as to examine the relationship between these two variables. This design was deemed appropriate as it allows for the systematic description of existing conditions and the identification of significant associations among variables without manipulating the research setting.

Research Local and Participants

The study was conducted at the College of Education in a state college institution in Masbate Province, Philippines. The institution offers undergraduate teacher education programs, including science and professional education courses. The respondents consisted of thirty-five (35) full-time faculty members. This number of samples is a critical case in Masbate province as the only state college offering science education program. Inclusion criteria required respondents to be currently teaching professional education or science-related courses and to have at least one year of teaching experience in the institution.

Research Instrument

Data were collected using a structured survey questionnaire composed of two major parts. The first part measured institutional readiness for AR integration across four dimensions: (1) technological infrastructure, (2) technical and administrative support, (3) faculty digital competence, and (4) organizational culture. The second part assessed faculty awareness of Ethno-STEM pedagogy in terms of (1) conceptual understanding, (2) perceived pedagogical value, and (3) contextual application.

All items were measured using a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The instrument was adapted from existing technology readiness and culturally responsive pedagogy frameworks and subjected to expert validation by three specialists in science education and educational technology. This includes the face-content validation to ensure the validity of the instrument. Comments and revisions were made that makes the instrument valid for implementation in the study. A pilot test yielded an overall Cronbach's alpha of 0.89, indicating a satisfactory internal consistency.

Data Collection Procedure

Prior to data collection, administrative approval was secured from the college administration. The survey questionnaires were distributed personally and electronically to faculty members. Participation was voluntary, and informed consent was obtained from all respondents. Data collection was completed within a two-week period.

Data Analysis

Descriptive statistics, including mean and standard deviation, were used to determine the levels of institutional readiness and faculty awareness. Pearson's product–moment correlation coefficient was employed to examine the relationship between institutional readiness dimensions and Ethno-STEM awareness. All statistical analyses were conducted using Jamovi (version 2.3), an open-source statistical software package built on the R statistical environment. The level of significance was set at 0.05.

Result and Discussion

This section presents an in-depth analysis of the findings based on the specific problems of the study. Results are organized according to institutional readiness for Augmented Reality (AR) integration, faculty awareness of Ethno-STEM pedagogy, the relationship between readiness and awareness, and the synthesis of findings for capacity-building initiatives.

Institutional Readiness for the Integration of Augmented Reality (AR)

Table 1 presents the level of institutional readiness for AR integration across four dimensions: technological infrastructure, technical and administrative support, faculty digital competence, and organizational culture.

Table 1. Level of Institutional Readiness for AR Integration

Dimension	Mean	SD	Descriptive Interpretation
Technological Infrastructure	3.21	0.54	Moderate
Technical and Administrative Support	2.78	0.61	Moderate
Faculty Digital Competence	3.05	0.57	Moderate
Organizational Culture	3.02	0.59	Moderate
Overall Readiness	**3.02**	**0.58**	**Moderate**

Results indicate that institutional readiness for AR integration is generally at a moderate level. Technological infrastructure obtained the highest mean, suggesting that basic facilities such as computers, internet connectivity, and multimedia equipment are available. However, the moderate rating implies that these resources may not be optimized for advanced AR applications, which often require high-performance devices, stable broadband connectivity, and institutionally supported platforms. Recent studies emphasize that while baseline infrastructure is a prerequisite for AR adoption, its presence alone does not ensure effective pedagogical integration, particularly for immersive and culturally contextualized learning environments such as Ethno-STEM (Radianti et al., 2020; Garzón et al., 2020).

Contrary to the expectations of a typical classroom teacher, the study found that having fast internet connectivity and available resources does not automatically translate to improved Ethno-STEM integration for student learning. This aligns with contemporary findings indicating that technology-rich environments often fail to produce instructional innovation when teachers lack pedagogical frameworks and contextual design skills to leverage emerging technologies meaningfully (Bond et al., 2021).

Technical and administrative support registered the lowest mean among the dimensions. This suggests limited access to technical personnel, insufficient professional training opportunities, and the absence of formal institutional mechanisms to sustain AR integration. Recent empirical evidence confirms that weak institutional support structures remain a critical barrier to the long-term adoption of immersive technologies in higher education, even in contexts where hardware and software are available (Makransky & Petersen, 2019; Scherer et al., 2021). This finding extends earlier work by Ertmer and Ottenbreit-Leftwich (2010), reinforcing that support systems remain a persistent challenge across generations of educational technologies.

Faculty digital competence and organizational culture both yielded moderate means, indicating that faculty members possess basic digital skills and exhibit openness toward innovation, yet lack advanced competencies and structured institutional encouragement. Recent studies suggest that AR integration requires not only operational digital skills but also higher-order competencies such as instructional design, data literacy, and adaptive pedagogy (Falloon, 2020; Redecker, 2021). Without targeted professional development and policy-driven incentives, institutional readiness remains at an exploratory rather than implementation stage.

Faculty Awareness of Ethno-STEM Pedagogy

Table 2 presents the level of faculty awareness of Ethno-STEM pedagogy in terms of conceptual understanding, perceived pedagogical value, and contextual application.

Table 2. Level of Faculty Awareness of Ethno-STEM Pedagogy

Dimension	Mean	SD	Descriptive Interpretation
Conceptual Understanding	3.32	0.56	Moderate
Perceived Pedagogical Value and Knowledge	3.41	0.52	Moderate
Contextual Application	2.82	0.60	Moderate
Overall Awareness	**3.18**	**0.56**	**Moderate**

Faculty members demonstrated relatively higher awareness of the pedagogical value of Ethno-STEM, reflecting strong recognition of its potential to enhance cultural relevance and student engagement in science education. This finding is consistent with recent literature emphasizing Ethno-STEM as a powerful framework for promoting inclusivity, contextualization, and epistemic justice in STEM instruction (Aikenhead & Elliott, 2022; Madrazo & Deo, 2020).

Conceptual understanding was likewise rated moderate, suggesting familiarity with the principles of integrating indigenous knowledge systems and local contexts into STEM education. However, contextual application received the lowest mean, revealing a clear gap between awareness and classroom practice. This finding mirrors recent international studies showing that teachers often value culturally responsive and indigenous pedagogies but struggle to operationalize them due to limited exemplars, curricular alignment issues, and insufficient instructional scaffolds (Santos, 2023; Chinn, 2021).

This disconnect underscores a recurring challenge in culturally responsive pedagogy, where positive beliefs do not automatically translate into enactment. Recent research highlights that sustained mentoring, co-design opportunities, and localized curriculum development are necessary conditions for transforming awareness into practice (Gonzalez-Howard & McNeill, 2019; Paris & Alim, 2021).

Relationship Between Institutional Readiness and Faculty Awareness of Ethno-STEM

Table 3 presents the correlation between institutional readiness dimensions and overall faculty awareness of Ethno-STEM pedagogy.

Table 3. Test of Relationship Results Between Institutional Readiness and Faculty Awareness of Ethno-STEM

Readiness Dimension	r-value	p-value	Interpretation
Technological Infrastructure	0.314	0.066	Not significant
Technical and Administrative Support	0.287	0.092	Not significant
Faculty Digital Competence	0.482	0.004	Significant
Organizational Culture	0.356	0.041	Significant

The correlation results indicate that not all dimensions of institutional readiness contribute equally to faculty awareness of Ethno-STEM pedagogy. Technological infrastructure and technical and administrative support were not significantly related to faculty awareness. This supports contemporary evidence in educational technology research showing that access to tools and institutional provisions, while necessary, do not directly influence pedagogical beliefs or culturally responsive awareness unless mediated by professional learning and pedagogical vision (Scherer et al., 2021; Tondeur et al., 2021).

In contrast, faculty digital competence emerged as the strongest and most significant correlate of Ethno-STEM awareness. This finding is consistent with recent large-scale studies

demonstrating that teachers' digital competence significantly predicts their capacity to adopt innovative, student-centered, and culturally responsive pedagogies (Scherer & Teo, 2019; Lucas et al., 2023). Digital competence functions not merely as technical proficiency but as pedagogical capital enabling faculty to experiment with AR, contextualize content, and integrate indigenous knowledge systems meaningfully.

Organizational culture also exhibited a statistically significant positive relationship with Ethno-STEM awareness. This reinforces recent international evidence that supportive leadership, collaborative professional cultures, and innovation-oriented norms are critical enablers of both technology-enhanced and culturally responsive teaching practices (Teo et al., 2021; OECD, 2023). The moderate level of organizational culture readiness may explain why faculty awareness exists but remains unevenly enacted, particularly in contextual application.

These findings affirm that the weakest link in the readiness–awareness continuum is not material provision but the human and cultural dimensions of innovation. This pattern aligns with recent reinterpretations of Rogers' diffusion of innovations theory, which emphasize capability-building, social influence, and institutional learning cultures as primary drivers of adoption in educational contexts (Rogers, 2003; Hall & Hord, 2020). Strengthening faculty digital competence and cultivating supportive organizational cultures therefore emerge as strategic priorities for advancing AR-enabled Ethno-STEM implementation.

Synthesis of Findings and Implications for Capacity-Building Initiatives

Anchored on the findings addressing Statements of the Problem 1, 2, and 3, this study provides an integrative synthesis of institutional readiness for Augmented Reality (AR), faculty awareness of Ethno-STEM pedagogy, and the relationship between these constructs. The results collectively indicate that while foundational conditions for innovation exist, the institution remains in a transitional stage that necessitates deliberate and sustained capacity-building initiatives.

First, the assessment of institutional readiness revealed that technological infrastructure, faculty digital competence, and organizational culture are all present at moderate levels. This suggests that the institution has progressed beyond the initial access stage of technology integration. However, the relatively lower level of technical and administrative support indicates a structural limitation that may impede sustained AR implementation. The findings imply that without consistent technical assistance, instructional design guidance, and institutional policies, AR integration may remain fragmented and dependent on individual faculty initiative rather than institutional practice.

Second, the evaluation of faculty awareness of Ethno-STEM pedagogy showed that faculty members possess moderate conceptual understanding and a strong appreciation of the pedagogical value of culturally contextualized STEM instruction. Nevertheless, the lowest mean observed in contextual application underscores a persistent gap between awareness and classroom enactment. This indicates that while faculty members recognize the importance of Ethno-STEM, many lack the pedagogical confidence, models, and experiential training necessary to translate cultural knowledge into structured STEM learning experiences.

In some areas of Masbate where prevalent Ethno-STEM practices such as in the fishing industry, farming system and those families residing in upland and lowland areas, teachers lack the application and dispositions of contextualizing instructional materials which are highly relevant to the local setup. The bottleneck of non-application of the context and AR integration was the mandate of utilizing the ready made instructional materials for instruction.

Third, the correlational findings provide a unifying explanation for the observed readiness–awareness patterns. Faculty digital competence and organizational culture demonstrated significant positive relationships with Ethno-STEM awareness, highlighting the primacy of human and cultural dimensions in educational innovation. These results suggest that faculty members who possess stronger digital skills and work within supportive institutional cultures are more likely to engage

meaningfully with innovative pedagogical frameworks.

Conversely, the non-significant relationships involving infrastructure and technical support indicate that material resources alone are insufficient drivers of pedagogical awareness. This is a novel finding that portrays significant indication that infrastructure and technical support must be embedded in the planning process prior to the start of the instruction or academic year. Sending teachers for capacity development to better equipped with technical knowhow particularly in solving digital problems that may arises during the integration of technological devices in the teaching and learning process. The same also is applied to the infrastructure development to house the educational technology equipment where teachers can strengthen their digital know how and also in manipulating different hardware for instruction.

This synthesis demonstrates that effective capacity building for Ethno-STEM and AR integration must be multi-level and systemic. Institutions must move beyond infrastructure provision toward sustained professional development, supportive organizational cultures, and policy-driven incentives. Capacity-building initiatives should therefore focus on strengthening faculty digital–pedagogical competence, promote a collaborative professional learning communities, and institutionalizing support mechanisms that enable the co-design and implementation of culturally grounded, AR-enhanced instructional practices.

Conclusion

This study concludes that the College of Education exhibits a moderate level of institutional readiness for Augmented Reality integration and a comparable level of faculty awareness of Ethno-STEM pedagogy. While basic infrastructure and positive pedagogical orientations are evident, significant limitations persist in technical support, advanced digital competence, and the contextual application of culturally grounded STEM instruction.

The findings further establish that faculty digital competence and organizational culture are more influential determinants of Ethno-STEM awareness than technological infrastructure alone. This emphasizes the central role of human capacity and institutional climate in driving pedagogical innovation within teacher education institutions. By providing empirical evidence from a provincial Philippine context, the study contributes a diagnostic baseline for higher education institutions seeking to adopt culturally sustaining, technology-enhanced pedagogies.

The study affirms that transitioning from awareness to effective implementation requires intentional and sustained capacity building that aligns institutional structures, faculty competencies, and pedagogical vision. Without such alignment, innovations such as AR and Ethno-STEM are likely to remain aspirational rather than transformative.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are proposed:

1. Higher education administrators should develop and institutionalize strategic policies that explicitly support the integration of AR and Ethno-STEM pedagogy, including clear implementation roadmaps and resource allocation for sustained support.
2. Continuous, practice-oriented professional development programs should be implemented to enhance faculty digital competence, with specific focus on AR instructional design and the contextualization of indigenous and local knowledge within STEM instruction.
3. Institutions should foster collaborative professional learning communities that encourage experimentation, peer mentoring, and the sharing of best practices related to Ethno-STEM and AR-based teaching.
4. Teacher education curricula should explicitly embed Ethno-STEM and AR pedagogies to ensure that pre-service teachers experience and practice culturally contextualized, technology-enhanced instruction.
5. Future studies may employ mixed-methods or longitudinal designs to examine how capacity-building initiatives influence instructional practices and student learning outcomes over time.

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