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Immersing Local Wisdom: Ethnopedagogy-Based Virtual Reality within Research-Based Learning for Regenerative STEM Education

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Abstract

STEM education has long been criticized for prioritizing technical proficiency over socio-ecological responsibility. This study investigates the potential of Ethnopedagogy-based Virtual Reality (Ethno-VR) within a Research-Based Learning (RBL) framework as a pathway toward regenerative education. Using a quantitative comparative design, perspectives of 72 undergraduate students from Universitas Negeri Jakarta, Indonesia 32 from science programs and 40 from non-science programs were examined across four constructs reflecting core dimensions of regenerative education: learning engagement, cultural understanding, ecological awareness, and technology integration. Data were collected via structured questionnaire and analysed using two-way ANOVA. Science students showed higher learning engagement (M = 21.100; SD = 2.654) than non-science students (M = 18.615; SD = 3.709), approaching significance (F = 4.119; p = 0.052). Cultural understanding was marginally higher among science students (M = 18.800) and female students (M = 18.444), though not significantly (F = 3.613; p = 0.067). Ecological awareness was significantly higher in science students (M = 17.860; F = 3.013; p = 0.047), the only dimension yielding a statistically significant result. Non-science and female students reported greater appreciation for technology integration (F = 3.023; p = 0.052). These findings confirm that Ethno-VR strengthens cognitive, affective, and ecological dimensions of learning as evidenced by significant ecological awareness outcomes and consistent near-significant trends though its impact varies by academic background and gender.

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Introduction

The transformation of 21st-century education demands a learning approach that is not only oriented towards cognitive achievement, but also fosters ecological, cultural, and sustainability awareness (Ariyatun et al., 2025). In this context, regenerative education is present as a new paradigm that encourages students to think systemically, act reflectively, and play an active role in restoring and maintaining the balance of social and natural ecosystems (Armon, 2021; Beresford-Dey, 2025; Buckton et al., 2023). The application of the concept of regenerative education in the world of higher education in Indonesia still faces challenges, especially in terms of its approach

and learning media. One of the learning approaches that is in line with the principles of regenerative education is research-based learning (RBL) (Lambert, 2009). In this approach, students are not only recipients of knowledge, but also active subjects in the process of knowledge construction through contextual and transformative research (Clement, 2000). RBL cultivates critical, collaborative, and reflective thinking skills that are essential in building regenerative awareness (Susiani et al., 2019). The urgency of this research arises from the urgent need for a learning model that is able to bridge local values and global challenges through educational technology that is relevant to the times. However, the integration between Ethno-VR, the RBL approach, and the regenerative education framework is still rarely used as a comprehensive object of study, especially from the perspective of students as the main actors of learning.

Innovation opportunities lie in the use of immersive technologies such as Virtual Reality (VR) developed based on local or ethno-pedagogy values known as Ethno-VR (Leon-Paredes et al., 2022; Sudarmin et al., 2025). This technology not only provides a contextual and engaging learning experience, but also has the potential to revive local wisdom as a foundation for regenerative thinking (Hidayat et al., 2023). When Ethno-VR is applied within the framework of RBL, students not only learn from the culture, but also conduct research on the culture itself forming a bridge between technology, tradition, and ecological awareness (Chiu & Lien, 2025; Harris, 2010). By combining elements of local culture living in society with immersive technology, Ethno-VR is a medium that is able to bring students into a more authentic and transformative world of learning (Wahyudi et al., 2023). The learning experience is no longer one-way or theoretical, but is based on a real exploration of cultural values, practices, and narratives that have been marginalized in the modern education system (Zinchenko et al., 2021).

This study addresses that gap. We examine student perspectives on Ethno-VR within an RBL framework, specifically analyzing variations based on study program and gender. By simulating traditional batik making in a virtual environment, we created a space where data collection and critical reflection meet cultural narrative (Rizki et al., 2025). This process not only strengthens academic skills such as research literacy and data analysis, but also builds empathy, love for the environment, and awareness of the importance of cultural preservation (Sari et al., 2024; Setiyaningsih et al., 2021). The virtual experiences presented allow students to explore cultural sites, listen to folklore directly from local narrators, or visualize traditional rituals in depth, which is conventionally difficult to reach in the classroom learning process (Verawati et al., 2025). Our goal is not simply to validate the technology, but to understand its pedagogical texture. Does Ethno-VR merely digitize tradition, or does it transform the way students relate to their environment? The answers lie in the nuances of student engagement, cultural understanding, and ecological awareness dimensions that this paper seeks to unravel (Degrave et al., 2017; Suryati et al., 2025). Therefore, the use of Ethno-VR is not only an innovation in terms of learning media, but also a pedagogical strategy that is rooted in local wisdom and oriented towards a regenerative future.

The implementation of Ethno-VR in research-based learning encourages students to study cultural and environmental phenomena holistically through the process of data collection, critical reflection, and presentation of findings in an interactive digital form (Rizki et al., 2025). This process not only strengthens academic skills such as research literacy and data analysis, but also builds empathy, love for the environment, and awareness of the importance of cultural preservation

(Sari et al., 2024; Setiyaningsih et al., 2021). The virtual experiences presented allow students to explore cultural sites, listen to folklore directly from local narrators, or visualize traditional rituals in depth, which is conventionally difficult to reach in the classroom learning process (Verawati et al., 2025). More than that, the integration of Ethno-VR within the framework of RBL also opens up a cross-disciplinary collaborative space between students, lecturers, local communities, and technology developers. This collaboration is a meeting point between science, humanities, and technology, as well as creating a learning space that is inclusive, adaptive, and relevant to the challenges of the times (Degrave et al., 2017; Suryati et al., 2025). Therefore, the use of Ethno-VR is not only an innovation in terms of learning media, but also a pedagogical strategy that is rooted in local wisdom and oriented towards a regenerative future.

Despite these promising developments, a critical gap remains in the existing literature. Prior studies on Ethno-VR have predominantly focused on its technical development and general effectiveness as an instructional medium, without sufficiently examining how students from diverse academic backgrounds perceive and respond to its integration within a structured pedagogical framework. Most research treats learners as a homogeneous group, overlooking how disciplinary identity whether rooted in science or the humanities may shape engagement with culturally immersive technology. Similarly, studies connecting regenerative education to STEM learning have remained largely conceptual, with limited empirical evidence linking local wisdom-based VR interventions to measurable outcomes such as ecological awareness and cultural. This study addresses these gaps by empirically investigating how academic background (science vs. non-science) and gender shape student perspectives on Ethno-VR within an RBL framework, thereby generating evidence-based insights that advance the field beyond prior theoretical and technical accounts.

Method

2.1. Research Design and Participants

This study employed a quantitative comparative design to examine how academic background and gender shape student perceptions of Ethnopedagogy-based Virtual Reality (Ethno-VR) within a Research-Based Learning (RBL) framework. The comparative approach was deliberately chosen because regenerative education aspires to be inclusive, yet empirical understanding of how learners from different disciplinary traditions engage with culturally grounded immersive technologies remains limited. By comparing science and non-science students as well as male and female participants, this design enables a systematic and evidence-based exploration of how learner identity interacts with ethnopedagogical technology an analytical lens that prior studies have largely overlooked. The study is exploratory in nature, aiming to generate nuanced insights for future, larger-scale research rather than to confirm rigid hypotheses.

To ensure treatment equivalence, all participants regardless of academic background were exposed to identical Ethno-VR content and followed the same structured RBL procedure. The Ethno-VR media was deliberately grounded in local cultural knowledge (traditional batik-making) rather than discipline-specific academic content, making it equally accessible to both science and non-science students. Consequently, the comparative design of this study was intended to examine differences in student perceptions, not differences in academic performance or disciplinary content mastery.

2.2. The Ethno-VR Intervention

Central to this study was the Ethno-VR media, designed to simulate the traditional process of natural batik making in an interactive virtual environment. Batik was selected not merely as a cultural artifact, but as a complex socio-ecological practice that embodies local knowledge of natural dyes, sustainable resource use, and aesthetic philosophy. Within the virtual environment, students navigated each stage of batik production from pattern selection and natural dye preparation to coloring and finishing while accessing contextual narratives from local artisans. The intervention was embedded within a structured RBL cycle. Students first engaged with the Ethno-VR simulation to gather experiential data, then formulated research questions related to cultural sustainability or ecological practices, conducted further literature or field-based inquiry, and finally presented their findings in digital or discursive formats.

Both groups participated under the same learning conditions, with no modifications to the Ethno-VR simulation or RBL cycle based on academic background. This standardization ensures that any observed differences in perception reflect genuine variation in how students from different disciplinary traditions engage with culturally grounded immersive technology, rather than differences in instructional exposure. This design ensured that technology served not as an end in itself, but as a catalyst for critical, culturally situated research. Figure 1 illustrates the virtual batik pattern design interface used during the learning sessions.

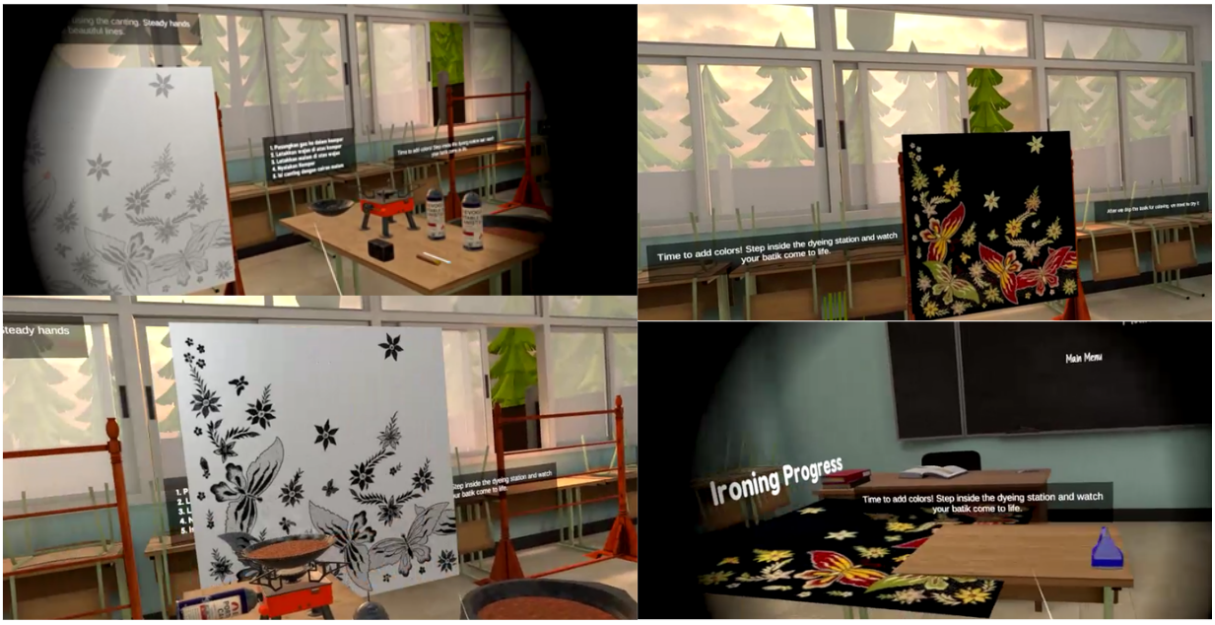

Figure 1. Visualization of The Virtual Batik Pattern Design Process in Ethno-VR

2.3. Instrumentation and Data Collection

Data were collected using a structured questionnaire developed around four constructs aligned with the study's aims: learning engagement, understanding of local culture, ecological awareness, and perception of technology integration. Items were adapted from established scales where available and refined through iterative review with three experts in educational technology, cultural pedagogy, and assessment. Content validity was confirmed through expert judgment, with

all items rated as relevant and representative of their intended constructs. The instrument employed a 5-point Likert scale ranging from strongly disagree to strongly agree. Prior to full deployment, a pilot test with a small group of students (n = 15) helped clarify ambiguous wording. Reliability analysis using Cronbach's Alpha yielded coefficients of 0.812 for learning engagement, 0.844 for cultural understanding, 0.798 for ecological awareness, and 0.765 for technology integration, with an overall alpha of 0.902, indicating strong internal consistency.

Following the RBL-Ethno-VR sessions, participants completed the questionnaire in a controlled setting, with options for online or paper-based response to accommodate access preferences. The procedure was designed to minimize social desirability bias by emphasizing anonymity and the absence of "correct" answers.

2.4. Data Analysis

Data analysis proceeded in two complementary phases. First, descriptive statistics (means and standard deviations) were computed to map the central tendencies and variability of responses across the four constructs, disaggregated by study program and gender. Second, a series of two-way Analyses of Variance (ANOVA) were conducted to test for significant differences based on academic background, gender, and their interaction. We acknowledge that the Shapiro-Wilk test indicated deviations from normality in several subscales, a common occurrence in perceptual data with modest sample sizes. While ANOVA is relatively robust to minor violations of normality, we interpret the results with appropriate caution, treating p-values near the 0.05 threshold (0.052, 0.067) as indicative of trends rather than definitive effects. This exploratory stance aligns with the study's aim to generate insights for future, larger-scale research rather than to confirm rigid hypotheses. All analyses were performed using software JASP, with an alpha level set at 0.05 for significance testing.

Results and Discussion

The survey was conducted on 72 students from education and non-science study programs at Universitas Negeri Jakarta who had participated in the same Ethno-VR-based learning experience within an identical RBL framework, ensuring treatment equivalence across groups. Before analyzing student perceptions, we established the psychometric quality of the measurement instrument. Content validity was confirmed through expert judgment, while empirical validity was assessed via Pearson's correlation analysis. All 16 items yielded calculated r values exceeding the table threshold (0.232 for $N = 72$, $p < 0.05$), confirming their statistical validity. Reliability was equally robust; Cronbach's Alpha coefficients ranged from 0.765 (technology integration) to 0.844 (cultural understanding), with an overall alpha of 0.902. These metrics assure us that the subsequent data reflects consistent student perceptions rather than instrument noise. The survey captured responses from 72 undergraduate students engaged in the Ethno-VR-based Research-Based Learning (RBL) module. Descriptive statistics and ANOVA results were examined across four dimensions: learning engagement, cultural understanding, ecological awareness, and technology integration. It is important to note that while Shapiro-Wilk tests indicated some deviations from normality (Tables 1, 3, 5, 7), we proceeded with ANOVA given its robustness, interpreting borderline p-values as exploratory trends rather than definitive effects.

3.1 Learning Engagement: Disciplinary Habits and Immersive Interaction

Findings from the perspective of students on their involvement in the learning process through the Ethno-VR-based RBL model were measured by four indicators. Learning engagement was measured through four indicators reflecting students' active involvement in the Ethno-VR-based RBL process: attentiveness during virtual exploration, motivation to conduct cultural inquiry, persistence in completing research tasks, and collaborative participation in presenting findings. The maximum possible score for this dimension was 25, based on five items rated on a 5-point Likert scale. Results of the analysis Table 1. shows that there is a difference in the average score of learning engagement based on the background of the study program and gender.

Table 1. Descriptive Statistics of Student Learning Engagement

	Science Program Study	**Non-Science Program Study**	**Female**	**Male**
Valid	32	40	48	24
Missing	0	0	0	0
Mean	21.100	18.615	19.667	20.667
Std. Deviation	2.654	3.709	3.464	3.109
Shapiro-Wilk	0.852	0.853	0.834	0.850
P-value of Shapiro-Wilk	0.106	0.131	0.081	0.067

Student engagement varied noticeably by academic background. Science students reported higher mean engagement scores (M = 21.100, SD = 2.654) compared to their non-science peers (M = 18.615, SD = 3.709). The ANOVA results (Table 2) revealed this difference approached statistical significance (F = 4.119, p = 0.052). While not strictly significant at the 0.05 level, this trend suggests that science students may find the Ethno-VR environment more congruent with their disciplinary habits. Accustomed to data exploration and experiential inquiry, science learners likely perceived the VR simulation as a natural extension of their laboratory work. This difference indicates that students of science study programs tend to show higher learning engagement in the context of using Ethno-VR media. This can be attributed to the tendency of science students to be more familiar with the experiential approach and data exploration-based technology inherent in research-based learning.

Table 2. ANOVA - Engagement

Cases	**Sum of Squares**	**df**	**Mean Square**	**F**	**p**
Gender	5.324	1	5.344	0.629	0.373
Study Program	40.630	1	31.630	4.119	0.052
Gender ✻ Study Program	1.358	1	1.408	0.124	0.607
Residuals	203.075	69	9.106		

Note. Type III Sum of Squares

The results of the ANOVA analysis in Table 2 were used to evaluate the influence of gender, study program, and interaction between the two on the level of student involvement in Research-Based Learning (RBL)-based learning using Ethno-VR media. Gender differences were less pronounced. Male students scored slightly higher (M = 20.667) than females (M = 19.667), but the effect was not significant (p = 0.373). This aligns with recent meta-analyses suggesting that once immersive technology is contextualized within pedagogy, gender gaps in technological engagement tend to narrow (Olshannikova et al., 2015). The lack of significant interaction between gender and study program (p = 0.607) further indicates that academic background operates independently of gender in shaping engagement levels.

3.2 Cultural Understanding: Empathy Across Disciplines

The use of Ethno-VR media in RBL-based learning not only aims to increase students' active participation, but also to enrich their understanding of the local cultural context. Based on the results of a descriptive analysis of indicators of local cultural understanding, data was obtained that showed differences in student perceptions based on study programs and gender.

Table 3. Descriptive Statistics of Understanding the Local Cultural Context

	Science Program Study	**Non-Science Program Study**	**Female**	**Male**
Valid	32	40	48	24
Missing	0	0	0	0
Mean	18.800	17.231	18.444	17.867
Std. Deviation	1.989	2.522	2.684	1.807
Shapiro-Wilk	0.937	0.768	0.832	0.822
P-value of Shapiro-Wilk	0.211	0.003	0.004	0.007

As shown in Table 3, students from science study programs have an average cultural comprehension score of 18,800 with a standard deviation of 1,989, slightly higher than non-science students who have an average of 17,231 with a standard deviation of 2,522. Although the difference is not very significant, this data suggests that female college students tend to have slightly higher cultural sensitivities, which may correlate with levels of empathy or emotional engagement in responding to cultural content. The results of statistical analysis of the understanding of the local cultural context are presented in Table 4.

Table 4. ANOVA - Understanding the Local Cultural Context

Cases	**Sum of Squares**	**df**	**Mean Square**	**F**	**p**
Gender	1.905	1	1.905	0.401	0.531
Study Program	17.143	1	17.143	3.613	0.067
Gender ✻ Study Program	9.219	1	9.219	1.943	0.174
Residuals	137.600	69	4.745		

Note. Type III Sum of Squares

One of the core aims of Ethno-VR is to deepen cultural comprehension. Descriptive data (Table 3) showed science students again leading slightly (M = 18.800) over non-science students (M = 17.231), with a trend approaching significance (F = 3.613, p = 0.067). This finding challenges the stereotype that humanities students are inherently more attuned to cultural content. Instead, it suggests that when culture is presented through a systematic, visual medium like VR, science students engage with it rigorously. Interestingly, female students recorded higher cultural understanding scores (M = 18.444) than males (M = 17.867), though this difference was not statistically significant (p = 0.531). This subtle variation may reflect higher empathic sensitivity among female participants, allowing them to connect more deeply with the narratives of local artisans embedded in the VR experience. However, the overall lack of significant gender effects implies that Ethno-VR serves as an equitable medium for cultural transmission, capable of bridging diverse learner profiles.

3.3 Ecological Awareness: The Significant Impact of Regenerative Design

The use of Ethno-VR in the framework of research-based learning not only focuses on cognitive aspects, but is also directed at fostering students' ecological awareness. Through virtual reality-based simulations featuring traditional practices, local wisdom, and representations of the natural environment, students are invited to see the relationship between culture, the environment, and sustainability (Seibert et al., 2023; Zhang et al., 2025). The results of the descriptive analysis are in Table 5.

Table 5. Descriptive Statistics of Ecological and Regenerative Awareness

	Science Program Study	**Non-Science Program Study**	**Female**	**Male**
Valid	32	40	48	24
Missing	0	0	0	0
Mean	17.860	16.256	16.454	14.886
Std. Deviation	1.809	2.596	2.786	1.908
Shapiro-Wilk	0.827	0.898	0.842	0.922
P-value of Shapiro-Wilk	0.111	0.002	0.003	0.001

The results of the descriptive analysis in Table 6 show that students from science study programs have an average ecological awareness score of 17,860 (SD = 1,809), higher than students from non-science study programs with an average of 16,256 (SD = 2,596). These findings indicate that science students are more sensitive to environmental sustainability and regeneration issues when studying with Ethno-VR media. Furthermore, the results of the ANOVA test in Table 6. provides a more detailed picture of the influence of study program and gender factors. The study program variable resulted in a value of F = 3.013 with p = 0.047, which means that there is a significant difference between science and non-science students in terms of ecological and regenerative awareness. Science students showed higher ecological engagement, reinforcing the

interpretation that academic background has an important role in shaping how students respond to environmental issues through Ethno-VR media.

Table 6. ANOVA - Ecological and Regenerative Awareness

Cases	Sum of Squares	df	Mean Square	F	p
Gender	1.805	1	1.795	0.561	0.421
Study Program	18.123	1	18.143	3.013	0.047
Gender ✻ Study Program	8.919	1	8.229	1.843	0.174
Residuals	147.600	69	4.945		

Note. Type III Sum of Squares

The most compelling finding emerged in the dimension of ecological and regenerative awareness. Here, the difference between science and non-science students reached statistical significance ($F = 3.013$, $p = 0.047$). Science students demonstrated markedly higher awareness ($M = 17.860$) compared to non-science students ($M = 16.256$). This result validates the hypothesis that Ethno-VR, when framed within RBL, effectively activates prior ecological knowledge held by science students. Their curriculum likely primes them to recognize sustainability cues such as natural dye processes in batik more readily than peers from other disciplines. Gender trends mirrored previous dimensions, with females scoring higher ($M = 16.454$) than males ($M = 14.886$), consistent with literature linking female gender to higher environmental empathy (Giusti & Samuelsson, 2020). However, since the gender variable itself was not significant ($p = 0.421$), the primary driver of ecological awareness appears to be academic socialization rather than gender identity. This underscores the potential of STEM education to lead regenerative initiatives, provided the technology connects abstract concepts to tangible local practices.

3.4 Technology Integration: Bridging the Gap for Non-Science Learners

The integration of technology through Ethno-VR is seen by students as a key element that enriches research-based learning experiences. The results of the descriptive analysis showed that most students felt more motivated and engaged when VR technology was used as a learning medium. Interactive visualization allows them to explore objects, cultures, and phenomena in a more in-depth way than conventional methods (Olshannikova et al., 2015), (Windhager et al., 2019). A descriptive analysis of students' perspectives on technology integration in RBL is presented in Table 7.

Table 7. Descriptive Statistics of Technology Integration in RBL

	Science Program Study	Non-Science Program Study	Female	Male
Valid	32	40	48	24
Missing	0	0	0	0
Mean	16.891	17.289	17.464	15.876
Std. Deviation	1.736	2.698	2.896	1.728
Shapiro-Wilk	0.827	0.998	0.742	0.922
P-value of Shapiro-Wilk	0.011	0.001	0.003	0.003

The results of the descriptive analysis in Table 7 show that students from non-science study programs have an average score of perception of technology integration in RBL of 17,289 (SD = 2,698), slightly higher than science students with an average score of 16,891 (SD = 1,736). This sensitivity can reflect women's openness to a learning approach that is contextual, interactive, and supports the understanding of socio-cultural values.

Table 8. ANOVA - Technology Integration in RBL

Cases	Sum of Squares	df	Mean Square	F	p
Gender	1.705	1	1.895	0.561	0.461
Study Program	17.123	1	17.184	3.023	0.052
Gender ✻ Study Program	8.817	1	8.229	1.963	0.184
Residuals	138.650	69	4.945		

Note. Type III Sum of Squares

In terms of understanding the local cultural context, Ethno-VR has proven to be effective in providing an immersive learning experience, which allows students to internalize cultural values through visual and narrative interaction (Bekele & Champion, 2019; Calvert & Hume, 2022). Female college students show slightly higher average scores, which may reflect empathic sensitivity to cultural content. These results show that cultural integration through VR media is able to bridge the gap between theory and practice (Li et al., 2024; Singer, 2025), as well as fostering student awareness of the importance of cultural preservation in the framework of regenerative education (Zidny, 2021). In the aspects of ecological and regenerative awareness, science students again showed higher scores, showing a close connection between academic background and ecological perception (Giusti & Samuelsson, 2020). These findings are important because they show that Ethno-VR is not only a technological instrument, but also a reflective medium that is able to encourage students to connect scientific knowledge with the value of sustainability. Although gender variables are not significant, there are indications that female students are more prominent in terms of ecological empathy.

Collectively, these findings paint a nuanced picture of Ethno-VR's role in regenerative education. The technology is not a "one-size-fits-all" solution; its impact varies by disciplinary background. Science students leverage Ethno-VR to deepen ecological awareness and engagement, aligning with their training. Non-science students, meanwhile, value the technology for its ability to visualize and contextualize abstract concepts. This duality is crucial for the future of STEM education. Regenerative education requires both technical competence (often found in science tracks) and socio-cultural empathy (often highlighted in humanities). Ethno-VR appears to nurture both, albeit through different pathways. The significant boost in ecological awareness among science students confirms that local wisdom, when digitized, can reinforce sustainability goals. Simultaneously, the high appreciation for technology integration among non-science students indicates that immersive media can dissolve barriers between disciplines.

However, we must remain cautious. The borderline p-values (0.052, 0.067) remind us that these effects are sensitive to context and sample size. The deviations from normality in several subscales suggest that student perceptions are complex and not always linearly distributed. Future

research with larger cohorts is needed to confirm these trends. Nevertheless, the current data supports the argument that Ethno-VR is more than a novelty; it is a pedagogical strategy capable of fostering the cognitive, affective, and ecological dimensions necessary for a regenerative future.

Conclusion

This study affirms that Ethnopedagogy-based Virtual Reality (Ethno-VR), integrated within Research-Based Learning, offers a meaningful pathway toward regenerative education. By grounding immersive technology in local wisdom, Ethno-VR strengthens students' ecological awareness, cultural understanding, and learning engagement though not uniformly. Science students demonstrated significantly higher ecological awareness, leveraging their disciplinary background to connect cultural practices with sustainability. Conversely, non-science students and female participants reported greater appreciation for technology integration, suggesting Ethno-VR serves as an accessible bridge for learners less familiar with technical inquiry. These nuanced responses underscore a critical implication: effective implementation requires pedagogical sensitivity to students' academic identities. Rather than a generic tool, Ethno-VR functions best when facilitation strategies are adapted to harness the distinct strengths each group brings. In sum, Ethno-VR illustrates that regenerative education need not reject technological innovation; rather, it thrives when technology is anchored in culturally meaningful contexts. Future research with larger, more diverse cohorts should examine the stability of these trends across settings. For now, the findings invite educators to reimagine immersive learning not as a simulation of reality, but as a space where students regenerate their relationship with culture, ecology, and knowledge itself.

Credit Authorship Contribution Statement

Ariyatun: Conceptualization, Methodology, Software, Visualization, Formal analysis, original draft writer, Writing review & editing. **Mukhlis and Ika Septiana**: Formal analysis, Supervision and Resources. **Wijayanto**: Writing review & editing, Project administration.

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