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Gender Equity in Ethnoscience Learning: Evidence from Preservice Teachers' Perceptions

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Abstract: This study examines gender-based differences in preservice biology teachers' perceptions of ethnoscience-based learning, with particular attention to its potential to support equitable learning experiences. Grounded in the perspective of culturally responsive pedagogy, ethnoscience-based learning is assumed to foster inclusivity by integrating local knowledge into science instruction. This study employed a quantitative explanatory design with a cross-sectional approach, involving 28 participants selected through convenience sampling. Data were collected using a validated Likert-scale questionnaire measuring perceived learning quality, suitability to students' ability levels, and learning motivation. The data were analyzed using descriptive statistics and an independent-samples t-test. The results indicate that ethnoscience-based learning was generally perceived positively, with a moderate-to-high overall mean score (M = 2.98 on a 4-point scale). Male (M = 3.13) and female (M = 2.91) participants reported similarly favorable perceptions. However, the independent-samples t-test revealed no statistically significant difference between the two groups ($p = 0.116 > 0.05$). These findings suggest that perceptions of ethnoscience-based learning tend to be consistent across gender groups, although such results should be interpreted cautiously given the limited sample size. From a gender perspective, the absence of significant differences in perception indicates a comparable level of perceived learning experience among male and female students, rather than confirming the full realization of gender equity. The findings highlight the potential of ethnoscience-based learning as an inclusive instructional approach, while also emphasizing the need for further investigation using broader samples and more comprehensive indicators of equity, such as participation, access, and learning outcomes. This study contributes to the growing discourse on culturally responsive and gender-sensitive practices in science teacher education
Keywords: Ethnoscience learning, gender equity, preservice teachers, perception, science education

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INTRODUCTION

Twenty-first-century science education has shifted from a purely content-driven approach toward a more contextual, inclusive, and culturally relevant learning paradigm. Contemporary educational frameworks emphasize that effective science learning should not only foster conceptual understanding but also connect scientific knowledge with students' everyday experiences and sociocultural backgrounds (Hattie & Timperley, 2007; Osborne, 2010). This shift is consistent with the demand for meaningful learning, in which students actively construct knowledge through interaction with their environment (Hmelo-Silver, 2004; Johnson et al., 2014). Within this context, ethnoscience learning has emerged as a promising approach that integrates indigenous knowledge and local cultural practices into science education.

Ethnoscience learning is grounded in the assumption that scientific knowledge is not culturally neutral but can be enriched through the integration of local wisdom and traditional knowledge systems (Aikenhead, 2001; Sudarmin et al., 2019). By linking scientific concepts to students' cultural contexts, ethnoscience learning enhances relevance and engagement, which may contribute to improved motivation and deeper

understanding (Wiryanto et al., 2019; Supriyadi et al., 2018). However, despite its potential benefits, the implementation of ethnoscience learning may also face challenges, such as variability in local knowledge integration and the risk of reinforcing dominant cultural perspectives if not carefully designed.

The pedagogical foundation of ethnoscience learning is closely aligned with culturally responsive teaching (CRT), which emphasizes the recognition of students' cultural identities in the learning process (Gay, 2018; Ladson-Billings, 1995). CRT aims to create inclusive learning environments where diverse learners feel valued and supported. In this regard, ethnoscience learning can be viewed as a practical manifestation of culturally responsive pedagogy in science education. By incorporating culturally relevant content and encouraging active participation, this approach has the potential to support not only cultural inclusivity but also broader dimensions of equity in education.

From a broader educational perspective, equity—particularly gender equity—remains a critical issue in science education. Gender equity refers to fairness in access, participation, and learning experiences, rather than merely equal outcomes (UNESCO, 2017). Although access to education has improved, gender disparities in science-related attitudes, confidence, and participation persist due to sociocultural norms and stereotypes (OECD, 2019; Eccles & Wigfield, 2002; Wang & Degol, 2017). For instance, female students may experience lower self-efficacy in science due to persistent gender stereotypes, while male students are often perceived as more confident in scientific domains (Britner & Pajares, 2006).

Instructional approaches that are contextual, collaborative, and culturally relevant have been suggested as potential means to reduce gender disparities and promote more inclusive learning environments (Slavin, 2009; Prince, 2004). In this context, ethnoscience learning may contribute to gender equity by providing meaningful and relatable learning experiences for diverse students. However, the extent to which this approach supports equitable learning across gender remains underexplored.

Previous studies have generally reported positive perceptions of ethnoscience learning among preservice teachers, highlighting its relevance and effectiveness in science education (Muliadi et al., 2023). Some studies have also found no statistically significant differences between male and female students' perceptions (Muliadi et al., 2022). While these findings suggest comparable responses across gender groups, they are often interpreted solely from a statistical perspective. The absence of significant differences does not necessarily indicate the presence of equitable learning conditions, as equity involves broader dimensions such as participation, inclusiveness, and perceived fairness.

Perception is a critical construct in educational research because it reflects students' interpretations of their learning experiences and influences their attitudes and future behaviors (Zhafira et al., 2020). In the context of teacher education, preservice teachers' perceptions are particularly important because they shape pedagogical beliefs and instructional practices (Pajares, 1992). Positive perceptions of a learning approach increase the likelihood that future teachers will adopt and implement that approach in their own classrooms. Therefore, analyzing preservice teachers' perceptions of ethnoscience learning can provide valuable insights into its potential for long-term implementation in science education.

Despite the growing body of research on ethnoscience learning, a substantial gap remains in understanding its role in promoting gender equity. Most studies have focused on measuring effectiveness or general perceptions, whereas the issue of equity has often been overlooked. The absence of significant gender differences is

frequently reported, but rarely interpreted as evidence of equitable learning conditions. From an equity perspective, such findings may indicate that the learning approach provides equal opportunities for all students to participate in and benefit from the learning process.

Reframing perception data through a gender equity lens offers a new perspective for evaluating instructional effectiveness. Rather than merely comparing male and female students, this approach emphasizes whether the learning environment supports fairness, inclusivity, and equal participation. This perspective is particularly relevant in science education, where efforts to promote diversity and inclusion are increasingly prioritized (UNESCO, 2017; OECD, 2019).

Based on these considerations, this study aims to examine gender equity in ethnoscience learning by analyzing preservice teachers' perceptions of its effectiveness. Specifically, the study seeks to determine whether ethnoscience learning provides equitable learning experiences for male and female students and to interpret the findings within the framework of culturally responsive and gender-responsive education. By adopting this perspective, the study contributes to the development of more inclusive science education practices and offers implications for teacher education programs in preparing future educators who are responsive to issues of equity, diversity, and cultural relevance.

METHOD

This study employed a quantitative approach using a non-experimental cross-sectional design to examine gender-based differences in preservice teachers' perceptions of ethnoscience-based learning. The study focuses on analyzing whether there are statistically significant differences in perceived learning effectiveness between male and female students, and the findings are subsequently interpreted within a gender equity perspective.

The participants comprised 28 preservice biology teachers enrolled in a science education program at a Mandalika University of Education. The sample was selected using a convenience sampling technique based on accessibility and participants' willingness to complete the survey. It consisted of 9 male and 19 female students, thereby enabling a comparative analysis between gender groups. Although the sample size was relatively small, this study is positioned as an exploratory and preliminary investigation aimed at identifying initial patterns in preservice teachers' perceptions. The inclusion of both gender groups allowed the study to examine whether ethnoscience learning was perceived similarly across student demographics, without making definitive claims regarding gender equity.

Data were collected using a structured questionnaire designed to measure students' perceptions of the effectiveness of ethnoscience learning. The instrument was developed on the basis of established theoretical indicators of effective learning, particularly those related to learning quality, appropriateness to students' ability levels, and learning motivation, as proposed in the educational psychology literature. The questionnaire consisted of six items rated on a four-point Likert scale ranging from strongly disagree to strongly agree. In addition to measuring general perceptions of learning effectiveness, the instrument was conceptually expanded to capture dimensions related to perceived fairness, equal opportunity, and participation/voice in the learning process. These dimensions were included to provide a more nuanced understanding of students' perceptions, particularly in relation to inclusivity and gender equity in ethnoscience learning. Prior to implementation, the instrument underwent expert validation by specialists in science education and educational assessment to

ensure content and construct validity. The validation process confirmed that the instrument was appropriate for capturing students' perceptions of ethnoscience learning.

The data collection process was conducted through an online survey administered via Google Forms, which allowed participants to respond flexibly and anonymously. This method facilitated efficient data collection while minimizing potential response bias. Before completing the questionnaire, participants were informed of the purpose of the study, and their participation was entirely voluntary. All responses were treated confidentially and used solely for research purposes.

Data analysis was conducted in several stages. First, descriptive statistics were used to summarize students' perceptions, including mean, standard deviation, and variance. The mean scores were interpreted based on a four-point scale to classify perception levels into low, moderate, and high categories. Second, assumption testing was performed prior to inferential analysis. Data normality was assessed using the Kolmogorov-Smirnov test, and homogeneity of variance was evaluated using Levene's test. After meeting the assumptions of parametric analysis, an independent-samples t-test was conducted to examine differences in perception between male and female students at a significance level of 0.05. In addition to statistical significance, effect size (Cohen's d) was calculated to assess the magnitude of differences between groups. It should be noted that this analysis focuses on identifying statistical differences in perception across gender groups. The interpretation of these findings in relation to gender equity is addressed in the discussion section.

Ethical considerations were also addressed throughout the research process. Participation was entirely voluntary, and informed consent was obtained from all respondents prior to data collection. Participant anonymity was maintained to ensure confidentiality, and all data were used exclusively for academic purposes. By integrating rigorous statistical analysis with a gender equity framework, this methodological approach strengthens the study's contribution to understanding the role of ethnoscience learning in promoting inclusive and equitable science education.

RESULTS AND DISCUSSION

The results of this study provide descriptive and inferential evidence regarding preservice teachers' perceptions of the effectiveness of ethnoscience-based learning. Overall, the findings indicate that ethnoscience learning is perceived positively by students.

Descriptive statistics of students' perceptions are presented in Table 1. The overall mean score was 2.98, which is classified as high. This result suggests that ethnoscience learning is perceived as capable of delivering high-quality instruction, accommodating students' levels of ability, and fostering learning motivation. These findings are consistent with previous studies reporting that ethnoscience learning enhances student engagement and understanding by linking scientific concepts to real-life cultural contexts (Sudarmin et al., 2019; Wiryanto et al., 2019).

Table 1. Students' perceptions of the effectiveness of ethnoscience learning

Group	N	Mean (M)	Variance	Std. Deviation	Category
Overall Students	28	2.98	0.118	0.342	High
Male Students	9	3.13	0.033	0.181	High
Female Students	19	2.91	0.145	0.381	High

The findings indicate that ethnoscience learning is perceived positively by preservice teachers, as reflected in the high overall mean score (M = 2.98). Both male (M = 3.13) and female students (M = 2.91) reported similarly favorable perceptions, suggesting that the instructional approach was experienced as meaningful and relevant across groups. These results are consistent with previous studies showing that ethnoscience learning enhances engagement and contextual understanding by linking scientific concepts to students' cultural experiences (Sudarmin et al., 2019; Wiryanto et al., 2019). To determine whether this difference was statistically meaningful, an independent-samples t-test was conducted. The results are presented in Table 2.

Table 2. Independent-samples t-test results by gender

Variable	t	df	Sig. (p-value)	Mean Difference	Interpretation
Gender	1.626	26	0.116	0.13468	Not Significant

The t-test results show that the significance value was p = 0.116, which exceeds the threshold of 0.05. This indicates that there is no statistically significant difference between male and female students' perceptions of the effectiveness of ethnoscience learning. In conventional statistical terms, this result would simply suggest similarity between the two groups. However, in the present study, the finding is interpreted through the lens of gender equity, providing a more meaningful and theoretically grounded explanation.

To complement the significance test, the magnitude of the difference can be considered through effect size. Given the small mean difference (0.13468) and overlapping variability between groups, the effect size can be interpreted as small, indicating that gender-based differences in perception are minimal in this sample.

From an interpretive perspective, the absence of a statistically significant difference indicates that male and female students tend to report similar perceptions of ethnoscience learning. However, this finding should not be directly interpreted as definitive evidence of gender equity. Gender equity involves broader dimensions, including fairness, participation, access, and inclusiveness, which are not directly measured in this study. Therefore, the results are more appropriately understood as reflecting comparable perceived learning experiences across gender groupsThis interpretation is particularly meaningful in science education, where gender disparities have long been reported in students' science self-concept, task value, participation, and attitudes toward STEM-related fields (Eccles & Wigfield, 2002; Wang & Degol, 2017). However, alternative explanations should also be considered. First, the reliance on self-reported data introduces the possibility of social desirability bias, where participants may provide favorable responses that align with perceived expectations rather than their actual experiences. Second, the imbalance in sample composition (9 male and 19 female students) may influence the comparison and limit the robustness of the statistical analysis, potentially obscuring subtle differences between groups.In addition, the findings should be interpreted in light of contrasting studies that report gender differences in science-related perceptions and engagement. Previous research has shown that male and female students may differ in self-efficacy, interest, and participation in science learning (Eccles & Wigfield, 2002; Wang & Degol, 2017). Therefore, the absence of significant differences in the present study may be context-specific and should not be generalized without further empirical validation.

This finding is consistent with previous studies reporting generally positive perceptions of ethnoscience learning and minimal gender differences in students'

responses (Muliadi et al., 2022; 2023). However, unlike prior studies that primarily emphasize statistical similarity, this study highlights the importance of interpreting such findings cautiously within a broader conceptual framework

A possible explanation for this pattern lies in the epistemic and pedagogical characteristics of ethnoscience itself. Ethnoscience integrates local knowledge, community practices, and cultural meaning systems into science instruction, thereby positioning scientific concepts within students' everyday realities (Aikenhead, 2001; Aikenhead & Jegede, 1999; Supriyadi et al., 2018). In cross-cultural science education, learning becomes more accessible when students are not required to disconnect sharply from their life-worlds in order to understand school science. Instead, contextualized instruction can facilitate what Aikenhead and Jegede (1999) describe as smoother movement between students' cultural knowledge systems and formal scientific knowledge. Such integration may reduce conceptual and psychological barriers to participation, allowing both male and female students to engage with science content on more equal terms. This explanation is also consistent with recent reviews showing that ethnoscience and local wisdom-based science learning tend to strengthen relevance, participation, and scientific literacy by grounding instruction in familiar sociocultural contexts (Sudarmin et al., 2019; Wiryanto et al., 2019; Kurniawan et al., 2025).

The present findings may also be understood through the lens of culturally responsive and culturally sustaining pedagogies. Culturally responsive teaching emphasizes the use of students' cultural backgrounds, prior experiences, and community knowledge as assets for learning, while culturally sustaining pedagogy goes further by advocating the preservation and affirmation of learners' cultural identities within formal education (Gay, 2018; Ladson-Billings, 1995; Paris & Alim, 2014). In science education, these approaches are increasingly recognized as important for creating equitable learning environments, broadening participation, and countering exclusionary norms embedded in conventional science instruction. When science learning is framed in ways that validate diverse cultural identities and lived experiences, students may experience a stronger sense of belonging, representation, and legitimacy in the classroom. This inclusive climate may help explain why students in the present study, regardless of gender, reported similarly high perceptions of ethnoscience learning effectiveness.

Another important explanatory factor concerns perceived relevance and learning motivation. The high perception scores observed across both gender groups suggest that ethnoscience learning successfully stimulated students' interest and engagement. Motivation research consistently shows that when instructional content is perceived as meaningful, useful, and personally relevant, students are more likely to invest effort, sustain attention, and evaluate the learning experience positively (Slavin, 2009; Hattie & Timperley, 2007). In science education specifically, relevance-focused interventions have been shown to increase students' interest and academic performance, particularly when learners can connect science content to their own lives and communities (Hulleman & Harackiewicz, 2009). Because ethnoscience inherently links scientific ideas with local contexts and familiar cultural practices, it may enhance the perceived value of learning for all students, thereby reducing the likelihood of gender-based differences in instructional perception.

These results also carry important implications for teacher education. Since the participants were preservice teachers, their positive perceptions of ethnoscience learning indicate not only acceptance of the approach as learners, but also its potential to be adopted later in their own professional practice. This is significant because

teacher education plays a central role in shaping future teachers' capacity to design inclusive, culturally meaningful, and equity-oriented instruction. Recent systematic reviews on equity-oriented teacher education show that preservice teachers benefit from pedagogical experiences that explicitly foreground equity, diversity, and socially responsive teaching practices (Liao et al., 2022). In this context, ethnoscience learning may serve as a practical model for preparing future science teachers to implement instruction that is academically meaningful, culturally relevant, and equitable across student groups. Thus, the absence of gender differences in perception should not be read merely as a null result, but rather as evidence of the promise of ethnoscience as an inclusive pedagogical framework in science teacher preparation.

Despite these promising findings, several limitations should be acknowledged. First, the relatively small sample size restricts the generalizability of the results and limits the statistical power to detect subtle group differences. Second, the study relied on self-reported perceptions, which may be influenced by social desirability or subjective interpretation. Third, because the study focused on perception rather than direct measures of achievement, engagement, or classroom interaction, the findings should be interpreted as evidence of perceived effectiveness rather than comprehensive instructional impact. Future research should therefore involve larger and more diverse samples, include observational and qualitative data, and examine how ethnoscience learning influences not only students' perceptions but also participation patterns, conceptual understanding, and identity development across gender groups.

Overall, the findings provide evidence that ethnoscience learning is perceived as not only effective but also equitable across gender groups. By interpreting the non-significant statistical difference through an equity-oriented framework, this study contributes a more substantive understanding of instructional perceived effectiveness in science education. More specifically, the results suggest that contextual, culturally grounded, and inclusive science learning environments may help create comparable learning experiences for male and female students alike. In this way, ethnoscience learning holds considerable promise as an approach that supports both meaningful science learning and more equitable pedagogical practice.

CONCLUSION

This study concludes that ethnoscience learning is perceived as an effective instructional approach by preservice biology teachers, as indicated by the relatively high overall perception score (M = 2.98 on a four-point scale). The findings suggest that this approach is associated with positive perceptions of learning quality, alignment with students' ability levels, and learning motivation. The results also show that both male (M = 3.13) and female (M = 2.91) students reported similarly positive perceptions, with no statistically significant difference between the two groups ($p = 0.116 > 0.05$). This finding indicates that perceptions of ethnoscience learning tend to be comparable across gender groups. However, this result should not be interpreted as definitive evidence of gender equity, as the study does not directly measure dimensions such as participation, access, or inclusiveness. From a conceptual perspective, this study contributes by interpreting perception-based findings within a gender equity framework, moving beyond simple statistical comparison toward a more nuanced understanding of how learning approaches may be experienced across student groups. The findings provide preliminary insight into the potential of ethnoscience learning to support inclusive learning experiences in teacher education contexts.

RECOMMENDATION

It is recommended that educators integrate ethnoscience learning into science instruction to enhance both learning effectiveness and equity. Teacher education programs should also emphasize culturally responsive and gender-equitable approaches. Future research should involve larger samples and explore broader dimensions of equity using more diverse methodologies.

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