



Epistemological Beliefs about Physics Learning: The Role of Gender, Grade Level, and Ethnicity Background toward Quality and Inclusive Education

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Abstract: This study explores high school students' epistemological beliefs about physics learning in East Nusa Tenggara (NTT) Province and evaluates the effects of gender, grade level, and ethnicity. Utilizing a descriptive-quantitative survey design, the study involved 390 science students (grades 10–12) across six high schools. Data were gathered via the validated Beliefs and Attitudes Toward Physics and Learning (BAPL) instrument and analyzed using a three-way ANOVA. The overall average BAPL score was 69.35 ± 7.03 . Statistics revealed that gender significantly impacted overall beliefs ($F = 3.99$, $p = 0.05$), with females reporting more positive baseline scores (70.00 ± 6.74) than males (68.55 ± 7.34). Grade level also exerted a significant main effect ($F = 3.60$, $p = 0.04$), showing more sophisticated views in higher grades. Conversely, the main effect of ethnicity was highly insignificant ($F = 0.006$, $p = 0.94$). While no significant overall three-way interaction was found ($F = 0.85$, $p = 0.43$), a dimension-specific three-way interaction emerged exclusively within the Relevance of Physics in Everyday Life (RLE) dimension ($F = 3.05$, $p = 0.05$). These findings suggest that uniform school systems act as epistemic equalizers across ethnic backgrounds in NTT, though gender-sensitive and context-aware pedagogy remains essential to foster sophisticated physics beliefs.

Keywords: Ethnicity; Gender; Grade; Physics; Student beliefs

Introduction

Students' beliefs about physics learning play an essential role in the physics learning process. Beliefs are individuals' views about the nature of knowledge and the process of acquiring knowledge (Peiser et al., 2025). These beliefs include how students understand the sources, structure, and certainty of physics knowledge, as well as how they interpret the physics learning process (Kapucu, 2021). In line with this, Ibrahim (2022) emphasize that student beliefs are closely related to how students view physics knowledge and interact with physics material. Bråten et al. (2015) add that beliefs about the sources and validity of knowledge influence how students motivate themselves and interact with learning material. In learning physics, students can view knowledge as either a collection of facts to be memorized

or a conceptual construct that can be developed through reasoning and learning experiences (Yağan & Parlar, 2023). Furthermore, Klopp et al. (2023) show that students' epistemic beliefs also influence their ability to explain physical phenomena scientifically, which ultimately influences how they interact with and process learning materials.

Students' beliefs also play an essential role in determining the quality of their understanding, motivation, and scientific identity as physics learners. Research shows that students' epistemological beliefs, which they bring to the classroom, are significantly correlated with their success in physics (Chen et al., 2019; Schiefer et al., 2022). Students who have positive beliefs that physics knowledge is dynamic and can be constructed through scientific inquiry tend to show high motivation and engagement in learning (X. Guo et al.,

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2022; Ondap & Hornejas, 2022; Wu et al., 2024). Panergayo (2023) also shows that students with developed positive beliefs tend to be more reflective and persistent in facing conceptual difficulties, because they view mistakes as part of the learning process. This aligns with research by Ulu et al. (2024), which found that positive beliefs about the nature of physics knowledge contribute indirectly to the formation of physics identity by increasing physics self-efficacy. However, negative beliefs about one's ability to understand physics often reduce motivation to learn, decrease interest in science, and limit students' active participation in meaningful learning activities (Bentayao & Ilagan, 2024; Kurbanoglu & Takunyaci, 2021). Negative beliefs can also lower self-confidence, create resistance to abstract concepts, and cause alienation from physics (Chetri, 2022). Consequently, identifying the factors that shape these epistemological beliefs serves as an empirical foundation for mitigating educational disparities, which constitutes a primary pillar in realizing quality and inclusive education under the framework of SDG 4 and SDG 5.

Various complex demographic, academic, and contextual factors influence students' beliefs about physics learning. Gender is one factor that consistently influences students' epistemological beliefs in physics learning (Ibrahim, 2022). Research by Kaltakci-Gurel (2025) shows that gender and academic achievement levels influence students' epistemological beliefs. Although there are no gender differences in physics metacognition, male students score higher than female students on physics identity and self-efficacy (Rosen & Kelly, 2020; Ulu & Yerdelen-Damar, 2024). Grade level is another important factor that influences students' epistemological beliefs. Cross-grade studies reveal a nonlinear pattern in learning environments dominated by traditional instruction emphasizing rote memorization, students' beliefs tend to shift toward less sophisticated orientations. Cross-grade-level studies reveal a nonlinear pattern where secondary students' beliefs often shift toward less sophisticated orientations when exposed to traditional instruction emphasizing rote memorization, conversely, advance educational levels, such as Master's-level programs, systematically rebuild sophisticated beliefs through research-driven inquiry and independent conceptual construction (Chen et al., 2019). In addition, students' epistemological beliefs are strongly influenced by their culture, which shapes their approach to learning and their views on knowledge as definite or evolving (Dorji & Namgyel, 2025; Pitaloka & Inayah, 2024; Safitri et al., 2024). Thus, students' beliefs about physics learning are multidimensional and dynamic constructs, shaped through complex interactions between individual characteristics,

developmental factors, and students' sociocultural contexts.

Differences in background between students from Sumba Island and Timor Island in East Nusa Tenggara (NTT) Province are particularly relevant in the context of this study, as the two regions exhibit distinct geographical, socioeconomic, and linguistic characteristics that may collectively shape unequal physics learning experiences. First, in terms of geography and educational access, NTT's remote island geography and arid conditions limit access to basic resources and services, including education, and these conditions are not distributed evenly between the Sumba and Timor regions. Inequalities in access to quality learning facilities, science laboratories, and competent physics teachers in remote areas potentially restrict the diversity of learning experiences that could foster the development of more sophisticated epistemological beliefs (Suryadarma & W. Jones, 2013). Second, from a socioeconomic perspective, the role of socioeconomic status on students' epistemic beliefs and science achievement has been confirmed at both the student and school levels (Rozgonjuk et al., 2023). Students' gender, grade level, and family SES are associated with their epistemic beliefs (J. Guo et al., 2022), indicating that students from families with more limited resources tend to have fewer stimulating learning experiences outside school, which may hinder the development of more adaptive epistemological orientations. Third, from a linguistic standpoint, the Indonesian-centered curriculum, lessons, materials, and assessment system have a negative impact on students' academic achievement, particularly in multilingual regions such as Sumba (Ekarina et al., 2025). In Sumba specifically, many early grade teachers do not use local languages in the classroom; in some schools, teachers are recruited from other areas of Indonesia and cannot be expected to have mastered the local language. This linguistic barrier potentially creates difficulties in conceptual understanding of physics, which in turn may affect how students form beliefs about the nature of physics knowledge.

Several studies related to students' beliefs about learning have been conducted. Most previous studies have focused more on attitudes, self-efficacy, or interest in physics (Guo et al., 2022; Ulu & Yerdelen-Damar, 2024; Wu et al., 2024). However, the dimension of belief has not been studied in depth. In fact, understanding how students view the nature of physics knowledge can provide a more comprehensive picture of their learning behavior. However, studies on students' beliefs about physics are still rare. Research focusing on the role of gender, grade level, and cultural background in shaping students' beliefs about physics is also limited. Furthermore, there is very little research comparing

students from different cultural backgrounds, such as those in Sumba and Timor. These two ethnic groups have different social practices and value systems, which can shape students' perspectives on knowledge and physics learning. The limited empirical studies examining the influence of gender, educational level, and ethnic background on students' epistemological beliefs in the NTT region indicate a significant knowledge gap that needs to be addressed. In addition, the region's geographical conditions, socio-cultural diversity, and variations in school learning quality have the potential to shape physics learning experiences that differ from those in other regions.

This study aims to explore students' beliefs about physics learning in Indonesia. Therefore, the primary focus of this study is the following research questions: what is the profile of high school students' epistemological beliefs about physics learning in NTT Province, and how do gender, grade level, and ethnic background influence students' beliefs about physics learning? By answering these questions, this study is expected to provide deeper insight into the factors that influence students' beliefs about physics.

Method

This study used a descriptive, quantitative approach and a survey to obtain an overview of students' beliefs and attitudes toward physics learning at the high school level in NTT Province.

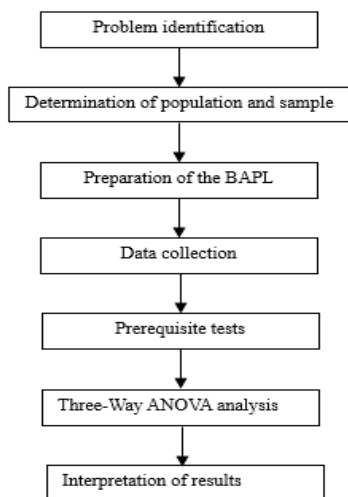


Figure 1. Research implementation flowchart

As illustrated, the research comprised seven main stages: (1) problem identification and formulation of research objectives; (2) determination of population and sample; (3) instrument preparation and reliability testing; (4) data collection through an online survey; (5) statistical prerequisite testing; (6) Three-Way ANOVA analysis; and (7) interpretation of results and conclusion

drawing. Each stage is described in detail in the following sections.

The population of this study consisted of all Natural Sciences high school students in NTT Province. The sample was selected using purposive sampling, a technique in which participants are chosen based on criteria relevant to the research objectives (Creswell & Poth, 2018). The inclusion criteria were: (1) active students enrolled in grade 10, 11, or 12 of the Natural Sciences track; (2) attending schools located in areas with a dominant Sumbanese or Timorese ethnic population; and (3) willing to participate voluntarily. Based on these criteria, a total of 390 students from six high schools spread across several districts in NTT Province were selected as respondents. In terms of gender, the sample comprised 185 male students (47.4%) and 205 female students (52.6%). By grade level, there were 136 tenth graders (34.9%), 145 eleventh graders (37.2%), and 109 twelfth graders (27.9%). By ethnic background, the sample included 188 Sumbanese students and 202 Timorese students. To ensure the absence of empty cells that could compromise the validity of the Three-Way ANOVA analysis, the full distribution of respondents is presented in a three-variable contingency table in Table 1.

Table 1. Details of Students Based on Gender, Grade Level, and Ethnicity

Grade Level	Ethnicity	Male	Female	Total
Grade 10	Sumba	30	36	66
	Timor	33	37	70
Grade 11	Sumba	37	32	69
	Timor	39	37	76
Grade 12	Sumba	25	28	53
	Timor	21	35	56
Total	Sumba	92	96	188
	Timor	93	109	202
Grand Total		185	205	390

Data were collected using the Indonesian version of the Beliefs and Attitudes toward Physics and Learning (BAPL) instrument, consisting of 20 items. These items measure four distinct dimensions of epistemological beliefs: Nature of Physics as a Science (NPS), Physics Learning Process in school (PLP), Self-Efficacy (SEF), and Relevance of Physics in Everyday Life (RLE). Responses were measured using a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) for positive statements, and reversed for negative statements. To ensure the instrument's psychological stability and internal consistency when deployed within this specific regional population in NTT, the reliability test yielded a reliable overall Cronbach's alpha coefficient of 0.76. This coefficient confirms that the BAPL instrument possesses sufficient internal

consistency and structural reliability for measuring the target variables in this study.

Result and Discussion

The epistemological belief profile presented in this study describes how students assess the nature of physics knowledge and the process of acquiring that knowledge based on BAPL instrument scores. This profile not only shows the positive or negative level of students' beliefs about physics, but also reveals their belief patterns in the four main dimensions of BAPL, namely beliefs about the nature of physics as a science, beliefs about the process of learning physics at school, beliefs about self-efficacy, and beliefs about the relevance of physics in everyday life. The BAPL scores reported in these descriptive findings reflect how students interpret physics as a dynamic science that can be developed through reasoning and is related to their real experiences. This explanation helps place the statistical results shown in Table 2, in the context of students' epistemological interpretations in NTT Province.

Table 2. Statistical Description of the BAPL Test

Characteristics	Mean	SD	Minimum	Maximum
Gender				
Male	68.55	7.34	50	87
Female	70.0	6.74	44	86
Grade Level				
Grade 10	68.44	7.40	44	86
Grade 11	68.97	6.59	49	87
Grade 12	70.86	7.37	52	86
Ethnicity				
Sumba	69.20	7.07	44	86
Timor	69.44	7.06	52	87
Total	69.35	7.03		

Table 2 presents descriptive statistics for students on the BAPL test for all participants and for groups categorized by gender, grade level, and Ethnic. The overall average score for students on the BAPL test was 69.35 (SD = 7.03), ranging from 44 to 87. For the gender variable, female students (mean = 70.0, SD = 6.74) showed slightly better results than male students (mean = 68.55, SD = 7.34). The lowest score for the male group was 50, while the female group's was 44. The highest scores for both groups were relatively equal, namely 87 for males and 86 for females. At the grade level, 12th-grade students showed the highest results with an average score of 70.86 (SD = 7.37), followed by 11th-grade students with an average score of 68.97 (SD = 6.59), and 10th-grade students with an average score of 68.44 (SD = 7.40). This pattern shows an increase in results along with an increase in grade level. The score ranges for the three grade groups are relatively similar,

with the lowest scores ranging from 44 to 52 and the highest from 86 to 87. Meanwhile, in terms of Ethnic, students of Timor Ethnic had a slightly higher average score (mean = 69.44; SD = 7.06) than students of Sumba Ethnic (mean = 69.20; SD = 7.07). However, the average difference between these two ethnic groups is minimal, indicating relatively equal results. Students of Timor Ethnic had the lowest score of 52 and the highest of 87, while students of Sumba Ethnic had the weakest of 44 and the highest of 86.

Inferential analysis in this study was conducted using three-way ANOVA with gender, grade level, and Ethnic as factors. Before the primary analysis, a prerequisite test, the Kolmogorov-Smirnov test, was conducted to assess the normality of the BAPL score distribution for each factor combination. The test results indicated that the data met the normality assumption ($p > 0.05$), making them suitable for further analysis using a three-way ANOVA. To test for homogeneity of variance, a Levene test was conducted, and there were no significant differences in variance between groups ($p > 0.05$). After both assumptions were met, a three-way analysis of variance with a 2 gender \times 3 grade level \times 2 Ethnic design was conducted, with student performance on the BAPL test as the dependent variable.

Table 3. Three-way Analysis of Variance on Students' Overall Confidence in Physics

Sources of Variation	df	F	p
Gender	1	3.99	0.05
Grade Level	2	3.60	0.04
Ethnicity	1	0.006	0.94
Gender x Grade Level	2	1.31	0.27
Gender x Ethnicity	1	3.85	0.05
Grade Level x Ethnicity	2	1.06	0.35
Gender x Grade Level x Ethnicity	2	0.85	0.43

The main effects and interaction outputs generated from this overall analysis are structured in Table 3. As presented in the table, the main effect of gender was statistically significant ($F = 3.99, p = 0.05$), indicating that differences between male and female students significantly contribute to the variation in overall physics belief scores. Similarly, grade level exerted a significant main effect on student performance ($F = 3.60, p = 0.04$), showing that academic progression through high school correlates with meaningful shifts in students' general epistemological stances. In contrast, the main effect of ethnicity was highly insignificant ($F = 0.006, p = 0.94$), confirming that baseline overall beliefs do not differ inherently between students of Sumba and Timor backgrounds. Regarding the interaction terms, the structural model did not yield any statistically significant interactions among the factors. Specifically, the two-way interaction between gender and grade level

was not significant ($F = 1.31, p = 0.27$), implying that the disparity between genders remains relatively stable regardless of the grade level. The interaction between gender and ethnicity approached but did not cross the significance threshold ($F = 3.85, p = 0.05$), and the grade level \times ethnicity interaction remained non-significant ($F = 1.06, p = 0.35$). Finally, the overarching three-way interaction between gender, grade level, and ethnicity on total physics confidence was also statistically non-significant ($F = 0.85, p = 0.43$). This lack of interaction indicates that while gender and grade level act independently as significant predictors of overall BAPL scores, their combined intersection does not create unique compounding effects on the total score, contrasting with the dimension-specific trends observed later in the sub-scale analyses.

Table 4. Three-Way Analysis of Variance (F-value) for Each Dimension of Students' Beliefs in Physics

Sources of Variation	NPS	PLP	SEF	RLE
Gender	7.85*	3.28	1.85	7.02*
Grade Level	3.43*	5.12*	0.27	2.12
Ethnicity	0.14	0.02	0.05	0.03
Gender \times Grade Level	0.35	2.52	0.44	0.47
Gender \times Ethnicity	3.02	2.32	0.29	3.23
Grade Level \times Ethnicity	0.15	1.93	0.53	0.11
Gender \times Grade Level \times Ethnicity	0.64	0.48	1.61	3.05*

Values in the table are F-values. * $p < 0.05$. NPS = Nature of Physics as a Science; PLP = Process of Learning Physics at School; SEF = Self-Efficacy; RLE = Relevance of Physics in Everyday Life

Based on the three-way analysis of variance presented in Table 4, several main effects and interaction effects on students' epistemological beliefs in physics learning were identified. The statistical output reveals a significant main effect of gender on the Nature of Physics (NPS) dimension ($F = 7.85, p = 0.005$) and the Relevance of Physics in Everyday Life (RLE) dimension ($F = 7.02, p = 0.008$). Grade level also exerts a significant main effect on both the NPS dimension ($F = 3.43, p = 0.03$) and the Process of Learning Physics (PLP) dimension ($F = 5.12, p = 0.006$). Crucially, a significant three-way interaction among gender, grade level, and ethnicity was detected exclusively on the fourth dimension, Relevance of Physics in Everyday Life (RLE) ($F = 3.05, p = 0.05$).

To unpack the significant three-way interaction on the RLE dimension, the estimated marginal means were analyzed across all sub-groups. The descriptive patterns indicate that the intersection of these three factors creates distinct micro-contexts for epistemological development. Specifically, female students from the Sumba ethnic group in the 12th grade exhibited the most prominent and highest RLE scores compared to all other factor combinations. This trend suggests that as female

students in Sumba advance through senior high school, they increasingly develop a more integrated view of how physics principles apply to their everyday life environments. Conversely, male students of Timor ethnicity in the 10th grade demonstrated the lowest baseline scores in this dimension. This interaction highlights that cultural socialization at home interacts with gendered expectations and academic progression, meaning that pedagogical interventions aiming to enhance the perceived real-world utility of physics must be tailored to these specific intersections rather than treating gender or ethnicity as isolated variables.

The analysis shows that gender plays a role in differentiating how students view and believe in physics. Overall, female students tend to report more positive beliefs than male students, especially in dimensions related to how they interpret the nature of physics and its relevance to everyday life. This indicates that gender differences are not only reflected in their confidence in solving problems, but also in how they assess the usefulness, dynamics, and relevance of physics to their life experiences. This pattern aligns with findings from several studies showing that female students can develop more constructive beliefs and attitudes towards science learning when learning emphasizes personal meaning and connection to the real world (Ibrahim, 2022; Mustafa Alpaslan, 2019; Wu et al., 2024). These studies generally describe female students as more reflective and cautious in evaluating knowledge, so that when they feel the subject matter is relevant and understandable, they tend to form stable, realistic beliefs. In contrast, male students in some contexts appear more confident, but mature epistemological beliefs do not always accompany this confidence. These findings reinforce this picture, as gender differences are more apparent in how students interpret the function and sustainability of physics knowledge than in their confidence in solving problems.

On the other hand, these results differ from those of Kaltakci-Gurel (2025), who reported that male students actually hold more expert-like beliefs in physics learning, as indicated by higher scores on several CLASS subscales. Male students tend to view physics knowledge as specific and unchanging, and to understand physics concepts in a more procedural, step-oriented manner than females do. The differences in the direction of these findings show that the influence of gender on beliefs is not universal but rather highly context-dependent. There are at least several factors that may explain these differences. First, the socio-cultural context and education system in this study differ significantly from those in the previous study. The students in this study come from a region with distinctive cultural, linguistic, and educational access characteristics, so their experiences with physics, both in

and out of the classroom, differ from those of students in other countries. In addition, the way teachers manage their classrooms and interact with male and female students may also contribute to gender influences. For example, suppose teachers consistently relate physics concepts to everyday experiences and open up space for dialogue. In that case, female students may feel more accommodated and find it easier to see the relevance of physics to their lives. Conversely, if learning is more centered on routine exercises and emphasizes speed, male students may benefit more, as this style of interaction aligns with the patterns of competition and performance they more often experience in learning and other activities. From a social cognitive theory perspective, differences in the experiences of success, role models, and forms of social persuasion received by male and female students will shape different sources of confidence in physics. Physics teachers need to design learning practices that are consciously sensitive to the different needs and perspectives of male and female students. Learning that connects physics to real-life contexts, provides opportunities to explore ideas, and encourages reflection on thought processes not only has the potential to strengthen positive beliefs in female students, but also helps male students develop deeper, more measurable beliefs that go beyond mere momentary confidence.

After considering gender-based findings, the following analysis shows that grade level also shapes students' epistemological beliefs. The grade level analysis underscores how the passage of time and learning experiences in the school system shape students' beliefs about physics. The results of the study show that students in higher grades tend to have a more mature perspective than those in the early grades, especially regarding their beliefs about the nature of physics as a science and the process of learning physics in school. In other words, grade level advancement is not only related to an increase in the amount of material studied, but also to changes in how students understand how physics is constructed as scientific knowledge and how physics learning should take place in the classroom.

These findings align with those of Chen et al. (2019) which show that higher levels of education are associated with students' thinking developing from simple memorization to a more conceptual, integrated understanding. In this framework, moving up a grade level does not simply mean facing more difficult material, but also dealing with a variety of situations, task types, and different thinking demands. This study reinforces the picture that students at higher levels appear to be better able to see physics as a dynamic science that is open to development, while also being more critical in interpreting classroom learning practices, for example, in terms of teacher explanations,

opportunities to ask questions, or how tasks are given and assessed. This means that the continuous learning process provides students with opportunities to revise and enrich their initial beliefs about what physics is and how it should be studied.

However, these results are not entirely consistent with Schiefer et al. (2022) who reported that, in some contexts, advancing to a higher grade level is associated with a stronger belief that physics knowledge is fixed and unchangeable. They argue that this pattern can emerge when learning is dominated by traditional instruction that emphasizes memorization of procedures and single answers. In such situations, the longer students remain in such a system, the stronger their belief becomes that knowledge is merely a collection of indisputable facts and that learning is a process of passively receiving information from teachers. The difference in the direction of these findings suggests that it is not simply advancing through grades that is important, but how the learning experience at each grade level is constructed and interpreted by students, both in terms of their understanding of the nature of knowledge and their assessment of the learning process at school. In this study, students at higher levels likely have greater exposure to a variety of learning activities, such as class discussions, problem-solving assignments, and teacher explanations that relate concepts to everyday phenomena, encouraging them to see physics as a science that can be developed and questioned, rather than just memorized. Even if learning practices still include traditional elements, encountering various types of questions, exam preparation, and repetition of key concepts can encourage some students to develop a more coherent understanding of physics.

Furthermore, the discussion of the role of ethnic shows different results compared to the variables of gender and grade level. The data show that ethnic background does not have a significant effect on students' epistemological beliefs, either overall or across dimensions. In other words, students from the Sumba and Timor ethnic groups tend to have similar beliefs about what physics is, how physics knowledge is constructed, the relationship between physics and everyday life, and how physics should be taught in the classroom. These findings indicate that, in the schools where the research was conducted, relatively homogeneous learning experiences seem to have a greater influence on belief formation than differences in ethnic background. On the other hand, the literature review in this study cites several studies that found cultural influences on students' epistemological beliefs. Lee et al. (2013) reported that students from more conservative cultures tend to view scientific knowledge as fixed and highly dependent on authority. In contrast, students from more open cultures hold more dynamic,

reflective beliefs about the nature of science. Zhu et al. (2008) also emphasized that cultural differences can shape how students understand scientific knowledge and the learning process, leading students from different cultural backgrounds to exhibit distinct belief profiles. This means that in the context they studied, culture functions as a factor that differentiates how students interpret scientific knowledge.

The differences between this study's findings and those of Lee et al. (2013) and Zhu et al. (2008) indicate that the influence of Ethnic or culture on student beliefs is not universal but rather highly contextual. There are several possible explanations. First, the national curriculum, the same language of instruction, and relatively uniform classroom management patterns in the sample schools may have created a strong shared learning space, so that the school experience suppressed the variation in beliefs that might have arisen from family cultural backgrounds. Second, the ethnic composition of the schools and the sample sizes within each group may limit the statistical power to detect differences, especially when some ethnic groups have relatively small student numbers. Therefore, the absence of detectable differences here should be understood as a lack of evidence of differences in beliefs based on Ethnic, rather than as proof that Ethnic never plays a role in shaping student beliefs. Cultural influences are likely more apparent in other areas not measured in this study, such as scientific identity, career aspirations in science, or school experiences. These findings underscore the importance of considering how schools, through relatively uniform curricula and learning practices, can serve as arenas of integration that equalize students' perspectives on physics learning across different ethnic backgrounds.

Conclusion

This study shows that gender and grade level significantly influence students' epistemological beliefs about physics learning in NTT Province. Female students hold more positive beliefs than male students, especially regarding the relevance of physics to everyday life. Students in higher grades also show more developed views on physics. However, ethnic background does not have a significant effect on students' epistemological beliefs. This is due to several factors, including a uniform national curriculum, homogeneous classroom management practices, and relatively similar learning experiences across the sample schools, which reduce differences in beliefs between ethnic groups. Therefore, physics instruction should emphasize the relevance of the material to real life to increase student engagement, especially among girls, and adjust teaching methods to each grade level to help

students gain a deeper understanding of physics concepts. In addition, teacher training is essential to make them more sensitive to gender and educational level differences, fostering more inclusive learning and supporting the development of positive epistemological beliefs in students.

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Author Contributions

Conceptualization, O.P and S.K.; methodologi, O.P.; formal analysis, O.P and S.; resource, O.P; writing-original draft preparation, O.P and S.K. ; All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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