

Critical Dispositions in Controversial Science Issues: Evidence From Science Education Students within the Context of the PISA 2025 Science Framework

Disposisi Kritis terhadap Isu-isu Sains Kontroversial: Hasil Temuan pada Mahasiswa Pendidikan IPA Berdasarkan Kerangka Konteks PISA 2025

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Abstract	Article Information
<p>Critical disposition is a crucial element in 21st-century science education, particularly in addressing controversial scientific issues across personal, societal, and global contexts. However, limited research has examined how these dispositions develop within internationally oriented programs such as the International Class Program (ICP) in Indonesia. This study aims to describe and compare the profiles of students' critical dispositions across Facione's seven indicators: Truth-Seeking, Open-Mindedness, Analyticity, Systematicity, Critical Thinking Self-Confidence, Inquisitiveness, and Maturity of Judgment within controversial science issues at personal, local/national, and global scales. A quantitative descriptive method was employed involving 114 ICP Science Education students from cohorts 2022 to 2025. The 21-item Science Critical Disposition Test (SCDT) (CVI = 0.83; $\alpha = 0.78$) was used to measure the seven indicators based on Facione's framework integrated with the PISA 2025 science contexts. The results revealed that all indicators were categorized as very high, with Open-Mindedness showing the highest mean score and Analyticity and Inquisitiveness the lowest. Across contexts, critical dispositions were strongest in personal issues, slightly lower in local/national issues, and lowest in global issues. These findings indicate that contextual familiarity enhances students' engagement in critical reasoning, while global issues require higher analytical effort. In conclusion, ICP students demonstrated strong critical dispositions consistent with the PISA 2025 framework.</p>	<p>Keywords: Critical Disposition; Controversial Science Issues; International Class Program (ICP); PISA; Science Education</p>
<p><i>Disposisi kritis merupakan elemen penting dalam pendidikan IPA abad ke-21, terutama dalam menghadapi isu-isu sains kontroversial pada konteks personal, sosial, dan global. Namun, penelitian mengenai perkembangan disposisi kritis dalam program berorientasi internasional seperti International Class Program (ICP) di Indonesia masih terbatas. Penelitian ini bertujuan mendeskripsikan dan membandingkan profil disposisi kritis mahasiswa berdasarkan tujuh indikator Facione, yaitu Truth-Seeking, Open-Mindedness, Analyticity, Systematicity, Critical Thinking Self-Confidence, Inquisitiveness, dan Maturity of Judgment dalam konteks isu sains kontroversial skala personal, lokal/nasional, dan global. Metode penelitian yang digunakan adalah kuantitatif deskriptif dengan melibatkan 114 mahasiswa ICP Pendidikan IPA Universitas Negeri Makassar angkatan 2022 hingga 2025. Instrumen Tes Disposisi Kritis IPA (SCDT) 21 butir (CVI = 0,83; $\alpha = 0,78$) digunakan untuk mengukur tujuh indikator disposisi kritis berdasarkan kerangka Facione yang terintegrasi dengan konteks sains PISA 2025. Hasil penelitian menunjukkan</i></p>	<p>Kata kunci: Disposisi Kritis; International Class Program (ICP); Isu Sains Kontroversial; PISA; Pendidikan IPA</p> <p>History Manuscript received : 29/09/2025 Revised : 15/10/2025 Accepted : 19/10/2025 Published : 31/10/2025</p>

bahwa seluruh indikator berada pada kategori sangat tinggi, dengan Open-Mindedness sebagai indikator tertinggi serta Analyticity dan Inquisitiveness sebagai yang terendah. Berdasarkan konteks, disposisi kritis tertinggi muncul pada isu personal, menurun pada isu lokal/nasional, dan terendah pada isu global. Temuan ini menunjukkan bahwa kedekatan konteks berpengaruh terhadap keterlibatan berpikir kritis, sedangkan isu global menuntut kemampuan analitis yang lebih tinggi. Dengan demikian, mahasiswa ICP menunjukkan disposisi kritis yang kuat dan sejalan dengan kerangka PISA 2025.

A. INTRODUCTION

Twenty-first century science education emphasizes critical thinking skills as the foundation of scientific literacy and problem-solving (Fitrianingsih et al., 2025; Handayani et al., 2023; Knight & Robinson, 2019). Modern scientific literacy is no longer confined to memorizing factual knowledge but requires the ability to formulate questions, evaluate evidence, construct logical arguments, and make informed decisions based on scientific data (Marshall & Ratnawulan, 2020; Sundapa, 2022). This aligns with the framework of 21st-century competencies that position critical thinking, communication, collaboration, and creativity (4C) as essential learning outcomes (Fitrianingsih et al., 2025; Handayani et al., 2023). Reports from UNESCO and OECD/PISA have become fundamental references in reforming science curricula that promote scientific literacy and critical thinking (Fitrianingsih et al., 2025). Various studies also highlight that learning experiences emphasizing inquiry and argumentation can strengthen the ability to evaluate evidence and construct scientific reasoning (Purwanti et al., 2022). Therefore, cultivating critical dispositions has become a crucial element in science education because it reflects the consistent willingness to apply critical thinking in authentic contexts and to evaluate evidence objectively and ethically.

Facione's framework conceptualizes seven indicators of critical thinking disposition: truth-seeking, open-mindedness, analyticity, systematicity, self-confidence, inquisitiveness, and maturity (Safitri & Syahfitri, 2023). These indicators distinguish cognitive skills from attitudinal and motivational tendencies that determine whether critical thinking is habitually applied in real situations. Previous studies have shown that critical dispositions strongly influence how students engage in scientific reasoning and problem-solving activities (Damayanti et al., 2021; Sari et al., 2023). For example, students with higher inquisitiveness and open-mindedness tend to explore evidence more deeply and perform better in inquiry-based science classes (Astuti et al., 2019; Purwanti et al., 2022). In contrast, students with weak analyticity or truth-seeking dispositions often rely on authority or intuition when facing socio-scientific dilemmas (Yorgancı, 2016). Several studies have emphasized that fostering these dispositions can enhance students' participation in reflective discussions, argument construction, and ethical decision-making in science classrooms (Guzzo & Garcia, 2015; Herdiansyah et al., 2024). However, most of these studies have been conducted in conventional science classrooms rather than in International Class Programs (ICP), which are characterized by bilingual instruction and globally oriented learning environments. This lack of empirical evidence limits our understanding of how critical dispositions function in contexts designed to prepare globally competent science educators.

The PISA 2025 Science Framework provides a conceptual basis for assessing critical dispositions in science education (Deta et al., 2024; Valio et al., 2025). PISA defines scientific literacy as the ability to engage with science-related issues through evidence-based reasoning and responsible decision-making (OECD, 2023). Its assessment emphasizes students' capacity to interpret data, evaluate evidence credibility, analyze complex problems, and reason across personal, local/national, and global contexts (Wardhana & Hidayah, 2022). These domains

correspond closely to Facione's indicators: truth-seeking aligns with evidence evaluation, analyticity and systematicity correspond to problem analysis and logical organization, open-mindedness supports perspective-taking in socio-scientific debates, and maturity of judgment underlies ethical reasoning and contextual decision-making (Khairrunisa et al., 2025). Integrating Facione's framework within the PISA 2025 context thus enables a more comprehensive evaluation of students' critical dispositions in science education and provides a meaningful basis for curriculum alignment with international standards (Cansız & Cansız, 2019).

Furthermore, controversial science issues provide an authentic platform to assess the manifestation of critical dispositions across different contexts (Dewi & Yahdi, 2025; Haetami et al., 2023; Mirza, 2025; Rosyidah & Subekti, 2023). Personal issues such as vaccination and health decisions often engage truth-seeking and open-mindedness, while local or national issues such as energy transition or environmental management require systematicity and analytical reasoning (Dubé et al., 2025; Nahdiyati et al., 2025; Tytler et al., 2025). Global issues such as climate change and genetic engineering challenge students' maturity of judgment and self-confidence in decision-making (Deta et al., 2024; Tytler et al., 2025). Situating these issues within the PISA 2025 framework, therefore, allows a balanced exploration of how critical dispositions operate in socio-scientific domains that vary in scope and complexity (Deta et al., 2024; Eames et al., 2024; Putri et al., 2025; Tytler et al., 2025).

Students enrolled in the International Class Program (ICP) of the Department of Science Education, Universitas Negeri Makassar, represent a relevant population for studying this phenomenon. The ICP program aims to prepare globally competitive science educators through bilingual instruction and international academic exposure. Within this framework, critical disposition serves as a strategic indicator of students' readiness to address controversial scientific issues at multiple scales. While previous studies have confirmed the effectiveness of 4C-oriented learning for developing critical thinking (Handayani et al., 2023; Prasetyo et al., 2021; Purwanti et al., 2022), little is known about how ICP students internalize specific critical dispositions when dealing with controversial science topics. This conceptual and empirical gap highlights the need for research that maps the structure of ICP students' critical dispositions within the contexts defined by the PISA 2025 Science Framework.

Therefore, this study aims to describe the profile of ICP Science Education students' critical dispositions based on Facione's seven indicators and to compare these dispositions across controversial science issues at personal, local/national, and global scales. The findings of this research are expected to enrich theoretical perspectives on critical dispositions within the framework of science literacy and provide practical insights for educators and curriculum developers to design instructional strategies that effectively strengthen weaker indicators while maintaining students' open-mindedness and reflective judgment (Fitrianingsih et al., 2025; Handayani et al., 2023; Purwanti et al., 2022; Safitri & Syahfitri, 2023).

B. METHOD

This research employed a quantitative descriptive approach aimed at systematically identifying the profile of critical dispositions among students of the International Class Program (ICP) in the Department of Science Education when responding to controversial science issues within the framework of PISA 2025. The study involved 114 active ICP students of Universitas Negeri Makassar, consisting of 18 males and 96 females from four cohorts: 34 students from the 2025 cohort, 33 from 2024, 25 from 2023, and 22 from 2022. Participation was voluntary and conducted during regular class sessions.

Data were collected using the Science Critical Disposition Test (SCDT), a written instrument consisting of 21 multiple-choice items that represent seven indicators of critical disposition based on Facione's framework: truth-seeking (TS), open-mindedness (OM), analyticity (AN), systematicity (SY), critical thinking self-confidence (SC), inquisitiveness (INQ), and maturity of judgment (MJ). Each indicator was represented by three items corresponding to the three contextual levels of the PISA 2025 Science Framework, namely personal, local/national, and global contexts. Each item presented a realistic scientific scenario aligned with PISA competencies such as evaluating evidence, reasoning across scales, and making decisions in socio-scientific issues (OECD, 2023). For instance, truth-seeking items involved evaluating misinformation about COVID-19 vaccination, investigating local disease outbreaks, and verifying global climate change claims; open-mindedness items addressed issues of zero-waste lifestyles, waste-to-energy debates, and international energy transitions; analyticity items focused on assessing evidence regarding dietary supplements, obesity policies, and biodiversity decline; systematicity items examined structured reasoning in sustainable living, urban waste management, and pandemic preparedness; self-confidence items reflected situations requiring assertive evidence-based reasoning such as 5G health misconceptions, mining impacts, and international research collaboration; inquisitiveness items illustrated curiosity through cases of vegetarian diets, local erosion phenomena, and space exploration; while maturity of judgment items emphasized balanced decision-making in nutritional controversies, nuclear energy debates, and sustainable land-use dilemmas. This contextual mapping ensured that each disposition indicator was operationalized consistently within the PISA 2025 framework and maintained conceptual alignment between national and international assessment standards.

The instrument's content validity was evaluated by three experts in science education and educational psychology using the Content Validity Index (CVI), yielding a CVI value of 0.83, indicating strong agreement among experts. Reliability analysis using Cronbach's Alpha produced a coefficient of $\alpha = 0.78$, confirming the internal consistency of the instrument. Prior to data collection, students participated in a brief orientation session designed to ensure their understanding of the meaning and behavioral manifestations of each critical disposition indicator. During this session, facilitators explained examples relevant to science learning, such as evaluating evidence in environmental issues to represent open-mindedness and examining health-related claims to represent truth-seeking. This preparatory stage aimed to calibrate students' understanding so that their responses would reflect authentic dispositions rather than misinterpretations of terminology.

The SCDT was administered under controlled supervision, with a completion time of approximately 60 minutes. Students were instructed to respond according to how they typically behave or reason when facing similar science-related situations, rather than selecting socially desirable answers. Each response was scored dichotomously, assigning a value of 1 for disposition-consistent answers and 0 for inconsistent ones. The resulting data were analyzed descriptively to determine the mean, minimum, and maximum values of each indicator across the three contextual levels (personal, local/national, and global). Comparative analyses by gender, cohort, and age group were also conducted to explore potential variations among subgroups. The findings were later visualized through graphs to display patterns and comparative tendencies across indicators and contexts.

C. RESULTS AND DISCUSSION

Results

The analysis of ICP Science Education students' critical dispositions provides an overview of their attitudinal tendencies in responding to controversial science issues across different contexts of the PISA 2025 Science Framework. The descriptive results indicate that students demonstrated consistently very high levels of critical disposition across all seven indicators and three contextual levels. The average scores for each indicator are presented in Figure 1. The results show that all indicators fall within the *very high* category ($M = 0.81\text{--}0.87$). The highest means were obtained in Open-Mindedness (OM) and Systematicity (SY) ($M = 0.87$), followed by Self-Confidence (SC) ($M = 0.86$) and Truth-Seeking (TS) ($M = 0.85$). Meanwhile, Analyticity (AN) and Inquisitiveness (INQ) obtained the lowest but still very high means ($M = 0.81$). These findings suggest that students are generally receptive to diverse perspectives, confident in their reasoning, and able to organize their thought processes systematically. However, analytical curiosity and deeper inquiry remain areas that can be strengthened through more inquiry-based or project-based learning experiences.

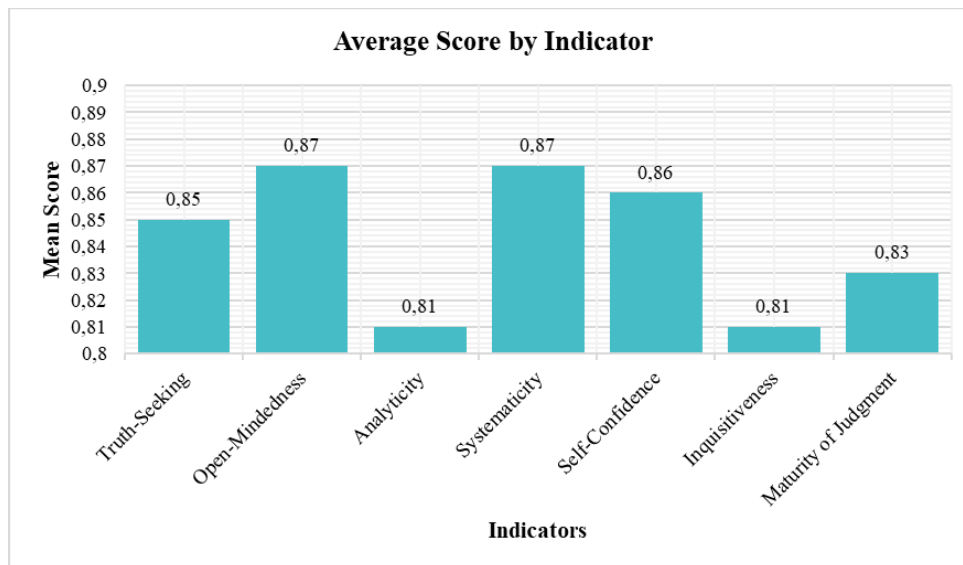


Figure 1. Average Score by Indicator

When viewed by context, as summarized in Figure 2, students' dispositions were also categorized as *very high* across all three contextual levels, with personal ($M = 0.85$), local/national ($M = 0.84$), and global ($M = 0.83$) contexts showing only minor variations. This pattern indicates that students exhibit relatively consistent critical engagement regardless of context, although slightly higher dispositions appear in issues personally or locally relevant to them. The findings imply that proximity and familiarity of issues tend to strengthen students' critical engagement.



Figure 2. Average Score by Context

As shown in Figure 3, both male and female students demonstrated *very high* dispositions across all contexts, with only minimal differences. Male students scored slightly higher (personal = 0.88; local/national = 0.87; global = 0.86) than female students (personal = 0.85; local/national = 0.84; global = 0.83). These small variations are not significant, confirming previous findings (Adawiyah et al., 2021; Ma, 2021) that gender does not substantially influence critical dispositions. Thus, the ICP environment equally supports the development of critical thinking attitudes among all students.

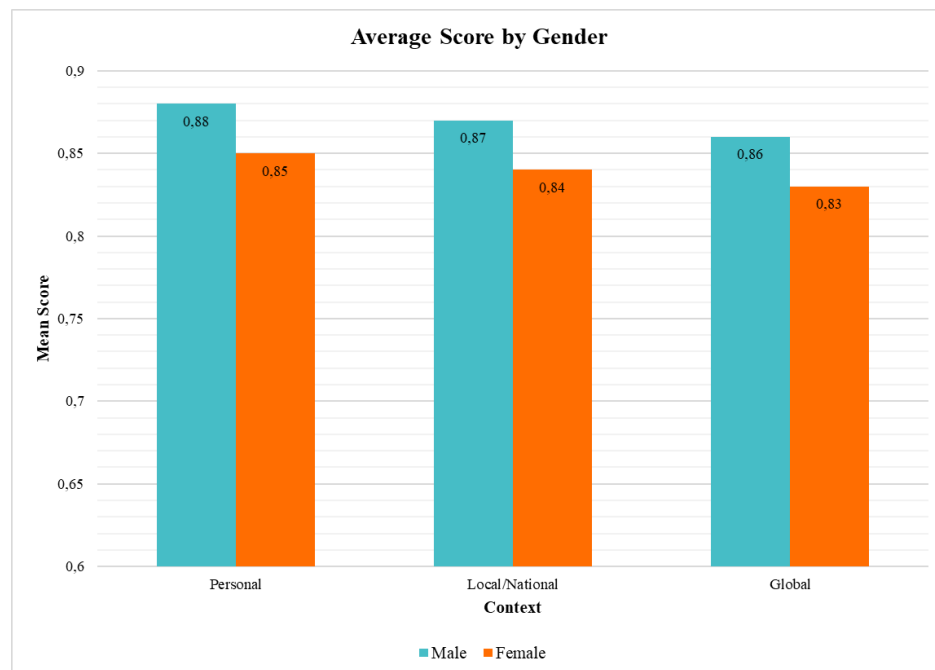


Figure 3. Average Score by Gender

The age-based analysis (Figure 4) shows a non-linear trend across all contexts. Students aged 19 years achieved the highest dispositions (personal = 0.91; local/national = 0.89; global = 0.88), while the 22-year-old group showed the lowest (personal = 0.64; local/national = 0.63; global =

0.62). The 18-, 20-, and 21-year-old groups maintained *very high* levels (0.82–0.85). The peak among 19-year-olds likely reflects active engagement in collaborative and inquiry-based courses typical of mid-program students. Conversely, the decline among older students may result from reduced participation in group learning during thesis completion, leading to fewer opportunities to articulate critical reasoning.

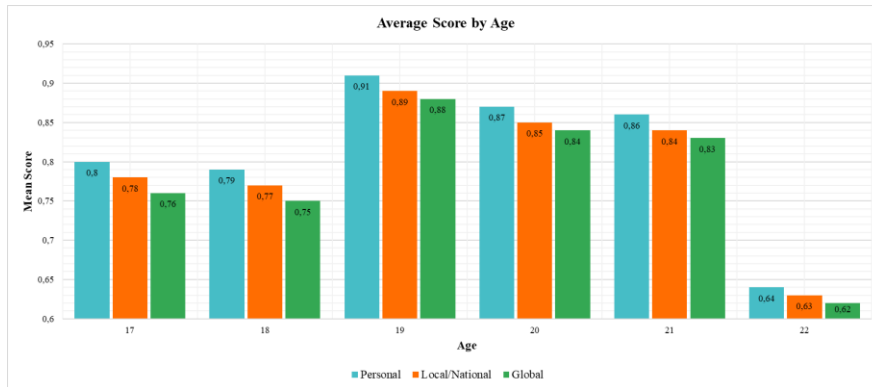


Figure 4. Average Score by Age

The cohort-based analysis (Figure 5) also revealed a consistent *very high* pattern with small contextual variations. The 2024 cohort achieved the highest dispositions (personal = 0.88; local/national = 0.87; global = 0.85), followed by 2023 (0.86; 0.85; 0.80), 2025 (0.83; 0.82; 0.78), and 2022 (0.84; 0.83; 0.77). This pattern parallels the age trend, suggesting that mid-level cohorts—who are deeply involved in project-based learning and interdisciplinary inquiry—demonstrate higher dispositions than newer or graduating cohorts, who may be in transitional or research-focused stages.

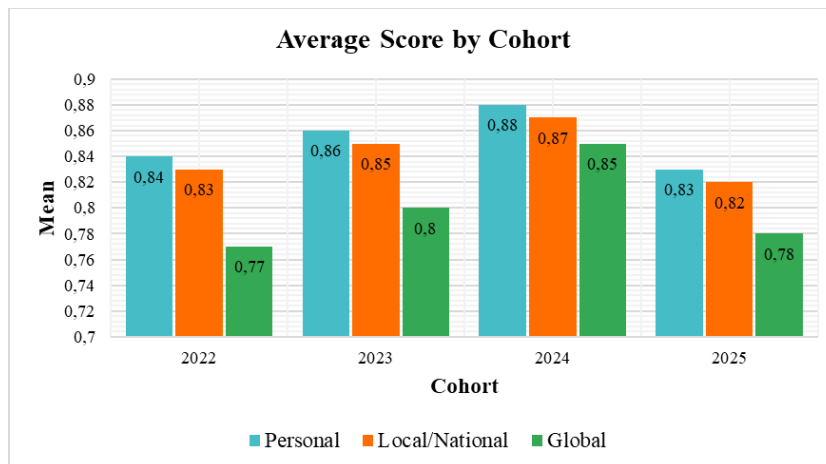


Figure 5. Average Score by Cohort

Discussion

The descriptive analysis results indicate variations in the critical disposition profiles of ICP students across Facione’s seven indicators. The Open-Mindedness (OM) indicator emerged as the strongest, with the highest mean score across contexts. This finding suggests that students tend to be highly receptive to new ideas and alternative perspectives. Conversely, Analyticity (AN) and Inquisitiveness (INQ) appeared as relative weaknesses. The low score in Analyticity

within the personal context indicates that students are less inclined to critically probe issues or proactively pose questions (Hadi & Maharani, 2022; Hunaepi et al., 2020). This aligns with Facione's view that critical thinking disposition comprises a set of attitudes, intellectual virtues, and thinking habits that vary among individuals but are all essential to forming a complete critical stance (Demir, 2023; McKeon & Ferkany, 2023; Redhana & Wahyuni, 2021).

PISA Context also influenced dispositions, with students achieving the highest scores in personal issues close to daily life, slightly lower in local/national issues, and lowest in global issues. This pattern suggests that personal issues are more effective in eliciting critical dispositions than global issues, which are often perceived as abstract and distant (Waghmare, 2021). The contextual gradient aligns with the PISA framework, which evaluates scientific reasoning across personal, societal, and global scales (OECD, 2019) (Ledger et al., 2019). In this study, students exhibited higher critical engagement in familiar contexts, while global-scale issues required stronger analytical scaffolding to connect scientific reasoning with broader implications (Liu, 2023).

Critical thinking disposition is understood as “a set of attitudes, intellectual virtues, and habits of mind” that support the consistent use of critical thinking skills (Miftahudin & Putra, 2025; Pratiwi et al., 2024; Siegel, 2017; X. Wang et al., 2019). Indicators such as Truth-Seeking (TS) and Systematicity (SY), which obtained relatively high scores, reflected students' commitment to upholding evidence and thinking in an organized manner (Comer et al., 2019; Kuti, 2023; Safitri & Syahfitri, 2023). Meanwhile, the high OM scores affirmed that ICP students have a strong readiness to consider multiple perspectives and new information, an essential trait for effective science educators (Guzzo & Garcia, 2015; Maia & Mororo, 2024; Morales-Garcés et al., 2025; Southworth, 2021). The consistency of this finding aligns with thematic research emphasizing openness as a vital disposition in science learning, although contextual variations remain possible (Bialystok & Ferkany, 2019; Morales-Garcés et al., 2025).

Despite the generally high results, the relatively lower Analyticity and Inquisitiveness scores highlight areas needing pedagogical reinforcement. This outcome indicates that although students are open-minded and confident in reasoning, they may lack persistent curiosity or deep analytical engagement, particularly when dealing with complex or controversial issues. Such findings are consistent with observations that students' inquiry behaviors tend to decline when tasks are not explicitly structured to promote questioning or exploration (Ben-Horin et al., 2023; Sciarretta & Testa, 2024). Therefore, learning strategies that integrate issue-based inquiry and project-based learning are recommended to stimulate questioning, enhance reasoning depth, and strengthen both analytic and inquisitive dispositions (Jones et al., 2022; Qamariyah et al., 2021). These approaches align with PISA's emphasis on fostering the ability to reason critically about evidence, construct explanations, and evaluate implications within socio-scientific contexts (Jaworski et al., 2021).

From the respondent profile perspective, no significant differences were found between male and female students in terms of critical disposition. The results demonstrated relatively consistent patterns for both genders, each showing high levels of disposition. Although male students had a slightly higher mean score, the differences were minimal and evenly distributed across contexts. This suggests that gender is not a determining factor of critical thinking disposition, as both groups are accustomed to practicing critical attitudes when confronted with controversial science issues (Kaymakci et al., 2023; Orhan, 2023). This finding corroborates previous studies that also reported no significant gender differences (Adawiyah et al., 2021; Kaymakci et al., 2023; Orhan, 2023). The consistency across genders in this study implies that the bilingual and globally oriented learning environment supports equal opportunities for

developing critical thinking regardless of gender (Simanjuntak et al., 2018). Consequently, both male and female students demonstrate relatively equal dispositions to participate actively in scientific discussions and make reasoned judgments about socio-scientific issues (Kaymakci et al., 2023; Shakurnia et al., 2021; D. Wang et al., 2023).

In contrast, age and cohort profiles revealed more dynamic patterns. No linear trend indicated that older students were necessarily more critical. The 19-year-old group recorded the highest disposition scores across all contexts, while the oldest group (22 years) had the lowest. Students aged 17–18 showed relatively lower scores, which peaked at age 19 and declined among older groups. This fluctuating pattern corresponds with the cohort data, where the 2024 cohort (third semester) consistently achieved the highest scores, while the 2022 cohort (seventh semester) recorded the lowest, especially in the global context. Pulungan et al. (2024) found a similar trend in critical thinking scores across different cohorts, suggesting that the peak around age 19 may reflect the positive impact of early curriculum experiences on fostering critical attitudes. During the second year, students are typically engaged in discussions, practicums, and project assignments that nurture critical reasoning and reflection (Ardiyansyah et al., 2021; Chandrawati & Aisyah, 2022; Hapidin et al., 2020; McDowall, 2020; Sutrisno et al., 2021). The decline among older students and senior cohorts may indicate possible cognitive or motivational saturation (Darcie et al., 2024; Dissen, 2023). Senior students may be more focused on thesis completion and less exposed to contextualized science discussions, while advanced courses may emphasize content mastery over critical inquiry (Assante et al., 2022; Danial et al., 2025; Hulwah & Suriani, 2025). This pattern underscores the need for continuous reinforcement of critical disposition development throughout students' academic progression (Álzate, 2025; Hebebcı & Usta, 2022; Sadek et al., 2024; Sulaiman, 2018). After substantial growth during the early years, senior students must continue cultivating their critical stance through seminars, research collaborations, and discussions on global science issues to prevent disposition decline before graduation (Álzate, 2025; Coşkun & Altınkurt, 2016; Dennett & DeDonno, 2021; Thome et al., 2025).

The context of this study provides important contributions to the development of science education literature in Indonesia. By focusing on ICP students in the Faculty of Mathematics and Natural Sciences at Universitas Negeri Makassar, this research illustrates the readiness of future science educators to compete at the international level. ICP students are equipped with foreign language proficiency and supported by an internationally oriented curriculum that promotes scientific reasoning across contexts. The integration of controversial science issues within the three PISA 2025 contexts serves as an authentic means of assessing their critical dispositions (Sun, 2023). Hence, ICP students are expected not only to understand issues at the personal level but also to engage critically and constructively with controversial science issues at the national and global levels (Maulidati et al., 2019; Sun, 2023). In this way, strong indicators such as Open-Mindedness (OM) can continue to be cultivated, while weaker indicators are targeted for further improvement (Dimaano, 2025; Nikmah et al., 2023).

Practically, these findings may serve as a reference for lecturers and curriculum developers to strengthen weaker indicators, particularly Analyticity (AN) and Inquisitiveness (INQ). A science curriculum grounded in critical literacy should be designed to emphasize activities that encourage deeper analysis, stimulate questioning, and promote reflective decision-making, especially when dealing with global issues (Kisworo et al., 2024). This would allow students' critical dispositions to be consistently maintained throughout their academic studies. Furthermore, such reinforcement will support the formation of science educators who are

scientifically literate, reflective, and resilient in addressing controversial issues at local, national, and global levels (Agus et al., 2022; Amalia et al., 2021).

Practically, these findings can serve as a reference for lecturers and curriculum developers to strengthen weaker indicators, particularly *Analyticity* and *Inquisitiveness*. A science curriculum grounded in critical literacy should be designed to emphasize activities that encourage deeper analysis, stimulate questioning, and promote reflective decision-making, especially in global contexts (Archila et al., 2020; Bhoi, 2025). Sustaining such reinforcement across academic years will help maintain students' critical dispositions at a high level (Archila et al., 2020). Moreover, consistent engagement in inquiry and issue-based science learning supports the formation of science educators who are scientifically literate, reflective, and resilient when addressing controversial issues at local, national, and global levels (Chowdhury et al., 2020; Nida et al., 2021).

D. CONCLUSION

This study confirms that students of the International Class Program (ICP) in Science Education demonstrate overall strong critical dispositions across Facione's seven indicators and the three PISA 2025 contexts. Among these, *Open-Mindedness* consistently appeared as the strongest indicator, while *Analyticity* and *Inquisitiveness* showed relative weaknesses. These findings indicate that students have internalized essential intellectual attitudes that support critical reasoning, although further enhancement is needed in analytical exploration and curiosity-driven inquiry.

When viewed across PISA contexts, the results revealed that students' dispositions were highest when engaging with personal issues, slightly lower in local or national issues, and lowest in global issues. This pattern reflects the influence of contextual familiarity, where proximity to daily experiences strengthens students' reflective and evaluative tendencies. Conversely, global-scale issues demand higher levels of analytical and interpretative reasoning. Therefore, contextual balance in science instruction is essential to help students apply their critical dispositions consistently from personal to global issues.

Theoretically, these findings enrich the literature on critical disposition by offering new perspectives from ICP students, a population that has rarely been explored in previous studies. They also affirm the applicability of the PISA 2025 science framework for evaluating critical dispositions across multiple contexts, emphasizing their role as key components of 21st-century scientific literacy.

Practically, the results provide valuable guidance for science educators and curriculum developers. Strengthening weaker indicators such as *Analyticity* and *Inquisitiveness* requires pedagogical strategies that encourage questioning, reflection, and evidence-based argumentation through issue-based and project-based learning. Integrating controversial science issues into learning activities can also enhance students' ability to think critically and ethically about science in personal, local, and global dimensions.

In conclusion, this study contributes to the advancement of a critical literacy-based science curriculum that aligns with global education goals. By maintaining strong dispositions such as open-mindedness and fostering analytic and inquisitive thinking, ICP students can become scientifically literate, reflective, and globally competent educators capable of addressing emerging scientific and societal challenges.

E. ACKNOWLEDGEMENT

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