Generation Z perceptions of the problem-based learning approach in science instruction at SMP Negeri 2 Tondano and SMP Santa Rosa de Lima Tondano

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Abstract

This study investigates Generation Z students' perceptions of Problem-Based Learning (PBL) in the context of Science instruction at SMP Negeri 2 Tondano and SMP Katolik St. Rosa de Lima Tondano, Indonesia. Generation Z learners, born between 1997 and 2012, are characterized by strong digital literacy, preference for visual and collaborative activities, and a need for contextualized, meaningful learning experiences. Despite existing research affirming PBL's effectiveness in promoting critical thinking and intrinsic motivation, limited attention has been given to Generation Z's own perceptions of PBL—especially within a local Minahasa setting—and to how educators might integrate Christian faith values within a PBL framework. Employing a mixed-methods, descriptive–quantitative design, data were collected from seven-item Likert-scale questionnaires (n = 50), structured interviews, and direct classroom observations. Quantitative analysis reveals that most participants perceive PBL as highly engaging, fostering collaboration, and enhancing conceptual understanding in ecological and biodiversity topics; average scale scores exceeded 80% on key items. Qualitative findings corroborate these results, indicating students' heightened motivation, increased participation, and appreciation of real-world scientific inquiry. However, some students reported challenges related to group dynamics, insufficient scaffolding by teachers, and initial unfamiliarity with autonomous problem-solving. Additionally, respondents valued the integration of Christian principles—such as stewardship of creation, integrity, and communal responsibility—as enriching the PBL experience and reinforcing character development. The study recommends targeted professional development for teachers in PBL facilitation, development of contextually relevant problems linked to local environmental issues, and deliberate incorporation of faith-based values to align science instruction with students' cultural and spiritual backgrounds.

Keywords: Generation Z, Problem-based learning, Science education, Student perceptions

1. Introduction

Over the past two decades, rapid advances in information technology have given rise to a distinct cohort known as Generation Z (individuals born between 1997 and 2012). In Indonesia, Generation Z constitutes the majority of the population in both junior and senior secondary schools. Having matured in an environment saturated with digital tools, these students enjoy immediate and streamlined access to information, routinely multitask, and gravitate toward instant, visually rich content (Welayana, A. S., 2024) [44]. However, despite these technological advantages, educators face significant challenges: Generation Z students frequently struggle to sustain attention, maintain consistent motivation, and often experience boredom with lecture-centric instruction and traditional written assignments.

This issue becomes particularly evident in the teaching of Natural Sciences (Ilmu Pengetahuan Alam, IPA), which fundamentally demands critical thinking, deep conceptual understanding, and active engagement in practical exercises. Yet at SMP Negeri 2 Tondano and SMP Katolik St. Rosa de Lima Tondano, interviews with two integrated IPA teachers (Maya Wolayan and Lanni Wawolangi) reveal that instruction remains dominated by lecturing and memorization. On occasion, lessons purport to be problem-based, but teachers do not explicitly communicate to students that they are employing a Problem-Based Learning (PBL) framework, nor do they follow its prescribed steps. Preliminary classroom observations confirm that many teachers have yet to adopt approaches that fully engage students in active learning. Meanwhile, a contextual, interactive pedagogy is crucial to accommodate Generation Z's learning preferences.

Problem-Based Learning (PBL) is an instructional approach that emphasizes the use of real-world problems as a context for students to acquire critical thinking, problem-solving skills, and content knowledge. Rather than relying on passive knowledge transmission through traditional lectures, PBL engages students actively in collaborative inquiry and authentic learning experiences. It requires students to work in groups to analyze complex, often interdisciplinary problems, propose hypotheses, conduct investigations, and present evidence-based solutions. In the context of science education, PBL aligns with the principles of constructivism, where learners build their understanding through exploration and social interaction. Research has consistently demonstrated that PBL enhances student engagement, promotes deeper conceptual understanding, and fosters the development of essential 21st-century skills, such as teamwork and independent learning. This approach is particularly relevant for Generation Z students, who are accustomed to dynamic, technology-mediated learning environments and prefer active, experiential learning methods that bridge theory with real-life application. (Paat, *et al*., 2021; Rantung., *et al*., 2025; Paat & Mokalu, 2023; Tampinongkol, *et al*., 2022; Kembuan, *et al*., Umar, *et al*., 2022; Tengor, *et al*., 2023) [21, 31, 22, 38, 43, 41].

An instructional model that effectively addresses these challenges is Problem-Based Learning. By presenting real-world problems and encouraging collaborative solution-finding, PBL engages students in situations that mirror everyday experiences. Within the IPA curriculum, PBL not only fosters conceptual comprehension but also cultivates critical thinking, group collaboration, and self-directed knowledge construction (Paat *et al*., 2023; Lelamula, *et al*., 2022; Paputungan, *et al*., 2023) [22, 12, 27]. Previous research has demonstrated that PBL enhances students' interest in science and bolsters their analytical problem-solving abilities (Yew & Goh, 2016; Kindangen, *et al*., 2023; Tauri, *et al*., 2023) [47, 10, 40]. For Generation Z—who seek authentic, discussion-oriented learning and deeper meaning—PBL offers a holistic approach. As Tong (2007) [42] has argued in *Arsitek Jiwa*, true education not only develops intellect but also shapes character and spirituality in accordance with biblical principles, thereby integrating Christian faith values into PBL. This aligns with the Indonesian Ministry of Education's character education program, which emphasizes seven habits to cultivate positive student character—beginning with regular worship (Kemendikbud, 2017; Paat, *et al*., 2024) [8, 24].

Although numerous benefits of PBL have been documented, research exploring Generation Z's own perceptions of this method remains scarce, particularly in the local Minahasa context. Understanding how these students view PBL is essential, since successful implementation depends on students' positive reception and engagement. Without clear insight into Generation Z's attitudes toward PBL, teachers may find it difficult to align their instructional strategies with students' needs.

Moreover, implementing PBL faces additional obstacles: teachers must be prepared to design contextually relevant problems, digital media resources are often limited, and many instructors lack sufficient training in facilitating problem-based instruction (Saputri *et al*., 2023; Manein, *et al*., 2025; Tangdilian, *et al*., 2023) [13, 39]. Ultimately, students' perceptions—since they are the primary actors in the learning process—are critical to PBL's success. Unfortunately, research on Generation Z's views of PBL remains limited, especially in localities such as Minahasa.

2. Materials and methods

A. Definition and characteristics of generation Z

Generation Z refers to individuals born between 1997 and 2012. This generation is the first to grow up immersed in digital technology from birth. Their daily environment is saturated with tools such as the internet, smartphones, social media, and various digital devices (Putri & Yulianti, 2021; Leasa., *et al*., 2024) [30, 11]. This constant exposure shapes their thinking patterns, learning styles, and social interactions in ways that differ significantly from previous generations.

According to Wibowo and Arifin (2020) [45], Generation Z are considered "digital natives" because technology is not merely a tool they use—it is integrated into their everyday lives, including in educational settings. They are accustomed to obtaining information rapidly through search engines like Google, educational videos on YouTube, and social media platforms like TikTok and Instagram. Consequently, their learning style tends to favor visual, fast-paced, and interactive approaches, while they often exhibit disinterest in monotonous, teacher-centered lectures.

Furthermore, Ichsan *et al*. (2022) [5] identify several unique educational characteristics of Generation Z, including:

- A critical mindset that often questions illogical concepts;
- Independence in exploring new knowledge;
- A preference for experiential learning or project-based activities, with high reliance on internet connectivity and digital devices.

Understanding these characteristics is essential for educators, as instructional strategies must be tailored to ensure Generation Z's successful learning outcomes. Accordingly, active, contextual, and technology-integrated approaches are highly relevant to this group (Sari & Lestari, 2019; Onsu, *et al*., 2023; Sondakh, *et al*., 2021) [33, 19, 35].

B. Characteristics of generation Z

Generation Z possesses distinctive attributes due to their upbringing in the digital era, setting them apart from prior generations, particularly within educational contexts. They are highly familiar with digital tools and the internet, making their life experiences deeply intertwined with digitalization, encompassing communication, entertainment, and learning processes.

As noted by Putri and Yulianti (2021) [30], Generation Z is highly tech-savvy. From an early age, they have been exposed to digital devices such as smartphones, tablets, and laptops, using them not only for socializing but also as primary means of accessing information and learning independently.

Wibowo and Arifin (2020) [45] add that Generation Z is particularly attracted to visual and hands-on learning experiences. They tend to become disengaged with passive instructional methods like lectures or rote memorization, preferring instead intellectually stimulating and contextually relevant activities such as projects or case studies.

Based on multiple studies, key educational characteristics of Generation Z include:

a) **Digital literacy:** Raised in an era of high connectivity, they access information predominantly online and rely on digital platforms for learning (Ichsan *et al*., 2022) [5].
b) **Short attention spans:** Accustomed to rapid and instant information, they require varied and interactive teaching methods to sustain interest (Sari & Lestari, 2019) [33].

c) **Critical and independent:** This generation is inclined to think critically, question information, and engage in self-directed learning using technology (Yuliana & Fatimah, 2021) [49].

d) **Visual and multimedia preferences:** They prefer learning via videos, infographics, animations, and interactive applications rather than lengthy texts, benefiting from direct experiences and visualization (Wijaya & Pratiwi, 2020; Pertiwi, *et al*., 2023; Patibang, *et al*., 2025) [46, 29, 28].

e) **Desire for meaningful and relevant learning:** They are more motivated when learning is relevant to real-life contexts, allowing for self-exploration and creativity (Ichsan *et al*., 2022; Sanudin, *et al*., 2023) [5, 32].

These attributes indicate that Generation Z requires adaptive and creative instructional approaches, such as Problem-Based Learning (PBL), Project-Based Learning (PjBL), and technology-enhanced learning integration. (Paat, 2022; Mokalu, Arundaa, & Lahinta, 2024) [20, 14].

C. Learning styles of generation Z

Generation Z's learning styles are profoundly influenced by the highly digital and dynamic nature of their era. Unlike previous generations, they exhibit a preference for learning that is rapid, flexible, technology-based, and fosters active engagement.

Mulyasa (2018) [17] asserts that Generation Z responds more effectively to interactive, collaborative, and contextual teaching approaches. They are less receptive to one-way lectures, which they perceive as tedious and irrelevant. Instead, they favor learning that emphasizes exploration, real-world problem-solving, and the integration of information technology. In line with this, Ardiansyah and Marzuki (2021) [2] emphasize Generation Z's affinity for visual and practical learning. They learn more effectively through simulations, videos, interactive media, and authentic projects that allow creativity and collaboration. This aligns with approaches such as Problem-Based Learning (PBL), Project-Based Learning (PjBL), and technology-enhanced models.

Recent research identifies several distinctive learning styles among Generation Z:

a) **Visual and multisensory:** They quickly absorb information through visual media such as images, videos, graphics, and infographics, and appreciate multisensory learning experiences (Hastuti & Wulandari, 2022) [4].

b) **Collaborative and social:** They prefer working in groups, discussing, and learning from peers, supporting cooperative and collaborative learning models (Ningsih, 2020) [18].

c) **Technology-oriented:** Highly familiar with digital platforms, they often use YouTube, Google Classroom, Quizizz, and other apps for learning, making ICT-based learning highly effective (Ichsan *et al*., 2022) [5].

d) **Independent and exploratory:** They like to independently explore knowledge, often using internet searches, and prefer teachers as facilitators rather than sole knowledge providers (Yuliana & Fatimah, 2021) [49].

e) **Flexible and instant:** They seek fast, efficient processes with immediate feedback and tangible results, requiring dynamic and engaging instruction (Wijaya & Pratiwi, 2020) [46].

Given these learning preferences, innovative, problem-based approaches are highly relevant for Generation Z, especially in Science Education, which demands critical thinking, problem-solving, and collaboration.

D. Generation Z and 21st century skills

Generation Z was born and raised in an environment heavily shaped by digital technology and globalization, facing challenges and opportunities that demand different skills from earlier generations. A pressing educational need today is to develop 21st-century skills.

According to Ichsan *et al*. (2022) [5], 21st-century skills encompass four key components:

- Critical thinking and problem solving
- Communication
- Collaboration
- Creativity and innovation

Furthermore, within the Generation Z context, digital literacy is integral to 21st-century skills. It extends beyond the mere use of technology to include the ability to critically evaluate information, understand digital ethics, and use technology productively and responsibly (Yuliana & Fatimah, 2021) [49].

The Indonesian Ministry of Education and Culture (Kemendikbud, 2020) [9] also emphasizes the integration of 21st-century competencies in instruction, aligning with the Merdeka Curriculum. Education now focuses not only on content knowledge but also on fostering character and global competencies, including collaboration, effective communication, and reflective thinking.

Sari and Hermawan (2021) [34] argue that innovative learning models, such as Problem-Based Learning (PBL), are particularly effective in developing these skills. PBL encourages students to identify real-world problems, collaborate in groups, generate creative solutions, and present ideas systematically—activities that directly reflect the demands of 21st-century competencies.

Generation Z has the potential to excel in this area because:

- They are highly adaptable to technological change;
- They are accustomed to rapid information access;
- They are open to new ideas;
- They show a preference for direct problem-solving challenges (Putri & Yulianti, 2021; Giroth, *et al*., 2023) [30, 3].

However, this potential must be harnessed through learning approaches that are relevant, contextual, and competency-oriented. Without a shift in instructional strategy, these essential 21st-century skills may not develop optimally in Generation Z students.

Challenges in educating generation Z

Generation Z students demonstrate remarkable potential in areas such as technological proficiency, creativity, and adaptability. However, this potential is often not fully harnessed in educational contexts due to various challenges. According to Wibowo and Arifin (2020) [45], traditional learning approaches—such as one-way lectures, rote memorization, and monotonous teaching materials—fail to engage Generation Z effectively. Instead, this cohort prefers active, contextual, and problem-solving-based learning. Consequently, a lack of diversity in instructional strategies remains a significant barrier to maximizing their learning potential.

Furthermore, Yuliana and Fatimah (2021) [49] emphasize that Generation Z is particularly susceptible to external distractions, especially from digital technologies. The widespread use of smartphones, social media, online games, and entertainment platforms often disrupts their concentration during study sessions. Therefore, integrating technology into education must be done purposefully and productively to ensure it supports, rather than hinders, learning.

Another key challenge is that Generation Z demands dynamic and meaningful learning experiences. This group is prone to boredom if learning materials are not connected to real-life contexts or if their active participation is not facilitated (Putri & Yulianti, 2021) [30]. Hence, collaborative, project-based, and contextually relevant learning approaches are essential for engaging them effectively.

In addressing these challenges, the role of teachers as facilitators is crucial. Teachers should not merely deliver content but also design engaging, interactive, and student-centered learning activities that align with the needs of Generation Z learners. Teachers must develop pedagogical and digital competencies to craft lessons that respond to these needs (Ichsan *et al*., 2022; Mokalu, *et al*., 2023) [5, 15].

Moreover, the availability of modern learning resources and infrastructure poses a challenge, especially in schools that are not yet fully equipped with adequate technology. Therefore, collaboration among schools, teachers, and educational stakeholders is imperative to create learning environments that are adaptive to the demands of contemporary learners.

Research methodology

This study employed a quantitative approach using a descriptive method. The primary aim of the research was to describe the perceptions of Generation Z students regarding the implementation of the Problem-Based Learning (PBL) approach in science education. Data were collected in numerical form and analyzed using descriptive statistical techniques to provide an overall depiction of students' perceptions. According to Sugiyono (2017) [36], a quantitative approach is typically used to investigate specific populations or samples by employing research instruments, with data analysis conducted through quantitative/statistical methods. Meanwhile, the descriptive method is utilized to depict phenomena as they naturally occur (Arikunto, 2019) [1].

Research design

This study was designed as a case study. A case study was chosen to allow for an in-depth exploration of students' perceptions within a specific context, namely at two randomly selected schools: SMP Negeri 2 Tondano and SMP Katolik St. Rosa de Lima Tondano. Yin (2011) [48] states that a case study is a research strategy used when the researcher seeks to understand phenomena within real-life contexts and lacks control over the variables being studied.

Research setting

The research was conducted at SMP Negeri 2 Tondano and SMP Katolik St. Rosa de Lima Tondano, both located in Tondano City. These schools were selected because they had already implemented the PBL approach in their science classrooms.

Population and sample

- **Population:** The study population consisted of all seventh-grade students at the two schools who had participated in science lessons using the PBL approach, totaling 138 students.
- **Sample:** The sampling technique applied was purposive sampling, which selects samples based on specific characteristics or attributes aligned with the research objectives (Widodo, 2017). The criteria included students who had attended at least two PBL-based science lessons. A sample size of 50 students was determined, proportionally distributed as follows:
  - SMP Negeri 2 Tondano: (120/138) x 50 = 43 students
  - SMP Katolik St. Rosa de Lima Tondano: (18/138) x 50 = 7 students

According to Sugiyono (2017) [36], purposive sampling involves selecting samples based on defined criteria relevant to the study's aims. The proportional sampling formula used was:

ni=NiN×nni=NNi×n

Where:

nini = number of samples from the i-th stratum

NiNi = population of the i-th stratum

NN = total population

nn = total sample size

Research instruments

- **Structured interviews:** Conducted to deeply explore students' perceptions of their experiences with PBL-based science learning. According to Herdiansyah (2019), interviews aim to obtain explanations about respondents' experiences and interpretations of particular phenomena.
- **Questionnaire:** Developed using a Likert scale to measure students' perceptions of key PBL elements (e.g., collaboration, teacher role, effectiveness, engagement). Sugiyono (2017) [36] states that Likert scales are commonly used to assess attitudes, opinions, and perceptions regarding social phenomena.
- **Observation:** Used to directly observe the PBL implementation in science classes and to record interactions between teachers and students.

Data collection techniques
- **Interviews:** Conducted in-person using both closed and open-ended questions.
- **Questionnaire:** Administered individually and collected immediately after completion.
- **Observation:** Performed using a pre-prepared observation sheet.

Data analysis techniques
Questionnaire data were analyzed using descriptive statistics, while interview and observation data were analyzed thematically.

- **Mean**

$$\bar{X} = \frac{\sum X}{N}$$

where:
X¯ = mean, ∑X = total score, N= number of respondents.
Sudjana (2005) notes that the mean indicates the central tendency of quantitative data.

- **Percentage**

$$\text{Percentage} = \frac{\bar{X}}{\text{Maximum Score}} \times 100\%$$

Arikunto (2019) [1] explains that percentages facilitate interpretation of quantitative results.

- **Interpretation categories**:

According to Riduwan and Akdon (2017):
80–100% = Very High
60–79% = High
40–59% = Moderate
20–39% = Low
0–19% = Very Low
Data analysis steps included scoring raw data, converting scores to percentages, categorizing results, and presenting data in tables and graphs.

Data analysis framework
- Data collection through interviews, questionnaires, and observations
- Transcription of interview data
- Thematic coding
- Descriptive statistical analysis
- Integration of qualitative and quantitative results
- Drawing conclusions.

Validity and reliability of data
- **Validity:** Content validity was assessed through expert judgment involving teachers and senior high school students.
- **Reliability:** Measured using Cronbach's Alpha coefficient:

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum \sigma^2_{\text{item}}}{\sigma^2_{\text{total}}}\right)$$

where:
α = reliability coefficient
k = number of items
σ^2_{item} = variance of each item
σ^2_{total} = total variance

According to Sugiyono (2017) [36], the criteria for interpreting Cronbach's Alpha are:
≥ 0.90 = Very Reliable
0.80–0.89 = Highly Reliable
0.70–0.79 = Sufficiently Reliable
0.60–0.69 = Moderately Reliable
< 0.60 = Not Reliable

This study employed a research and development (R&D) approach using the ADDIE model, which comprises five systematic stages: Analysis, Design, Development, Implementation, and Evaluation. The R&D method is commonly used to produce specific educational products and assess their effectiveness. As a bridge between basic and applied research, R&D aims to create practical solutions grounded in empirical inquiry.
The general stages of the R&D process include:

a) **Needs analysis:** Identifying existing problems or needs and analyzing user characteristics and the learning environment.
b) **Product design:** Designing the intended product, including its objectives, features, and specifications.
c) **Product development:** Creating the product based on the finalized design.
d) **Product testing:** Conducting trials to determine whether the product functions as expected.
e) **Product evaluation:** Assessing the product's effectiveness and efficiency in achieving its intended goals.
f) **Product revision:** Improving the product based on evaluation results and feedback.
g) **Product dissemination:** Distributing the final product to target users or relevant stakeholders.

Research subjects
The subjects of this study were Grade VII students at SMP Negeri 4 Ratahan. A small-scale trial was conducted at SMP Negeri 7 Ratahan, located within the same sub-district (Ratahan Timur), chosen due to its similar topography and school conditions.

Research instruments
The instruments used to collect data in this study included:
- Questionnaires (administered to media and content experts),
- Interviews,
- Classroom observations

Data collection techniques

Data were collected using various techniques:

- Questionnaires were used to gather information on students' learning motivation.
- Tests were used to measure students' critical thinking skills and conceptual understanding.
- Interviews were conducted with teachers and students to explore their experiences using the Canva-based blended learning model.
- Observations were employed to examine classroom learning processes and teacher–student interactions during implementation.

Data analysis techniques

Quantitative data were analyzed using descriptive and inferential statistical techniques. Qualitative data were analyzed using descriptive methods to gain in-depth insights into participants' experiences and perspectives.

3. Results & discussion

A. Overview of respondents

This study involved 50 respondents from two schools that have implemented the Problem-Based Learning (PBL) approach in science instruction. The demographic profile of the respondents is presented below:

Table 1: Number of respondents by school

School	Number of Students	Percentage
SMP Negeri 2 Tondano	43	86%
SMP Katolik St. Rosa de Lima Tondano	7	14%
Total	50	100%

Table 2: Number of respondents by gender

Gender	Number	Percentage
Male	28	56%
Female	22	44%

B. Student perception questionnaire results

a. Rating scale

The Likert scale was used with five response options:

Table 3: Likert scale

Score	Category
5	Strongly Agree
4	Agree
3	Neutral
2	Disagree
1	Strongly Disagree

Source: Adapted from Sugiyono (2017) [36]

Data processing formula mean score per item:

$$\bar{X} = \frac{\sum X}{N}$$

Where, $\sum X$ = total score, N = number of respondents.

Percentage conversion

$$\text{Percentage} = \frac{\bar{X}}{\text{Maximum Score}} \times 100\%$$

Interpretation categories

- 80–100% = Very High
- 60–79% = High
- 40–59% = Moderate
- 20–39% = Low
- 0–19% = Very Low

C. Observation and interview results

Observation

Observation data were analyzed using a prepared observation sheet with indicators such as:

- Active participation in discussions
- Group collaboration
- Accuracy in problem-solving

Observations were conducted during science lessons, focusing on student engagement, collaboration, and problem-solving skills.

Table 4: Observation results of students in PBL activities

Indicator	General Description
Active participation in discussions	Most students actively asked questions, expressed opinions, and engaged in discussions.
Group collaboration	The majority demonstrated cooperative behavior and equitable task distribution.
Accuracy in problem-solving	Some groups displayed precise solutions; others required teacher guidance.

Interviews

Interview data were analyzed through:

- Transcription
- Thematic coding (e.g., engagement, challenges, motivation)
- Data interpretation

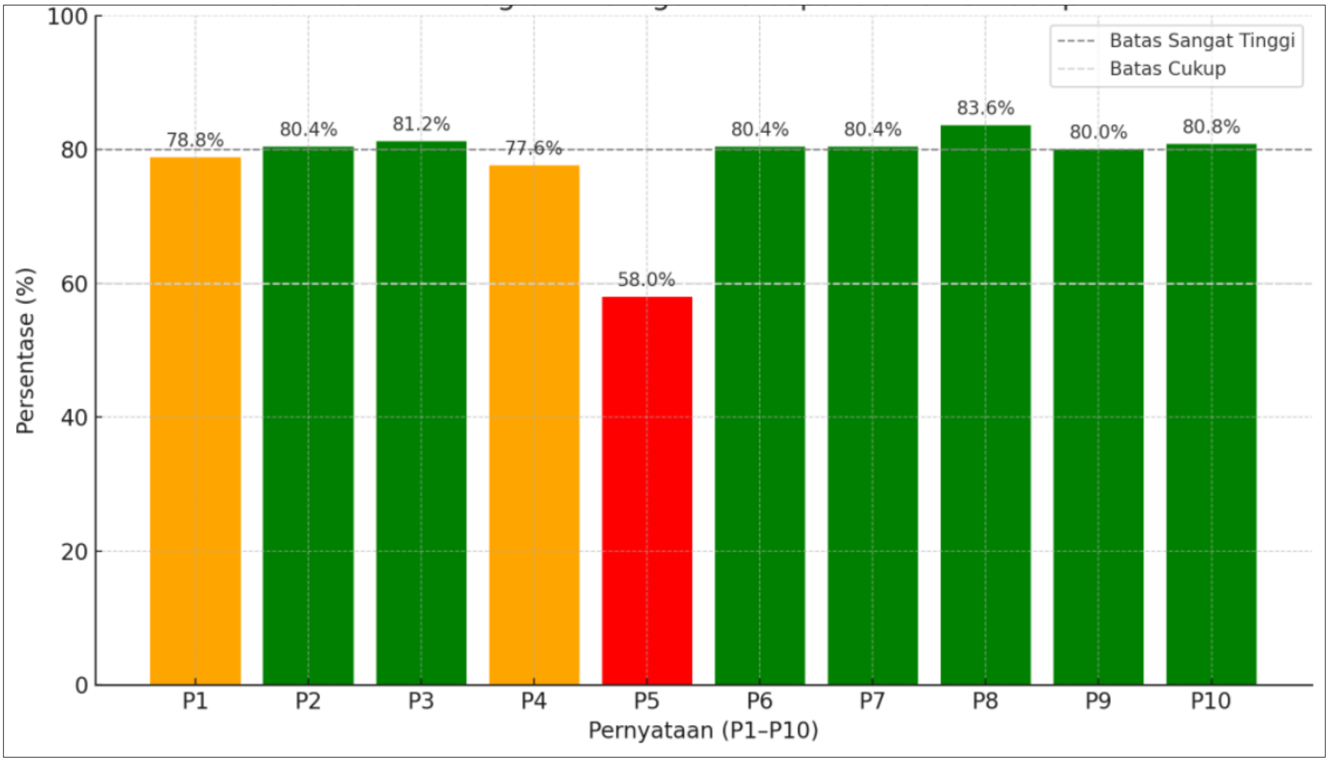
Example quote

"I prefer this learning approach because it allows for hands-on practice and discussion." — Student 17, SMP Negeri 2 Tondano.

D. Summary of research findings

Table 5: Summary of students' perceptions of PBL

Assessed Aspect	Mean Score	Percentage	Category
I am aware that problem-based learning is used in science lessons.	3.94	78.8%	High
I enjoy participating in science learning using the PBL approach.	4.02	80.4%	Very High
PBL makes me more active in the science learning process.	4.06	81.2%	Very High
PBL helps me better understand ecological and biodiversity concepts.	3.88	77.6%	High
I am more interested in learning science using PBL than traditional methods.	2.9	58%	Moderate
I am accustomed to collaborating with peers in solving problems during science lessons.	4.02	80.4%	Very High
The teacher provides adequate guidance when I encounter difficulties during PBL.	4.02	80.4%	Very High
I can connect science lesson materials to real life through PBL.	4.18	83.6%	Very High
The PBL approach challenges me to think more critically and creatively.	4.00	80%	Very High
Overall, I find PBL to be an effective approach in science learning.	4.04	80.8%	Very High



Source: *Processed from student questionnaires, 2025*

Fig 1: Students' Perceptions of PBL in Science Learning

Legend

- Green = Very High (≥80%)
- Orange = High (60–79%)
- Red = Moderate (<60%)

Quantitative discussion

The questionnaire results from 50 students across the two schools revealed predominantly positive perceptions of the PBL implementation in science learning. The mean score for each item was converted into a percentage and classified accordingly:

- Seven of the ten statements were categorized as "Very High" (≥80%).
- Two statements were categorized as "High" (60–79%).
- One statement (related to interest in PBL compared to traditional methods) was categorized as "Moderate" (58%).

Key findings

- The highest percentage was observed in the statement, "I can connect science lessons to real life through PBL" (83.6%), indicating the success of PBL in fostering contextual relevance.
- The lowest score was found in the statement, "I am more interested in learning science through PBL than traditional methods" (58%), suggesting that some students remain less engaged with PBL, potentially due to individual learning preferences or prior experiences.

Overall, the average scores across all items fell within the high to very high range, indicating that most students held a positive perception of PBL.

4. Conclusions

Based on the findings regarding students' perceptions of the Problem-Based Learning (PBL) approach in science education at SMP Negeri 2 Tondano and SMP Katolik St. Rosa de Lima Tondano, the following conclusions can be drawn: Overall, students' perceptions of the implementation of the PBL approach in science learning fall into the positive category. The majority of students expressed responses categorized as High to Very High. This indicates that the PBL approach is generally well received and can enhance student engagement in science education. Key aspects of the PBL approach that align with the learning preferences of Generation Z include active participation in discussions, collaborative group work, and the ability to connect learning materials with real-life contexts. However, a minority of students reported less interest in the PBL approach compared to conventional lecture-based and rote memorization methods, suggesting that PBL may not fully align with all students' preferences. Challenges perceived by students in participating in PBL-based learning encompass the need for consistent teacher guidance, difficulties in understanding concepts without direct explanations, and suboptimal group dynamics. Conversely, opportunities include increased motivation, enhanced critical thinking skills, and improved collaborative problem-solving abilities. The integration of Christian values and character formation through the PBL approach is reflected in the cultivation of teamwork, honesty, responsibility, and the practice of reflecting on God's creation within the context of science learning. This approach holds potential to foster scientifically literate individuals who are also grounded in Christian values throughout their learning experiences.

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