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Analysis of Learning Needs for Cell Biology: a Study From the Perspectives of Lecturers and Students in Palangka Raya City

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ABSTRACT

Cell Biology education at the university level, including in Palangka Raya City, continues to face significant challenges due to the abstract and complex nature of the subject matter. The predominant reliance on conventional teaching methods—such as lectures and static visual aids has proven inadequate in supporting students' conceptual understanding. This study aims to analyze the learning needs of Cell Biology from the perspectives of both lecturers and students to formulate more adaptive and innovative instructional strategies. A descriptive qualitative approach with a mixed-methods design was employed, involving 9 lecturers and 120 undergraduate students from three higher education institutions in Palangka Raya: Universitas Palangka Raya, Universitas Muhammadiyah Palangkaraya, and IAIN Palangka Raya. Data were collected through questionnaires, semi-structured interviews, and document analysis. The results showed that 72% of students found Cell Biology difficult, particularly on topics such as cellular respiration, membrane transport, and organelle interactions. Most students reported a lack of interactive learning media, while lecturers acknowledged the need for training in the integration of educational technologies. A comparative analysis revealed a clear gap between lecturers' focus on content delivery and students' expectations for contextual and visually rich learning experiences. The findings underscore the urgent need to develop technology-enhanced learning strategies such as 3D media, AR/VR tools and to strengthen institutional support to improve Cell Biology education in the local context of Central Kalimantan.

INTRODUCTION

Cell Biology is a core subject in biology and biology education programs that explores the structure, function, and dynamics of cells as the basic unit of life (Wulandari, 2023). A solid understanding of cell biology is essential, as it serves as the foundation for more advanced courses such as genetics, physiology, and biotechnology (Permatasari et al., 2023). However, teaching and learning Cell Biology present notable challenges due to the abstract and complex nature of the content, which often requires advanced visualization to be fully understood (Prasetyo & Kurniawan, 2023) (Wulandari, 2023)

At the university level including institutions in Palangka Raya City Cell Biology instruction is still largely conventional, relying on lectures and static presentation tools. This approach tends to hinder conceptual understanding and student engagement, especially in topics such as organelle interactions, membrane transport mechanisms, and DNA replication. A study by (Rahmawati *et al*., 2022) found that over 60% of students reported difficulties in learning Cell Biology due to limited access to interactive learning media and practical experiences. Similarly, research by

(Aini, Prasetyo, et al., 2023) emphasized that students require technology-enhanced learning resources to grasp cellular concepts more effectively (Aini, Herdina, et al., 2023; Joeliaty, 2024). On the other hand, lecturers also face challenges in delivering Cell Biology in an engaging and accessible manner. The most lecturers expressed the need for training in the use of interactive learning tools and the development of contextual materials (Wu et al., 2013). Nevertheless, discrepancies between lecturer expectations and student learning needs often remain unaddressed due to the lack of comprehensive and localized needs assessments (Purwanti & Ardiansyah, 2019).

The local context of higher education in Palangka Raya City adds relevance to this inquiry. With multiple institutions offering biology related programs such as Universitas Palangka Raya (UPR), Universitas Muhammadiyah Palangkaraya (UMP), and IAIN Palangka Raya there is a clear need to map out the learning needs across diverse institutional settings. That students in Central Kalimantan highly favor visual and contextual learning methods, particularly for abstract subjects like Cell Biology (Aini, Prasetyo, et al., 2023).

Given these circumstances, this study aims to conduct a thorough needs analysis of Cell Biology learning by examining the perspectives of both lecturers and students from universities across Palangka Raya City. The findings are expected to provide a comprehensive overview of existing challenges, learning expectations, and opportunities for the development of more adaptive, innovative, and locally relevant learning strategies for Cell Biology (Wulandari, 2023).

MATERIALS AND METHODS

1. Time and Location of the Study

This research was conducted over a three-month period, from January to March 2025, at three higher education institutions in Palangka Raya City: Universitas Palangka Raya (UPR), Universitas Muhammadiyah Palangkaraya (UMPR), and the State Islamic Institute of Palangka Raya (IAIN). These institutions were purposively selected due to the presence of Biology or Biology Education programs that are directly relevant to the study's focus on Cell Biology instruction.

2. Type of Research

The study employed a descriptive qualitative design within a mixed-methods framework, integrating both quantitative and qualitative data to provide a comprehensive understanding of learning needs in Cell Biology courses. This approach enables the triangulation of numeric data with in-depth qualitative insights, offering both breadth and depth in understanding educational phenomena (Creswell & Plano Clark, 2018). The qualitative aspect was used to explore detailed perceptions, challenges, and expectations, while the quantitative component captured general trends among participants.

3. Instruments and Materials

The primary instruments used in this study included questionnaires and semi-structured interview guides. The student and lecturer questionnaires were developed with reference to existing validated instruments for learning needs analysis in biology education, such as those proposed by Rahmawati et al. (2022) and Situmorang et al. (2019) (Harlis & Aswan, 2023)**,** and adapted to the context of Cell Biology. The questionnaire items consisted of both closed-ended questions using a Likert scale and open ended questions to collect in-depth qualitative responses. The semi-structured interview guides were formulated to explore deeper insights into students' and lecturers' experiences, challenges, and expectations regarding Cell Biology instruction. In addition, relevant instructional documents such as syllabi, lesson plans, and teaching materials were collected and analyzed to support triangulation and contextual validation of findings.

4. Population and Sample

The target population comprised lecturers and undergraduate students from Biology and Biology Education programs at the selected institutions. Participants were selected using purposive sampling to ensure that they had direct experience with the teaching or learning of Cell Biology. A total of nine lecturers and 120 students participated in the study. This sampling technique was chosen for its effectiveness in capturing rich and relevant information from

individuals who are most knowledgeable about the subject (Etikan, Musa, & Alkassim, 2016).

5. Research Procedure

The research began with a planning phase, which included the development of research instruments and obtaining permissions from the relevant institutions. Data collection was carried out in three main stages: distribution of questionnaires to all selected respondents, conducting semi-structured interviews with six lecturers and twelve students selected based on institutional representation and availability, and collecting instructional documents for further analysis. This procedure follows the qualitative research best practices outlined by Creswell & Plano Clark (2018), emphasizing triangulation and purposive sampling to ensure the credibility**,** transferability, and dependability of the findings. Each stage was carefully designed to capture both the breadth of perceptions and the depth of learning needs related to Cell Biology instruction (Winarni et al., 2021).

6. Data Analysis Techniques

Quantitative data from the questionnaires were analyzed using descriptive statistics, including frequencies, percentages, and mean scores, to identify patterns and trends in participants' responses. Qualitative data from open-ended responses and interviews were analyzed thematically following Braun and Clarke's (2006) method, which involves data transcription, coding, categorization, theme identification, and interpretation. This approach allowed for the identification of recurring issues and insights related to instructional needs and expectations.

7. Data Validity and Reliability

To ensure the validity and reliability of the findings, data triangulation was employed across the three sources: questionnaires, interviews, and document analysis. Triangulation enhances the credibility of qualitative research by cross-verifying information from multiple perspectives (Patton, 2015). Additionally, member checking was conducted with selected participants to confirm the accuracy of the researcher's interpretations and to minimize bias in qualitative analysis.

RESULTS AND DISCUSSION

Students' Perceptions of Cell Biology Learning

Cell Biology, by its nature, involves the exploration of microscopic structures and processes that are not directly observable. This intrinsic abstraction contributes significantly to students' cognitive burden. The findings of this study confirm this reality, with 72% of students reporting difficulty in understanding the subject. Furthermore, 65% noted that the material was too abstract and lacked visual contextualization, and 58% indicated a reliance on limited instructional media mostly PowerPoint presentations and printed textbooks

Tabel 1. Students Perceptions

No.	Student Perception Aspects	Persentase (%)
1	Difficulty in understanding the subject	72%
2	The material was too abstract	65%
3	Reliance on limited instructional media	58%

These results are consistent with constructivist learning theory, which posits that learners build understanding more effectively when new knowledge is grounded in visual and experiential contexts (Vygotsky, 1978; Mayer, 2005). Students' qualitative feedback further emphasized their struggle with specific topics such as cellular respiration, membrane transport, and the dynamics of organelles topics that are highly dynamic but often taught through static representations (Akbar et al., 2024). Quantitative analysis from the student questionnaire *(n = 120)* revealed that:

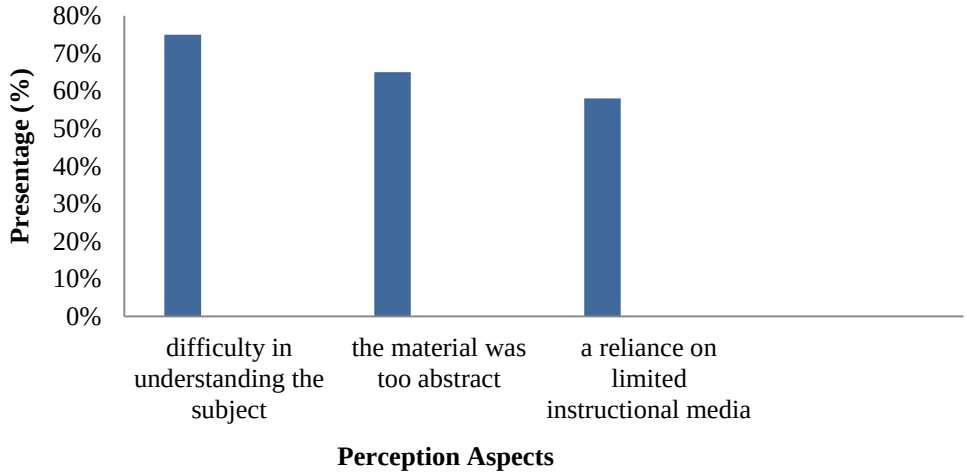

Figure 1. Quantitative analysis from the student questionnaire (*n = 120*)

Students expressed a preference for learning that incorporates interactive simulations, animations, and immersive technologies such as AR and VR. These tools, according to Winarni et al. (2021), help bridge the gap between abstract biological processes and learners' mental models by providing concrete representations. Similarly, Madya & Abdurahman (2021) argue that multimodal learning environments, particularly those with visual interactivity, significantly increase comprehension and engagement in STEM disciplines. Therefore, the students' feedback reflects not only subjective difficulty but a legitimate need for pedagogical modernization aligned with cognitive learning principles (Wardhani & Habisukan, 2024).

Lecturers' Perspectives on Teaching Cell Biology

Lecturers also recognize the challenges inherent in teaching Cell Biology. From the lecturer survey (n = 9), the majority acknowledged:

Tabel 2. Lecturers Perceptions

No.	Statement	Percentage (%)
1	Challenges in making abstract content accessible	89%
2	Limited time for in-depth practical activities	78%
3	Need for capacity building in digital pedagogies (e.g., integration of interactive media and online labs)	100%

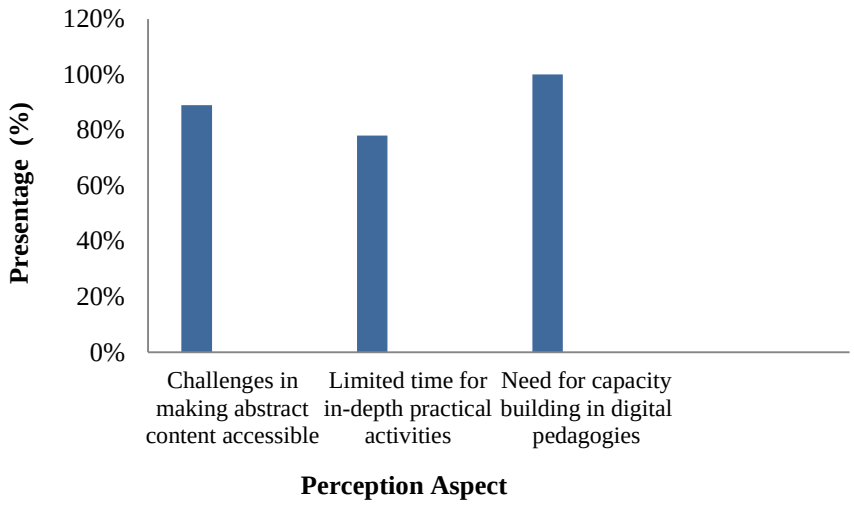

Figure 2. Quantitative analysis from the lecturers questionnaire (*n = 9*)

These findings highlight a critical tension in higher education biology instruction: the need to balance comprehensive content delivery with deep conceptual engagement (Wulandari, 2023). Through semi-structured interviews, lecturers revealed an awareness of the potential benefits of integrating technological tools into their teaching (Martinez & Nguyen, 2024; Prasetyo & Kurniawan, 2023). However, they also identified significant institutional constraints, including a lack of infrastructure, insufficient access to AR/VR tools or virtual laboratories, and limited training in digital pedagogies (White & Green, 2024). This gap between intention and practice reflects the "technological readiness" dilemma described by Harlis & Aswan (2023), who found that biology educators, particularly in less-resourced universities, often face structural and professional development barriers that inhibit innovation (Susanto et al., 2022) (H. Liu & Zhang, 2021). Although faculty members are open to change, systemic support both logistical and policy-based is essential for meaningful transformation (Suryani & Kurniawati, 2017) (Purwanti & Ardiansyah, 2019). Without such support, even the most motivated educators are unlikely to adopt or sustain digital innovation in their pedagogy (Harlis & Aswan, 2023) (Gokhan & Karaca, 2019).

Gap Analysis: Divergence Between Student Expectations and Teaching Practices

Comparative analysis of student and lecturer data reveals a fundamental disconnect in pedagogical priorities. Lecturers tend to emphasize curricular completeness and scientific accuracy, aiming to cover all required content within limited instructional time. In contrast, students prioritize clarity, relevance, and engagement, expressing a need for instructional practices that connect biological concepts to real-life applications. This divergence suggests that teaching strategies may currently be more content-driven than learner-centered (Prasetyo, et al., 2023). The students' desire for contextual learning echoes the principles of *situated cognition*, which holds that knowledge is best acquired and retained when it is learned in context and applied in meaningful ways (Winarni et al., 2021) (Brown, Collins, & Duguid, 1989). Furthermore, the lack of real-world relevance in current Cell Biology instruction is likely to reduce student motivation and limit conceptual retention an issue previously identified in studies of science education across Southeast Asia Addressing this gap requires not only revising content delivery but also rethinking instructional design, moving toward models that integrate inquiry based learning, problem-solving scenarios, and the use of digital technologies to simulate biological phenomena (Rahayu et al., 2024)

Implications for Learning Development in Palangka Raya

The findings of this study hold particular relevance for higher education institutions in Palangka Raya and other regions with similar educational landscapes (Aini et al., 2023) (Situmorang et al., 2019). First and foremost, a shift toward student-centered pedagogies is needed (Ardiansyah et al., 2023). These should incorporate inquiry-based approaches that encourage active exploration, critical thinking, and hands-on experimentation even in virtual formats : Second, institutions must invest in the development and adoption of interactive learning media (O'Neill, 2019). Tools such as AR/VR applications, 3D molecular visualizations, and virtual laboratories offer transformative potential for Cell Biology learning, especially in environments where physical laboratory access is limited (Kurniawati & Fitriani, 2020). Third, faculty development is crucial (Johnson, 2017). Lecturers need structured, sustained training opportunities to build competencies in digital pedagogy (Wijaya & Hasudungan, 2022). Such training must go beyond one-time workshops to include mentorship, peer learning, and communities of practice focused on education technology (Sari et al., 2022). Finally, systemic institutional support is essential (Hanik et al., 2018). This includes providing budgets for educational technology procurement, formulating policies that encourage innovation in teaching, and ensuring equitable access to technological infrastructure (Zhou & Li, 2017) (Sinaga et al., 2024). Importantly, educational strategies must remain sensitive to the sociocultural and technological context of Central Kalimantan. As Ardiansyah et al. (2023) emphasize, successful learning innovation in regional settings requires solutions that are not only pedagogically sound but also culturally relevant and logistically feasible (C. Liu & Tan, 2020).

CONCLUSION

This study analyzed the learning needs in Cell Biology based on the perspectives of students and lecturers from three universities in Palangka Raya City. The findings demonstrate that 72% of students experienced difficulty understanding Cell Biology, particularly abstract topics like cellular respiration and organelle dynamics. In parallel, 100% of lecturers acknowledged the urgent need for training in digital pedagogies and the use of interactive media. These data reveal a clear mismatch between current instructional practices and learner expectations, highlighting the dominance of traditional, content-heavy methods that are not aligned with students' preferences for contextual, visual, and technology-supported learning. Addressing this gap requires a transition toward student-centered approaches, adoption of AR/VR tools, and systemic institutional support for digital innovation in teaching. In conclusion, improving Cell Biology education in Palangka Raya must involve not only curriculum and media redesign but also capacity building for lecturers and policy support from institutions. Concrete, data-driven interventions are essential to ensure that learning becomes more meaningful, accessible, and effective for all students.

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