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Analysis of Learning Styles and Multiple Intelligences Among Pre-Service Biology Education Students

Nanda Eska Anugrah Nasution
UIN Kiai Haji Achmad Siddiq Jember, Indonesia
Correspondence author, nsteska@gmail.com

Abstract Understanding the diverse cognitive abilities of students is essential for improving teaching strategies, particularly for pre-service biology teachers. This study examines the learning styles and multiple intelligences of second-year students enrolled in the Tadris Biology program at UIN Kiai Haji Achmad Siddiq Jember during the 2021/2022 and 2022/2023 academic years. A descriptive quantitative research design was used, with data collected through structured questionnaires assessing learning styles and multiple intelligences. The study found that the majority of students exhibited a visual learning style (52%, n=72), followed by kinesthetic (25%, n=34) and auditory learners (23%, n=32). In terms of multiple intelligences, spatial-visual (17.4%, n=24) and logical-mathematical (16.7%, n=23) intelligences were the first and second most dominant, followed by musical (13.8%, n=19) and bodily-kinesthetic (13.8%, n=19) intelligences. These results suggest that the majority of pre-service biology education students rely on visual and kinesthetic modalities for learning, while their cognitive strengths are primarily in spatial-visual and logical-mathematical intelligences. This distribution highlights the need for instructional strategies that integrate visual representations, hands-on activities, and structured problem-solving tasks to support their dominant learning preferences.

Keywords: Learning styles, Multiple intelligences, Pre-service teachers, Biology education

INTRODUCTION

Effective teaching in biology requires not only a strong understanding of scientific concepts but also the ability to convey these ideas in ways that accommodate diverse student needs (Qorib, 2024; Milner, 2021). One key factor that influences teaching effectiveness is an understanding of students' learning styles and cognitive strengths (Wahyudin & Wahyuni, 2022; Sheromova et al., 2020). Learning styles refer to the ways individuals prefer to absorb and process information (Nasution et al., 2023; Huang et al., 2020), while multiple

intelligences describe different cognitive abilities that affect how people engage with learning material (Supartini & Weismann, 2020; Gardner, 2008). Recognizing these differences is crucial in designing instructional methods that optimize student comprehension and engagement.

The study of learning styles has been widely explored in educational research, categorizing students into visual, auditory, and kinesthetic learners (Nasution et al., 2023; Huang et al., 2020). Visual learners prefer information presented through images, diagrams, and written text, auditory learners benefit from verbal instruction and discussion, and kinesthetic learners learn best through hands-on activities and movement (Oladele, 2024; Blessing et al., 2024; Nasution et al., 2023; Wahyudin & Wahyuni, 2022; Gidaris et al., 2019). Understanding these preferences allows educators to create balanced instructional approaches that cater to different learning modalities. For prospective biology educators, developing an awareness of their own learning styles may help them adopt more effective teaching strategies in their future classrooms.

Howard Gardner's Multiple Intelligences theory (Gardner, 2008) further expands this perspective by suggesting that intelligence is not a single ability but a combination of various cognitive strengths. Gardner's model identifies eight primary intelligences: linguistic, logical-mathematical, spatial-visual, musical, bodily-kinesthetic, interpersonal, intrapersonal, and naturalistic. Each intelligence type represents a unique way of processing information, which influences both learning and teaching styles. For example, individuals with strong logical-mathematical intelligence may excel in structured problem-solving tasks, while those with spatial-visual intelligence may prefer conceptualizing information through diagrams and visual representations. In the biology education, recognizing these cognitive strengths can enhance both personal learning and instructional effectiveness.

Understanding learning styles and multiple intelligences is particularly important for prospective teachers, as their own cognitive tendencies can shape their approach to instruction (Sood & Sarin, 2021; Yavich & Rotnitsky, 2020; Ridwan et al., 2019). Teacher education programs should not only provide subject matter knowledge but also equip future educators with the skills to adapt their teaching to diverse classroom needs (Wong & Moorhouse, 2021; Onyishi & Sefotho, 2020). If teachers are aware of their own learning preferences and cognitive strengths, they can consciously diversify their instructional methods, ensuring that they do not inadvertently favor one learning style over others. This is especially relevant in biology education, where complex concepts often require multiple representations, such as verbal explanations, visual models, and hands-on experiments.

The need for this research arises from the increasing emphasis on student-centered learning in higher education (Schell & Martin, 2020; Wulf, 2019; Harahap et al., 2019). As educational institutions shift away from one-size-fits-all teaching approaches (Yang et al., 2019; Srivastava, 2023), there is growing recognition of the importance of differentiated instruction, tailoring teaching strategies to

accommodate different learning styles and intelligences. For biology education students who will become teachers, this knowledge is not only valuable for their own academic success but may also for their ability to foster inclusive and effective learning environments in their future classrooms.

This study aims to analyze the learning styles and multiple intelligences of biology education students who are studying to become teachers. By identifying patterns in how these students learn, this research provides insights that can inform curriculum design and instructional practices in teacher education programs. Additionally, the findings can help prospective educators reflect on their own cognitive tendencies and develop teaching strategies that are more responsive to the diverse needs of their future students.

METHOD

This study employs a descriptive quantitative research design to analyze the learning styles and multiple intelligences of second-year students enrolled in the Tadris Biology program at UIN Kiai Haji Achmad Siddiq Jember. The study aims to identify dominant learning styles and intelligence types among pre-service biology teachers using established assessment tools. A survey research approach was adopted, as it allows for the systematic collection of data through standardized questionnaires. The study spans two academic years, 2021/2022 and 2022/2023, to enhance the reliability of findings by capturing data across different student cohorts.

The target population includes all second-year students of the Tadris Biology program at UIN Kiai Haji Achmad Siddiq Jember. A voluntary sampling technique was used, meaning that only students who willingly participated in the study were included. The total sample size was 138 students, derived from the two academic cohorts. Data collection was conducted through structured questionnaires administered via Google Forms. To determine students' preferred learning styles, a validated questionnaire from How to Study was utilized. This assessment categorizes learning styles into visual, auditory, and kinesthetic, based on widely accepted learning style theories. Additionally, to evaluate students' dominant intelligence types, a Multiple Intelligences test from PersonalityMax was used. This test is grounded in Howard Gardner's Multiple Intelligences Theory (Gardner, 2008), which identifies eight distinct intelligence types: spatial-visual intelligence, logical-mathematical intelligence, musical intelligence, bodily-kinesthetic intelligence, naturalistic intelligence, linguistic intelligence, intrapersonal intelligence, and interpersonal intelligence. Each participant completed both assessments, after which they reported their dominant learning style and intelligence type through a Google Form.

The collected data were analyzed using descriptive statistical methods. The percentage distribution of each learning style and intelligence type was calculated to identify predominant trends among the participants. The results were then visualized to facilitate better interpretation. To ensure the accuracy of the findings, data from both cohorts were analyzed to identify any emerging patterns or

variations. The inclusion of students from two different academic years strengthens the study's validity.

Participation was entirely voluntary, and informed consent was obtained from all participants before data collection commenced. The study ensured participant anonymity and confidentiality, with all collected data stored securely and used exclusively for research purposes. Additionally, students were informed that their participation or non-participation would have no impact on their academic standing. This ethical framework ensured that students felt comfortable participating in the study, which, in turn, improved the reliability of the responses.

The significance of this research lies in its potential contribution to improving instructional strategies for pre-service biology teachers. By understanding the predominant learning styles and intelligence types among students, educators can develop more tailored teaching methods that align with students' natural preferences, ultimately enhancing learning outcomes. Recognizing diverse learning styles and multiple intelligences allows for a more inclusive educational approach, catering to the strengths of each student while also addressing potential learning challenges. This study's findings can also inform curriculum development and instructional design within teacher education programs. The identification of dominant intelligence types and learning styles among pre-service teachers is particularly valuable because these individuals will eventually become educators themselves.

FINDINGS AND DISCUSSION

Based on the research findings, it was found that the majority of students' learning styles were visual (52%, n=72), followed by kinesthetic (25%, n=34), and lastly, auditory (23%, n=32). The diagram depicting the distribution of students' learning styles can be seen in Figure 1.

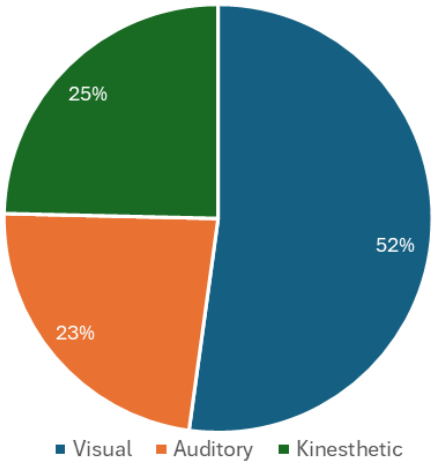

Figure 1. Diagram of the majority of respondents' learning styles.

When categorized by academic cohort, it was found that second-year Tadris Biology students in the 2021/2022 academic year predominantly had a Visual learning style (53%, n=37), followed by Auditory (26%, n=18), and lastly Kinesthetic (21%, n=15). Meanwhile, second-year Tadris Biology students in the 2022/2023 academic year showed a slightly different distribution, with Visual still being the most dominant learning style (51%, n=35), but followed by Kinesthetic (28%, n=19) and Auditory (21%, n=14). The diagram illustrating the distribution of dominant learning styles based on the students' academic cohorts can be seen in Figure 2.

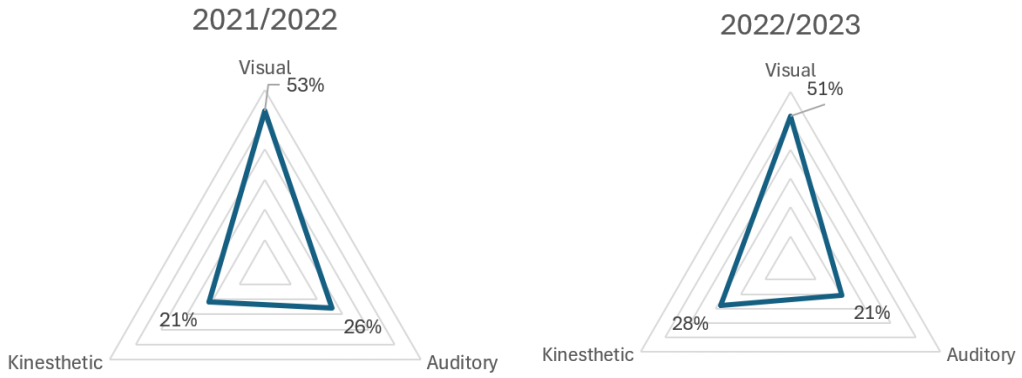

Figure 2. Diagram of the majority of respondents' learning styles based on cohort.

Based on the research findings, it was found that the majority of respondents' Multiple Intelligences were Spatial-Visual Intelligence (17.4%, n=24), followed by Logical-Mathematical Intelligence (16.7%, n=23). This was then followed by two intelligences with the same percentage, namely Musical Intelligence (13.8%, n=19) and Bodily-Kinesthetic Intelligence (13.8%, n=19), followed by Naturalistic Intelligence (11.6%, n=16), Linguistic Intelligence (10.9%, n=15), Intrapersonal Intelligence (8.7%, n=12), and finally, Interpersonal Intelligence (7.2%, n=10). The diagram depicting the distribution of the respondents' dominant Multiple Intelligences can be seen in Figure 3.

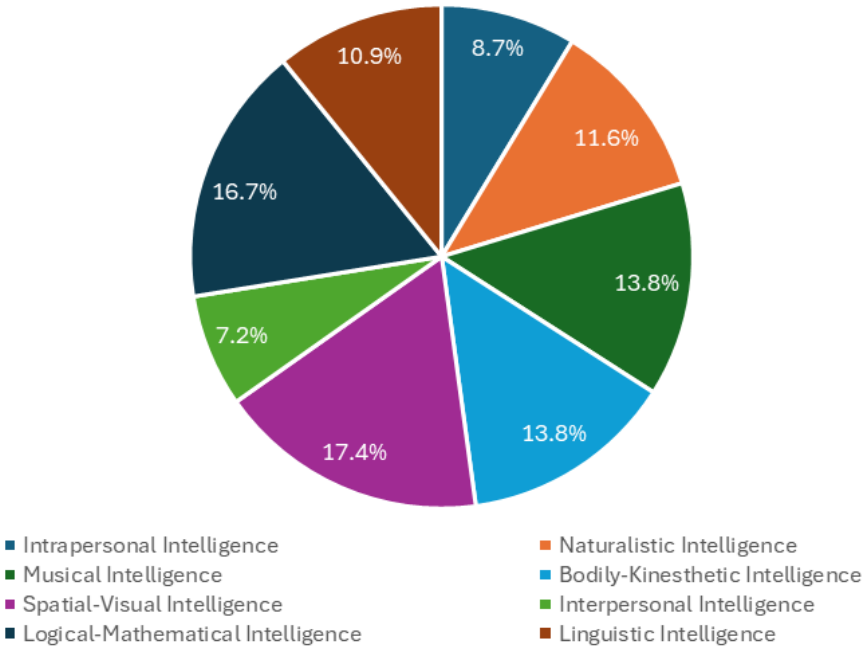

Figure 3. Diagram of the majority of respondents' Multiple Intelligences.

When analyzed by academic cohort, it was found that second-year Tadris Biology students in the 2021/2022 academic year primarily exhibited Spatial-Visual Intelligence (20%, n=14), followed by Logical-Mathematical Intelligence (19%, n=13), Linguistic Intelligence (16%, n=11), and two intelligences with the same percentage: Musical Intelligence (11%, n=8) and Bodily-Kinesthetic Intelligence (11%, n=8). These were followed by Naturalistic Intelligence (10%, n=7), Intrapersonal Intelligence (7%, n=5), and lastly Interpersonal Intelligence (6%, n=4). The second-year Tadris Biology students in the 2022/2023 academic year exhibited different dominant intelligences, with Musical Intelligence (16%, n=11) and Bodily-Kinesthetic Intelligence (16%, n=11) being the most common, followed by Spatial-Visual Intelligence (15%, n=10) and Logical-Mathematical Intelligence (15%, n=10). These were followed by Naturalistic Intelligence (13%, n=9), Intrapersonal Intelligence (10%, n=7), Interpersonal Intelligence (9%, n=6), and finally Linguistic Intelligence (6%, n=4). The distribution of the majority of respondents' Multiple Intelligences based on academic cohort can be seen in Figure 4.

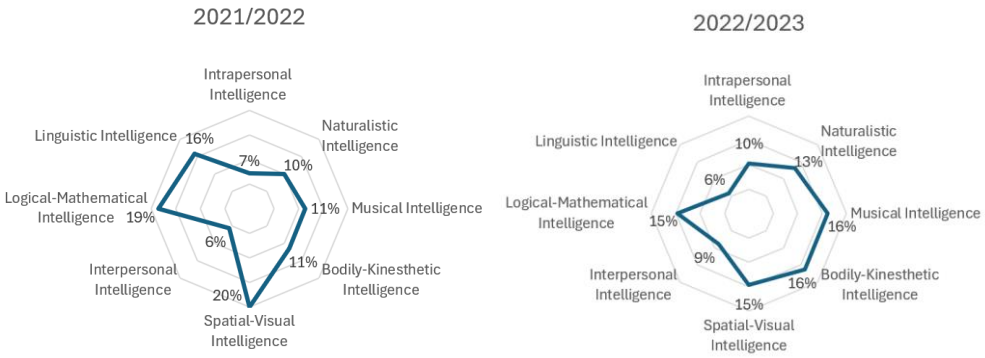

Figure 4. Diagram of the majority of respondents' Multiple Intelligences based on cohort.

The findings of this study provide significant insights into the learning styles and multiple intelligences of second-year students in the Tadris Biology program at UIN Kiai Haji Achmad Siddiq Jember. The results indicate that the majority of students (52%) have a visual learning style, followed by kinesthetic learners (25%) and auditory learners (23%). These findings align with existing research that suggests visual learning is one of the most common preferences among students, particularly in scientific and technical disciplines where diagrams, charts, and visual representations play a crucial role in understanding complex concepts (Wahyudin & Wahyuni, 2022; Rido & Wahyudin, 2020; Chetty et al., 2019). The predominance of visual learners in this study suggests that educators should incorporate more visual aids, such as infographics, videos, and interactive diagrams, into their teaching methods to optimize student comprehension and retention.

Kinesthetic learners, who make up 25% of the participants, benefit from hands-on activities and experiential learning (Oladele, 2024; Blessing et al., 2024). This is relevant in biology education, where laboratory work, field studies, and practical demonstrations are essential components of the learning process. The presence of a significant proportion of kinesthetic learners underscores the importance of integrating interactive and physically engaging teaching strategies, such as simulations, experiments, and group activities, into the curriculum. Meanwhile, auditory learners, who comprise 23% of the sample, rely on verbal explanations, discussions, and auditory stimuli for learning (Avni, 2023; Fallace, 2023). This suggests that lectures, discussions, and audio-based materials, such as podcasts and recorded explanations, remain valuable instructional tools for a considerable portion of students.

The results regarding multiple intelligences further support the diversity of cognitive strengths among students. The most prevalent intelligence type among the participants is spatial-visual intelligence (17.4%), followed closely by logical-mathematical intelligence (16.7%). The dominance of spatial-visual intelligence is consistent with the high percentage of visual learners in the sample, reinforcing the idea that many students process information more effectively through imagery, spatial reasoning, and visual organization (Safarudin, 2024; Mansour &

El-Senousy, 2022). This finding suggests that instructional approaches incorporating visual representations, such as concept mapping, 3D modeling, and graphical data interpretation, can significantly enhance student engagement and comprehension in biology courses.

Logical-mathematical intelligence, which is prevalent among 16.7% of students, reflects strong analytical, reasoning, and problem-solving abilities. Students with this intelligence type excel in recognizing patterns, applying logical sequences, and working with numerical data (Rakimahwati et al, 2022; Hardiyanti et al., 2020). This intelligence type aligns well with the analytical nature of scientific inquiry, data interpretation, and experimental design. Educators can support these students by incorporating problem-based learning, hypothesis testing, and structured analytical exercises into their teaching strategies.

The study also reveals that musical intelligence (13.8%) and bodily-kinesthetic intelligence (13.8%) are equally represented among students. Musical intelligence is characterized by sensitivity to sound patterns, rhythm, and auditory elements, which can be leveraged in teaching through mnemonic devices, rhythmic learning strategies, and music-integrated lessons (Khatoon & Ambreen, 2024; Chapman, 2023). Meanwhile, bodily-kinesthetic intelligence suggests that a substantial number of students learn best through movement and hands-on experiences (Dilmac & Tezcan, 2024).

Naturalistic intelligence, which accounts for 11.6% of students, is particularly relevant in the study of biology, as it involves an affinity for the natural world, observation skills, and environmental awareness. Linguistic intelligence (10.9%) and intrapersonal intelligence (8.7%) are also present among students, though to a lesser extent. Linguistic intelligence, which involves strong verbal and written communication skills, suggests that some students may benefit from assignments that involve reading, writing, and verbal expression. Meanwhile, intrapersonal intelligence indicates self-awareness and reflective thinking, which can be supported through self-assessment activities, journaling, and independent research projects. Finally, interpersonal intelligence, which is the least represented (7.2%), relates to social interaction and collaboration. While this intelligence type is less dominant in this sample, it remains important for fostering teamwork, discussion-based learning, and peer collaboration in the classroom.

The overall findings of this study highlight the importance of differentiated instruction that accommodates various learning styles and intelligence types. By understanding the diverse cognitive strengths of students, educators can design more inclusive and effective teaching strategies that cater to different preferences (Sood & Sarin, 2021; Yavich & Rotnitsky, 2020; Ridwan et al., 2019). For instance, a blended instructional approach that combines visual materials, interactive activities, problem-solving exercises, and verbal discussions may help maximize student engagement and learning outcomes.

Moreover, these findings have broader implications for teacher education. As future educators, pre-service biology teachers must not only be aware of their own learning styles and intelligences but also be equipped to identify and address the

diverse learning needs of their future students (Wong & Moorhouse, 2021; Onyishi & Sefotho, 2020). Teacher training programs can integrate these insights by incorporating strategies that promote adaptive teaching, student-centered learning, and multiple intelligence-based instruction.

Future research could expand on these findings by examining the relationship between learning styles, multiple intelligences, and academic performance in biology courses. Additionally, qualitative studies, such as classroom observations and student interviews, could provide deeper insights into how students apply their learning preferences in different academic settings.

CONCLUSION

This study highlights the diverse learning styles and multiple intelligences among pre-service biology educators. The findings indicate that the majority of students prefer visual learning (52%, n=72), followed by kinesthetic (25%, n=34) and auditory (23%, n=32). This suggests that instructional strategies should prioritize visual aids such as diagrams, concept maps, and interactive digital tools, while also incorporating hands-on activities to support kinesthetic learners. Similarly, the analysis of multiple intelligences revealed that the most dominant intelligence was Spatial-Visual Intelligence (17.4%, n=24), followed by Logical-Mathematical Intelligence (16.7%, n=23). Other significant intelligences included Musical (13.8%, n=19) and Bodily-Kinesthetic Intelligence (13.8%, n=19), with lower but still notable representation in Naturalistic (11.6%, n=16), Linguistic (10.9%, n=15), Intrapersonal (8.7%, n=12), and Interpersonal Intelligence (7.2%, n=10).

While learning styles and multiple intelligences influence teaching and learning, they represent distinct constructs. Learning styles describe how students prefer to receive and process information, whereas multiple intelligences refer to broader cognitive strengths that shape problem-solving abilities and creativity. Recognizing this distinction is crucial for designing instructional strategies that not only align with students' preferred learning approaches but also leverage their cognitive strengths for deeper engagement and understanding. These findings underscore the importance of differentiated instruction in teacher education. By integrating both learning styles and multiple intelligences into training programs, future educators can develop more adaptive and inclusive teaching methods. Further research should examine the interaction between these cognitive factors, academic performance, and teaching effectiveness to enhance educational practices and support diverse learners effectively.

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