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The Integration of Artificial Intelligence in Enhancing Students' Digital Literacy in Plant Taxonomy Course

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Abstract
This study examines the role of Artificial Intelligence (AI) technology in enhancing students' digital literacy skills in the Plant Taxonomy course. A descriptive quantitative approach was employed using a survey method involving 32 Biology Education students at Universitas HKBP Nommensen Pematangsiantar. Data were collected through a Likert-scale questionnaire measuring AI utilization and key aspects of digital literacy, including information access, critical evaluation, data analysis, and ethical awareness. The findings reveal that students responded positively to the integration of AI in learning. AI-based applications were perceived as effective in supporting plant identification, understanding complex morphological characteristics, accelerating access to scientific references, and improving classification accuracy. Most students also demonstrated the ability to critically interpret AI-generated results, compare them with manual field observations, and use digital technology responsibly. In addition, students reported an improvement in their overall digital literacy skills after using AI in learning. In conclusion, AI technology plays a significant role in supporting interactive learning and strengthening digital literacy skills in the Plant Taxonomy course, indicating its potential for broader integration in biology education.
Keywords: Integration, Artificial Intelligence, Students, Digital Literacy, Plant Taxonomy

1. Introduction

The development of digital technology and artificial intelligence (AI) in the era of the Fourth Industrial Revolution has brought significant changes across various sectors of life, including higher education (Sinaga et al., 2024). The paradigm shift from conventional to digital learning has become an inevitability that must be faced by both lecturers and students (Silaban et al., 2021).

Universities are now required not only to produce graduates with strong academic competence but also to equip them with adequate digital literacy skills to adapt to global changes (Silaban et al., 2021). Digital literacy has become a fundamental 21st-century competency, encompassing the ability to access, understand, analyze, evaluate, and communicate information effectively and ethically through digital technologies (Silaban et al., 2024).

In the context of biology education, particularly in the *Plant Taxonomy* course, students' digital literacy skills play a crucial role (Pardede et al., 2024). Plant taxonomy is a branch of biology that studies the classification, identification, and naming of plants based on morphological, anatomical, and molecular characteristics (Sirait et al., 2025). To this day, taxonomy learning in higher education tends to remain conventional, relying heavily on direct observation of specimens and the use of manual determination keys (Pasaribu et al. 2024). While this method trains accuracy and observational skills, it does not sufficiently facilitate students in integrating information technology into their learning process (D. L. Pardede et al., 2025). As a result, students tend to only understand the descriptive aspects and lack the ability to process, interpret, and utilize the vast digital data sources available regarding plant biodiversity (Alexander, Siregar, et al., 2025).

The emergence of Artificial Intelligence (AI) offers tremendous opportunities to overcome these limitations (Pardede et al., 2024). AI can function as an intelligent learning assistant that helps students automatically recognize plant species through image recognition, machine learning, and natural language processing technologies (Sibarani et al., 2023). With the support of AI, students can digitally analyze plant morphology, access global taxonomy databases such as *The Plant List* or *GBIF* (Global Biodiversity Information Facility), and obtain scientific classification recommendations more quickly and accurately (Sirait et al., 2019). The use of such technology not only improves learning efficiency but also strengthens students' digital literacy skills, as they actively interact with data-driven and algorithmic systems (Sirait et al., 2023).

Although the potential of AI in education has been widely discussed, its implementation in biology learning—especially in *Plant Taxonomy*—remains relatively limited (Silaban et al., 2020). Based on preliminary observations, most students are still unfamiliar with using AI-based applications to support laboratory or field data collection activities (Simatupang et al., 2025). They remain dependent on conventional taxonomy manuals and determination keys (Sirait et al., 2024). Meanwhile, lecturers face challenges in designing pedagogically sound and effective learning models that integrate AI technology (Alexander et al., 2023). This situation reveals a research gap between the significant potential of AI application and the reality of learning practices that remain traditional and less innovative (Sirait et al., 2023).

Previous studies have demonstrated the effectiveness of digital technology in improving the quality of science education. For instance, (Alexander et al., 2024) found that the use of digital learning management systems can enhance student engagement and participation in biology learning. (Sholikhah et al., 2025) also noted that AI implementation in science education helps students grasp abstract concepts through interactive simulations and automated analysis. Similarly, (Febrianti et al., 2025) highlighted that AI-based image recognition systems can significantly accelerate plant species identification compared to manual methods (Sinurat et al., 2024). However, most of these studies have focused on improving learning outcomes or the effectiveness of digital media use

(Barus et al., 2024), without specifically exploring how AI contributes to enhancing students' digital literacy in classification-based courses such as *Plant Taxonomy* (Pane et al., 2025).
Furthermore, digital literacy in the context of science education extends beyond technical proficiency in using digital devices; it also includes cognitive, critical, and ethical dimensions. According to (Siahaan et al., 2023), digital literacy is the ability to understand and use information in various digital formats effectively. In modern biology education, this implies that students should not only be capable of using software for plant identification (Sirait et al., 2021) but also be able to assess data validity, manage scientific information from online sources, and critically and responsibly utilize AI-generated analyses (Sirait et al., 2023). Therefore, research on the application of AI in *Plant Taxonomy* learning should be directed toward strengthening these digital literacy aspects, rather than merely focusing on technological efficiency (Sirait., 2025).
Based on the aforementioned background, it can be identified that the main problem lies in the low level of AI integration in *Plant Taxonomy* learning and the limited digital literacy skills among biology students (Sirait et al., 2025). This condition highlights the need for innovation in instructional design that can leverage artificial intelligence as an adaptive and interactive learning medium (Silaen et al., 2025). Thus, this research aims to bridge the gap between theory and practice by exploring in depth the role of AI technology in improving students' digital literacy skills in the *Plant Taxonomy* course (Silaban et al., 2025).
The objectives of this study are to analyze the extent to which the implementation of artificial intelligence technology contributes to enhancing biology students' digital literacy skills and to identify the most effective forms of instructional interventions applicable in the context of *Plant Taxonomy* learning. This research is expected to provide theoretical contributions to the development of AI-based biology learning models and offer practical implications for lecturers (Harita et al., 2025) and higher education institutions in integrating intelligent technologies to support adaptive, innovative, and digitally oriented 21st-century learning (Silaban et al., 2024).

2. Methods

This research employs a quantitative approach using a survey method through the administration of questionnaires to students as respondents. The quantitative approach was chosen because this research aims to objectively measure the extent to which artificial intelligence (AI) technology influences the enhancement of students' digital literacy skills in the *Plant Taxonomy* course (Sirait et al., 2023). Through this approach, the researcher can obtain numerical data that can be statistically analyzed to explain the relationships among the studied variables. The survey method is considered the most appropriate because it allows for the collection of data from a larger number of respondents within a relatively short period of time and can provide a representative description of students' perceptions and levels of digital literacy skills (Sirait et al., 2025).

a. Type and Research Design

This study belongs to the category of descriptive quantitative research, as it focuses on describing ongoing phenomena without manipulating variables. The researcher does not provide any specific treatment but aims to describe how AI technology plays a role in the *Plant Taxonomy* learning process and how it relates to students' levels of digital literacy. This design enables the

researcher to obtain factual, systematic, and accurate information regarding students' perceptions, experiences, and attitudes toward the use of AI in learning.

b. Population and Sample

The population in this study consists of all students in the Biology Education study program who have taken or are currently enrolled in the *Plant Taxonomy* course during the current academic year. Sampling was carried out using the purposive sampling technique, in which respondents were selected based on specific considerations relevant to the research objectives, such as active involvement in AI-based learning activities or the use of digital platforms within the course. The sample size was determined by considering population representativeness and data adequacy principles for statistical analysis, ranging between 30–50 respondents, which represents the minimum requirement for descriptive quantitative research.

c. Data Collection Techniques

The primary data collection technique in this study was a closed-ended questionnaire, constructed using a five-point Likert scale, namely: (5) Strongly Agree, (4) Agree, (3) Neutral, (2) Disagree, and (1) Strongly Disagree. The questionnaire was distributed online using digital survey platforms such as Google Forms to ensure efficiency and accessibility for all respondents. Before large-scale distribution, the researcher conducted a pilot test with a small group of students to ensure the clarity of wording and the ease of response. The questionnaire instrument was divided into three main sections:

- **Respondent identity**, including (optional) name, gender, semester, and learning experience with AI technology.
- **Statements related to the use of AI technology** in *Plant Taxonomy* learning (e.g., the use of AI-based plant recognition applications, digital learning platforms, and automated assessment systems).
- **Statements regarding digital literacy skills**, covering aspects such as the ability to access information, analyze and evaluate digital sources, think critically about AI-generated results, and use technology ethically in the learning process.

d. Instrument Validity and Reliability

To ensure the appropriateness of the research instrument, tests of **validity** and **reliability** were conducted on the questionnaire. **Content validity** was assessed by three experts with backgrounds in biology education, educational technology, and digital literacy. These experts evaluated the relevance of each item to the research variables, the clarity of wording, and the content's alignment with the research objectives. The expert validation results showed that all questionnaire items had a calculated validity coefficient (r_{count}) greater than the critical value (r_{table}) = 0.30, indicating that the items were valid and appropriate for use. **Reliability testing** was carried out using **Cronbach's Alpha coefficient**. The calculation result showed an α value of **0.87**, which indicates a **very high reliability level** (≥ 0.80). Therefore, the questionnaire instrument can be considered reliable for consistently measuring the variables under investigation (Alexander et al., 2025).

e. Instrument Scoring Rubric

The instrument rubric was developed to interpret the questionnaire scores, with the measurement scale based on the average Likert score obtained from each respondent. The interpretation of the results is presented in the following table:

Table 1.

Students' Digital Literacy Category

Average Score	Category of Students' Digital Literacy
4.21 – 5.00	Very High
3.41 – 4.20	High
2.61 – 3.40	Moderate
1.81 – 2.60	Low
1.00 – 1.80	Very Low

This rubric was used to determine students' levels of digital literacy after overall analysis and to compare them with the level of AI technology utilization in learning (Sinaga et al., 2026).

f. Data Analysis Technique

The questionnaire data were analyzed using quantitative descriptive analysis techniques. The steps of data analysis included:

- Collecting and tabulating questionnaire data from all respondents.
- Calculating the total and average scores of each variable indicator (AI utilization and digital literacy).
- Interpreting the results based on the categories defined in the scoring rubric.
- Analyzing the relationship between variables using the Pearson Product-Moment correlation technique to determine the degree of correlation between the use of AI technology and students' digital literacy skills.

The results of the analysis were presented in the form of tables and charts to facilitate data interpretation (Susanti et al., 2025). Through this method, the study is expected to objectively describe the extent to which AI technology contributes to enhancing students' digital literacy skills in the *Plant Taxonomy* course, while also providing an empirical foundation for the development of AI-based learning models in the future (Pardede et al., 2026).

3. Result and Discussion

Result

The results of this research includes:

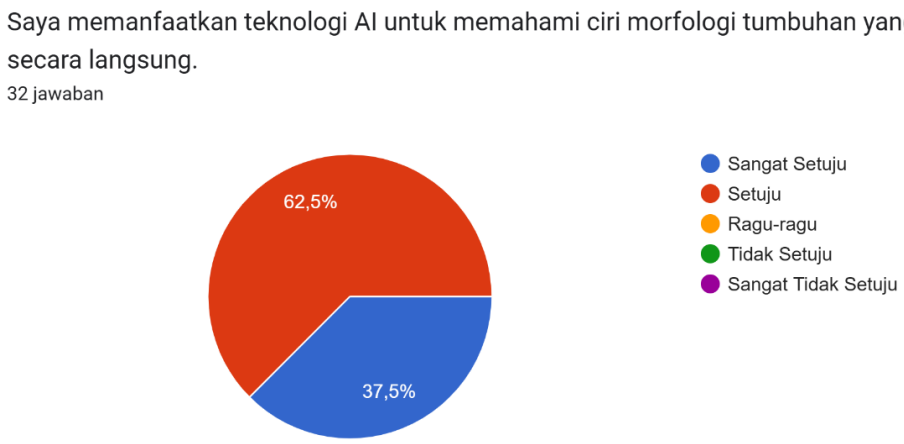
a. Question 1 : I often use AI-based applications to assist in plant identification during Taxonomy practical sessions.

Figure 1.
The results of Question 1

Out of a total of 32 respondents, all (100%) provided a positive response regarding the use of AI applications in Taxonomy practicals. Specifically, 75% (24 respondents) stated "Agree" and 25% (8 respondents) stated "Strongly Agree." There were no respondents who expressed hesitation or disagreement. This data indicates that AI technology has become a primary tool fully accepted by students to assist in plant identification.

b. Question 2 : I utilize AI technology to understand the morphological features of plants that are difficult to observe directly

Figure 2.
The results of Question 2



Based on data from 32 respondents, all students (100%) provided a positive response regarding the use of AI to understand plant morphology that is difficult to observe directly. Specifically, 62.5% (20 respondents) stated "Agree" and 37.5% (12 respondents) stated "Strongly Agree." There were no respondents in the "Undecided" or "Disagree" categories.

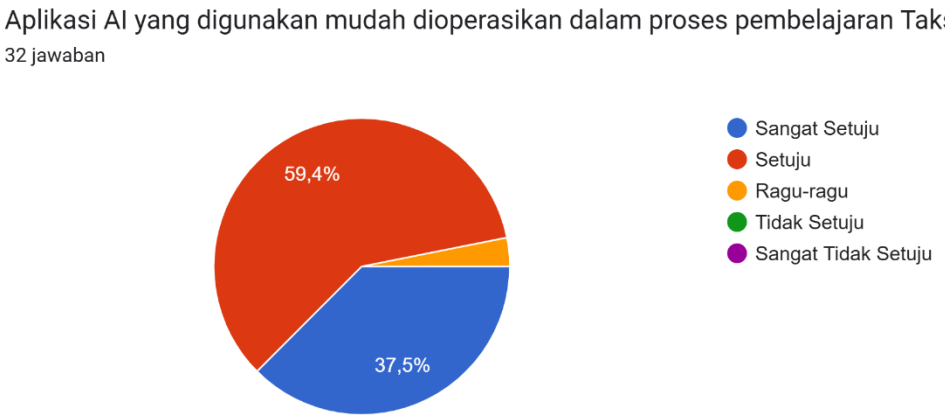
c. Question 3 : AI helps me find scientific references related to plant classification more quickly.

Figure 3.
The results of Question 3

Based on the data from 32 respondents, all students (100%) agree that AI helps them find scientific references related to plant classification more quickly. The breakdown of the data shows that 53.1% of respondents stated "Agree" and the remaining 46.9% stated "Strongly Agree". No respondents provided "Undecided" or "Disagree" answers.

d. Question 4 : The AI application used is easy to operate during the Taxonomy learning process.

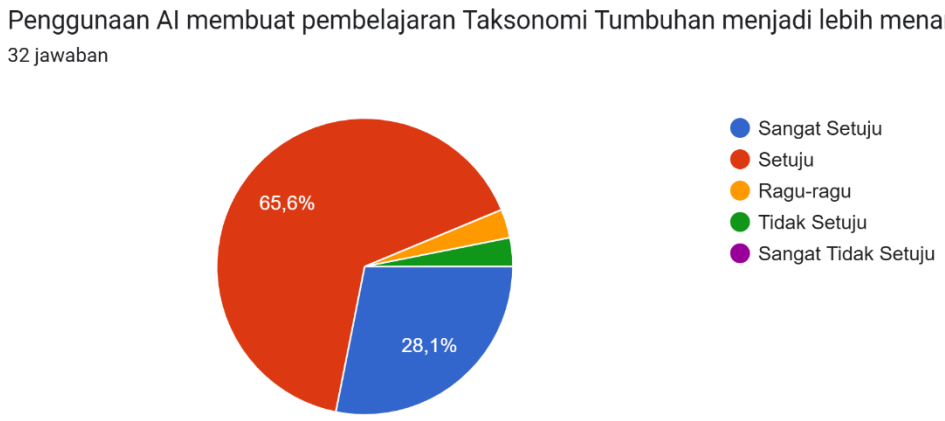
Figure 4.
The results of Question 4



Based on the survey results from 32 respondents, indicates a high level of satisfaction regarding the operational aspects of the technology used. The majority of respondents, at 59.4%, Agreed that the AI applications used were easy to operate within the Taxonomy learning process, while another 37.5% Strongly Agreed. There was a small portion of respondents, amounting to 3.1%, who responded as Undecided. No respondents expressed disagreement or strong disagreement.

e. Question 5 : The use of AI makes Plant Taxonomy learning more engaging and interactive.

Figure 5.
The results of Question 5



The utilization of artificial intelligence (AI) technology has brought significant transformations to the learning methods and practical sessions of Plant Taxonomy for students. Based on a survey of 32 respondents, all students (100%) confirmed that they frequently use AI-based applications to assist in plant identification, with 75% agreeing and 25% strongly agreeing. This high usage rate is closely related to AI's ability to visualize details that are difficult to reach manually; as many as 62.5% of respondents agreed and 37.5% strongly agreed that AI helps them understand morphological characteristics that are difficult to observe directly. Furthermore, AI features were considered effective in supporting the understanding of taxonomic relationships between species, as stated by 71.9% of respondents who agreed and 25% who strongly agreed.

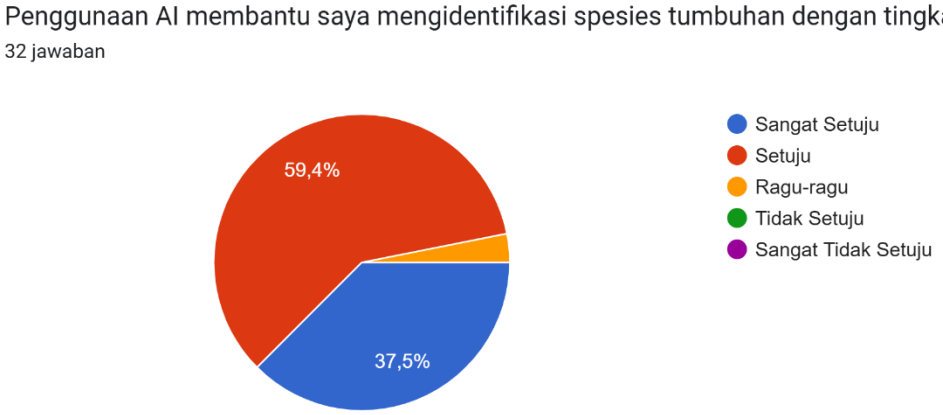
f. Question 6 : The use of AI accelerates my understanding of plant classification and nomenclature concepts.

Figure 6.
The results of Question 6

Based on data from 32 respondents, the majority of students experienced a positive impact of AI on the speed of understanding fundamental material. A total of 68.8% of respondents Agreed and 25% Strongly Agreed that the use of AI accelerates their understanding of plant classification and nomenclature concepts. A small portion of respondents provided Undecided (3.1%) and Disagree (3.1%) responses.

g. Question 7 : The use of AI helps me identify plant species with a high level of accuracy.

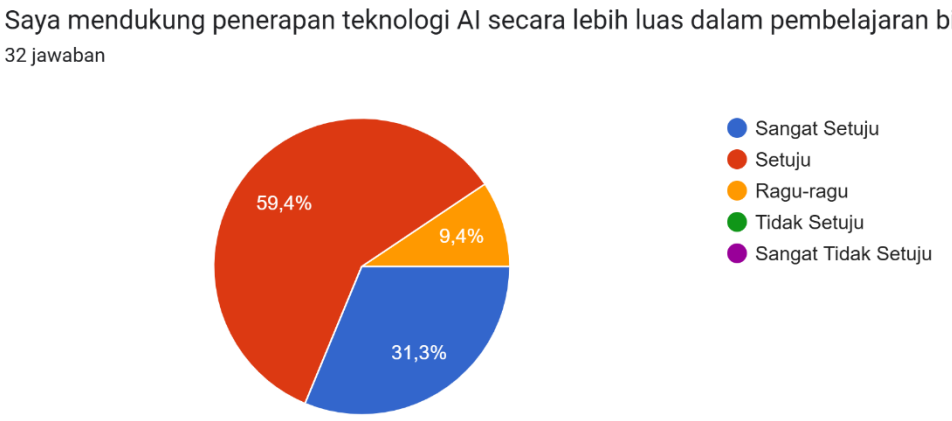
Figure 7.
The results of Question 7



Based on the survey results of 32 respondents, the majority of students acknowledge the reliability of AI technology in the species identification process. A total of 59.4% of respondents stated Agree and 37.5% stated Strongly Agree that the use of AI helps them identify plant species with a high level of accuracy. There was a small portion of respondents (3.1%) who responded as Undecided, yet not a single respondent expressed disagreement.

h. Question 8 : I support the broader implementation of AI technology in biology learning.

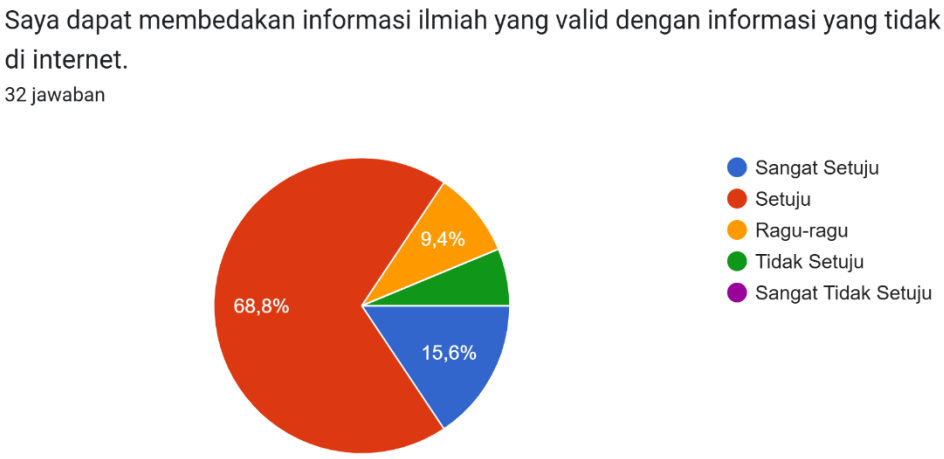
Figure 8.
The results of Question 8



Based on data from 32 respondents, there is very strong support from students regarding the expanded implementation of AI technology in the field of biology. A total of 59.4% of respondents stated Agree and 31.3% stated Strongly Agree in supporting the broader application of AI in biology learning. Although the majority gave a positive response, 9.4% of respondents remained Undecided, yet no respondents rejected or expressed disagreement.

i. Question 9 : I am able to distinguish valid scientific information from unreliable information on the internet.

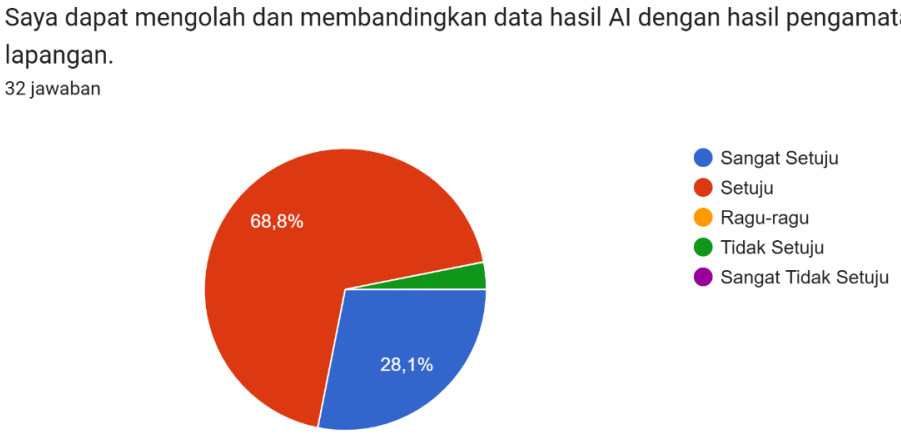
Figure 9.
The results of Question 9



Based on data from 32 respondents indicates a fairly high level of student confidence in selecting digital information. A total of 68.8% of respondents stated Agree and 15.6% stated Strongly Agree that they can distinguish between valid scientific information and unreliable information on the internet. However, 9.4% of respondents felt Undecided and 6.3% of respondents stated Disagree regarding their ability to validate such information.

j. Question 10 : I am able to process and compare data generated by AI with the results of manual field observations.

Figure 10.
The results of Question 10



Based on the data from 32 respondents, the majority of students feel capable of performing independent data verification. A total of 68.8% of respondents stated Agree and 28.1% stated Strongly Agree that they can process and compare AI-generated data with manual observation results in the field. Only a small portion of respondents (3.1%) expressed Disagree, and no respondents provided undecided or strongly disagree answers.

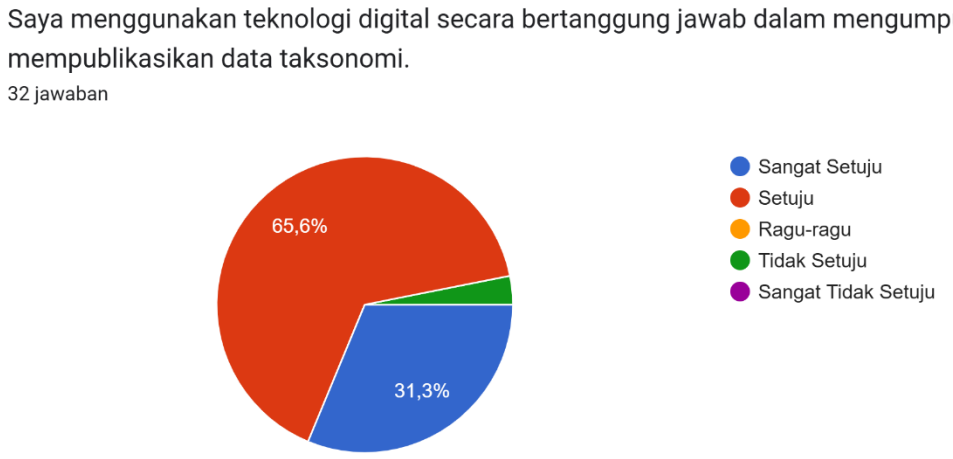
k. Question 11 : I often use AI-based applications to assist in plant identification during Taxonomy practical sessions.

Figure 11.
The results of Question 11

Based on data from 32 respondents, the majority of students stated that they understand the moral aspects of using digital technology. A total of 71.9% of respondents Agreed and 18.8% Strongly Agreed that they understand the ethics of using AI, including issues regarding copyright and digital data sources. Nevertheless, some respondents provided Undecided (6.3%) and Disagree (3.1%) responses regarding their understanding of these ethics.

l. Question 12 : I use digital technology responsibly in collecting and publishing taxonomic data.

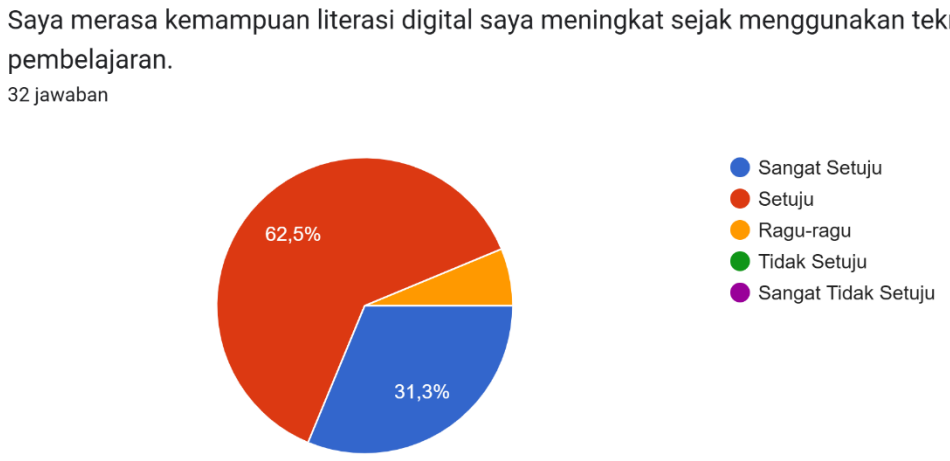
Figure 12.
The results of Question 12



Based on the survey results of 32 respondents, all students (100%) provided a positive response regarding their commitment to using technology ethically. The data shows that 65.6% of respondents stated Agree and 31.3% stated Strongly Agree that they use digital technology responsibly in collecting and publishing taxonomic data. There was a small portion of respondents (3.1%) who expressed Disagree, but no respondents provided undecided or strongly disagree answers.

m. Question 13 : I feel that my digital literacy skills have improved since using AI technology in learning.

Figure 13.
The results of Question 13



Based on data from 32 respondents, the majority of students experienced a positive impact on their digital skills. A total of 62.5% of respondents Agreed and 31.3% Strongly Agreed that their digital literacy skills have improved since using AI technology in their learning. A small portion of respondents, amounting to 6.3%, provided an Undecided response, while no respondents expressed disagreement.

Discussion

The findings of this study confirm that AI integration in Plant Taxonomy learning supports the development of students' digital literacy skills. The positive student responses align with previous research indicating that AI-based learning tools enhance access to information and promote interactive learning environments.

The improvement in students' critical evaluation skills suggests that AI does not merely function as a source of information but also encourages students to engage in reflective and analytical thinking (Sinurat et al., 2026). By comparing AI-generated outputs with traditional learning resources, students develop a deeper understanding of plant taxonomy concepts and strengthen their critical literacy skills (Hai et al., 2025).

Furthermore, the increase in ethical awareness highlights the importance of integrating digital ethics into AI-supported learning. This finding supports earlier studies emphasizing the role of

digital literacy education in fostering responsible and ethical technology use among students (Sitorus et al., 2025).

4. Conclusion

This study concludes that the integration of Artificial Intelligence in the Plant Taxonomy course plays a significant role in enhancing students' digital literacy skills. AI-based applications support interactive learning, facilitate access to scientific information, and promote critical evaluation and ethical awareness in digital technology use.

The findings suggest that educators are encouraged to integrate AI tools into biology learning to strengthen students' digital competencies. Future research may explore experimental designs or broader samples to further examine the impact of AI integration on learning outcomes and digital literacy development.

5. References

Alexander, I. J., Sinurat, H., Sirait, G., Siahaan, M. M., Silaban, R., & Nainggolan, J. R. (2024). Edukasi Literasi Bahasa dan Teknologi pada Anak Usia Dini di Yayasan Aku Melihat Engkau (AME) Medan. *JURNAL ComunitÃ Servizio : Jurnal Terkait Kegiatan Pengabdian Kepada Masyarakat, Terkhusus Bidang Teknologi, Kewirausahaan Dan Sosial Kemasyarakatan*, *6*(2).

Alexander, I. J., Silaban, B., Nababan, N. G., Sitompul, J. J., & Sinaga, D. (2025). Workshop on Healthy Food Production Using Simple Chemical Technology at GBI Bukit Zaitun Medan. *Sinesia : Journal of Community Service*, *2*(2), 106–117.

Alexander, I. J., Sirait, G., Sibarani, I. S., & Sitorus, L. (2023). Edukasi Literasi Digital Dalam Menangkal Penyebaran Hoax Di Masyarakat. *Pengembangan Penelitian Pengabdian Jurnal Indonesia*, *1*(4), 1–5.

Alexander, I. J., Siregar, S. S., Sitorus, G. M. N., & Zalogo, W. K. (2025). *Pengendalian Cyberbulllying Dan Hoax Melalui Pelatihan Terbimbing Di SMK Negeri 2 Tebing Tinggi*. *2*(1), 49–56.

Barus, M., Saragih, R. S., Sirait, G., Simbolon, F., Simanjuntak, S., Saragih, Y., Wardany, N., & Saragih, M. (2024). *Penguatan Literasi Digital Bagi Guru-Guru Di UPTD SD Negeri 122345 Kecamatan Siantar Timur*. *5*(4), 4207–4213.

Febrianti, Badriah, L., & Putra, R. R. (2025). Analisis Tingkat Literasi Digital Siswa pada Pembelajaran Biologi. *Biosintesa*, *2*(1), 1–6.

Genius, P., Strategy, L., Berpikir, K., Tinggi, T., Materi, P., & Manusia, P. (2019). *Jurnal Pelita Pendidikan PENGARUH GENIUS LEARNING STRATEGY TERHADAP*. *7*, 191–196.

Gloria Sirait. (2025). Analysis of the quality of biobriquettes from salak skin with starch adhesive. *EduMatSains: Jurnal Pendidikan, Matematika Dan Sains*, *9*(2), 232–243.

Hai, I., Ben, M., & Fes, A. (2025). Enhancing Student Engagement in online through Artificial Intel- ligence Enhancing Student Engagement in online through Artificial Intel- ligence. *International Journal of Accounting, Finance, Auditing, Management and Economics - IJAFAME*, *6*(3), 505–516.

Harita, T. H., Pardede, H., Marbun, J., Silaban, B., Josafat, I., Fisika, P., Keguruan, F., Ilmu, D., & Nommensen, U. H. (2025). *Identification Of Students ' Misconceptions And Information Sources Using The Five-Tier Diagnostic Test Model Fluid Dynamic Concept*. *10*(2), 541–550.

Hersakso, Sinurat; Justinos Ray, Nainggolan; Irving Josafat, A. (2024). Peran Gereja Terhadap Pencegahan Perilaku Kekerasan Dalam Rumah Tangga: Sudut Pandang Teologis. *Nuansa Akademik: Jurnal Pembangunan Masyarakat*, *9*(2), 535–544.

Pane, E. P., Purba, N. A., Saragih, V. R., Pasaribu, S., Simarmata, G., Barus, M., Sitohang, S., Sirait, G., & Novatrasio, G. (2025). *Sosialisasi Pendampingan Penyusunan Bahan Ajar Sekolah yang Inovatif bagi Guru SMAS Surya Pematangsiantar dalam Meningkatkan Mutu Pembelajaran*. *6*(3), 2281–2288.

Pardede, D. L., Pardede, L., Siahaan, M., Alexander, I. J., & Sirait, G. (2024). Implementasi Model Pembelajaran Berbasis Masalah Terhadap Hasil Belajar PKN Siswa Pada Materi Persamaan Kedudukan Warga Negara. *Jurnal Darma Agung*, *32*(6), 426–430.

Pardede, L., Pardede, D. L., Sinurat, H., Alexander, I. J., Silalahi, D. P., & Surbakti, M. (2024). Pemberdaya Kesetaraan Gender Dalam Organisasi Intra Sekolah Di SMA Negeri 1 Medan. *PKM Maju UDA*, *5*(3).

Pardede, D. L., Pardede, L., Alexander, I. J., Sirait, G., Soripada, T. A., & Sirait, S. (2025). Usaha Pencegahan Terjadinya Perundungan Terhadap Remaja di Media Sosial. *SAMBARA: Jurnal Pengabdian Kepada Masyarakat*, *3*(3), 529–536. https://doi.org/10.58540/sambarapkm.v3i3.970

Pardede, L., Pardede, D. L., Alexander, I. J., Sirait, G., Siahaan, M. M., & Silalahi, D. P. (2026). Edukasi Belajar Sambil Bermain Sebagai Penguatan Nilai Gotong Royong Dan Nilai Kebhinekaan. *SAMBARA: Jurnal Pengabdian Kepada Masyarakat*, *4*(1), 17–26. https://doi.org/10.58540/sambarapkm.v4i1.1155

Pasaribu, K., Pardede, L., Alexander, I.J., & Pardede, D. (2024). Pendekatan Pembelajaran Aktif Dengan Metode Card Sort Untuk Meningkatkan Prestasi Belajar Siswa. *Jurnal Darma Agung*, *32*(5).

Sam, P., Sitorus, P., Situmorang, E., Sirait, G., Ms, A. A., Sirait, G. D., Arista, K. J., & Pematangsiantar, H. N. (2025). Pelatihan Peningkatan Nilai Tambah Jagung Dari Pengolahan Hingga Pemasaran Digital Bagi Kelompok Tani Harapan Jaya Di Desa Balata Dua Parbalan. *Nusantara Hasana Journal*, *5*(7), 243–249.

Sholikhah, M., & Puspitawati Pratiwi, R. (2025). Tinjauan Literatur Augmented Reality pada Pembelajaran Biologi dalam Melatihkan Literasi Digital pada Artikel. *Berkala Ilmiah Pendidikan Biologi (BioEdu)*, *14*(1), 240–248. https://doi.org/10.26740/bioedu.v14n1.p240-248

Siahaan, R. D. R., & Sirait, G. (2023). The Importance of Digital Literacy in The Era of Society 5.0. *Indo-MathEdu Intellectuals Journal*, *4*(3), 1734–1742. https://doi.org/10.54373/imeij.v4i3.417

Sibarani, I. S., & Sirait, G. (2023). *Penerapan Metode Drill Untuk Meningkatkan Kristen Kalam Kudus Pematangsiantar*. *1*(3), 70–78.

Silaban, R., Panggabean, F. T., Panggabean, M. V., Sianturi, P. A., & Alexander, I. J. (2021). Android Based Learning Media Development For Chemical Balance Materials 121-131. *Jurnal Ilmu Pendidikan Indonesia*, *9*(3), 121–131.

Silaban, R., Panggabean, F. T. M., Hutahaean, E., Hutapea, F. M., & Alexander, I. J. (2021). Efektivitas model problem based learning bermediakan lembar kerja peserta didik terhadap hasil belajar kimia dan kemampuan berpikir kritis peserta didik SMA. *Jurnal Ilmu Pendidikan Indonesia*, *9*(1).

Silaban, R., Panggabean, F. T. M., Hutapea, F. M., Hutahaean, E., & Alexander, I. J. (2020). Implementasi problem based-learning (pbl) dan pendekatan ilmiah menggunakan media kartu untuk meningkatkan hasil belajar peserta didik tentang mengajar ikatan kimia. *Jurnal Ilmu Pendidikan Indonesia*, *8*(2).

Silaban, B., Surbakti, M. B., Josafat, I., & Silaban, A. (2024). *Lensa : Jurnal Kependidikan Fisika Identifikasi Miskonsepsi Peserta Didik SMA Melalui Tes Diagnostik Four-Tier pada Hukum Newton Identification of Senior High School Learner ' s Misconceptions Through A Four-Tier Diagnostic Test on Newton ' s Law PENDAHUL*. *12*(2), 260–274.

Silaban, R., br Girsang, O. A., Manalu, R. T., Sitorus, M., Tarigan, S., & Alexander, I. (2024). *Analysis of Teachers and Student Responses to Android-based Chemical Bonding Learning Media Using Smart Apps Creator Program*. https://doi.org/10.4108/eai.24-10-2023.2342270

Silaban, R., Sijabat, C. Y., & Nasution, H. A. (2025). *Development Of An E-Module Based On The Savi*. *10*(July), 76–87.

Silaen, S., Silaban, I., Sitepu, C., Pratiwi, C. G., Sitepu, C., & Grace, C. (2025). *Histological Analysis of Langerhans Islets and β -Cell Morphology in Diabetic Rats Treated with Bischofia javanica Nanoherbal*. *07*(02), 146–152.

Simatupang, I. M., Surbakti, M. B., Alexander, I. J., Fisika, P., & Hkbp, U. (2025). *JKIP : Jurnal Kajian Ilmu Pendidikan The Effect Of Phet Simulation-Based Problem-Based Learning (PBL) On Increasing Students ' Interest In Learning About Global Warming Pengaruh Model Problem Based Learning (PBL) Berbasis Phet Simulasi Untuk Meningkat*. *6*(3), 1362–1378.

Sinaga, G. H. D., Halawa, A., Prasetyo, R. A., Silaban, I. J. A., & Sinaga, M. P. (2024). Coulomb Stress Changes in the 2004 Aceh Earthquake on the Mount Sibualbuali and Mount Lubukraya. *Jurnal Pendidikan Fisika Dan Teknologi*, *10*(2), 264–273.

Sinaga, G. H. D., Alexander, I. J., Gohanda, F., Sormin, G., Sirait, S., & Sirait, G. (2026). Education on the Application of AI as a Strengthening of Digital Literacy in the Indonesian Pentecostal Church (GPI) Paya Kapar Congregation. *Jurnal Pengabdian Masyarakat Bangsa*, *3*(11), 6104–6111.

Sinurat, H., Nainggolan, J. R., Sinaga, R., Hulbert, J., Nommensen, U. H., Negeri, S. M. A., Sei, P., Hkbp, U., & Pematangsiantar, N. (2026). Implementasi Edukasi Interaktif untuk Meningkatkan Kesadaran dan Mencegah Bullying di SMA Negeri 1 Percut Sei Tuan. *Jurnal Pengabdian Masyarakat Bangsa*, *3*(11), 6455–6463.

Sirait, G., Alexander, I. J., Susanti, Soripada, T. A., & Sirait, S. (2024). Pelatihan Wirausaha Digital kepada Jemaat Gereja Pentakosta Indonesia Sidang Paya Kapar Tebingtinggi. *JURNAL ComunitÃ Servizio : Jurnal Terkait Kegiatan Pengabdian Kepada Masyarakat, Terkhusus*

Bidang Teknologi, Kewirausahaan Dan Sosial Kemasyarakatan, *6*(2).
Sirait, G., Tobing, P. U. A. L., & Djulia, E. (2021). Biology Teacher's understanding of Nature of Science (NOS). *Journal of Mathematics and Natural Sciences*, *1*(2).
Sirait, G., Alexander, I. J., & Mahulae, S. H. R. (2023). Sosialisasi Penanaman Nilai-Nilai Luhur Pancasila. *Pengembangan Penelitian Pengabdian Jurnal Indonesia (P3JI)*, *1*(3), 104–108.
Sirait, G., Alexander, I. J., & Silaban, R. (2023). *Analysis of the Utilization of Hydroponic Media in Welsh Onion (Allium fistulosum L .) Cultivation*. *6*(2), 147–157.
Sirait, G., Alexander, I. J., Uli, M., Purba, M., Lestari, K., & Miranda, X. S. (2025). *Sampah Plastik Di Perguruan Tinggi*. *10*(1), 309–324.
Susanti, Silalahi, D. P., Siahaan, M. M., Simanullang, Y., Pasaribu, A., Butarbutar, H. R., Alexander, I. J., Sirait, G., & Simamora, R. (2025). Pelatihan Penerapan Teknologi Pendidikan untuk Meningkatkan Kualitas Pembelajaran di SD Melbourne Medan. *JURNAL ComunitÃ Servizio : Jurnal Terkait Kegiatan Pengabdian Kepada Masyarakat, Terkhusus Bidang Teknologi, Kewirausahaan Dan Sosial KemasyarakatanServizio*, *07*(2), 289–298.