**Jurnal Pembelajaran Dan Biologi Nukleus** p-ISSN: 2442-9481
Vol 12 (1): 64 - 78, March 2026 e-ISSN: 2685-7332

# Digital Learning Media Needs Analysis of Plant Physiology to Improve Learning Ownership and Creative Thinking Skills at Universitas Negeri Malang

**Luffi Karimah, Balqis Balqis(*), Herawati Susilo**

Department of Biology, Mathematics and Natural Sciences Faculty, Universitas Negeri Malang, Semarang Street Number 5, Malang, East Java, Indonesia,

***Corresponding Author:** balqis.fmipa@um.ac.id

*Submitted December 28 Th 2025, and Accepted February 14 Th 2026*

## Abstract

**Background:** *The digital transformation of higher education demands instructional media that not only deliver content but also foster reflective engagement and self-directed learning, particularly in experimental biology learning characterized by complex and abstract concepts. Despite the growing implementation of digital tools, limited empirical research has systematically examined learning media needs as a foundational stage prior to development, especially in relation to learning ownership and creative thinking skills in the Plant Physiology courses.* **Methodology:** *The research methods employed a descriptive mixed-method design. Participants consisted of 42 undergraduate students selected through purposive sampling and four Plant Physiology lecturers. Data were collected through questionnaires, semi-structured interviews, and analysis of lesson plans (RPS and SAP). Quantitative data were analyzed using descriptive statistics and categorical percentage classification, while qualitative data were analyzed thematically and integrated through data triangulation.* **Findings:** *The findings indicate that instructional practices remain dominated by PowerPoint presentations (58.6%) and summative assessments such as written examinations (22.8%), with minimal implementation of reflective and process-oriented assessment. Students' learning ownership was categorized as proficient (78.4%), with persistence scoring highest (84.1%) and goal orientation and self-direction lowest (69.6%). Creative thinking skills were also categorized as proficient (76%), with collaboration highest (85.4%) and elaboration lowest (69.6%). These patterns reveal specific dimensions requiring instructional reinforcement, particularly in self-direction and idea elaboration. These findings highlight the need to develop interactive digital learning media grounded in Deep Learning and Problem-Based Learning (PBL), which can facilitate reflection, collaboration, and systematic documentation of the learning process. Media such as e-portfolios are considered relevant to strengthen learning ownership and enhance students' creative thinking skills in the Plant Physiology course.* **Contributions:** *This study contributes by providing an empirical, needs-based foundation for the systematic design of digital learning media in experimental biology learning, thereby informing future development and effectiveness research in higher education contexts.*

**Keywords:** *e-Portfolio; Learning Media; Need Analysis; Plant Physiology; Problem-Based Learning*



https://doi.org/10.36987/jpbn.v12i1.8854

## INTRODUCTION

The transformation of higher education in the digital era requires students to take an active role as self-directed learners who manage their learning processes in a reflective and sustainable manner (Jivet et al., 2023; Urbina et al., 2021). However, student engagement in learning remains relatively low, resulting in learning ownership that has not yet developed optimally (Babaee et al., 2021). Low levels of learning ownership often lead students to receive knowledge passively, without initiative in selecting learning strategies that align with their individual needs (Hoidn & Klemenčič, 2021). This condition can hinder the development of reflective, critical, and creative thinking skills that are essential for understanding complex scientific concepts (Natalie, 2023; Thornhill-Miller et al., 2023; Zeng & Ravindran, 2025). These challenges become more evident in experimental biology learning, where students must interpret dynamic biological processes and construct conceptual understanding from experimental evidence.

The limited variety of learning media is one of the factors contributing to low student engagement and a weak sense of responsibility for the learning process (Aulia et al., 2024). A lack of innovation in instructional media use further exacerbates this condition by limiting students' active involvement, thereby hindering the development of learning ownership (Korhonen et al., 2024; Bond et al., 2020). This limitation may restrict students' opportunities to elaborate and to apply their creative thinking skills (Avcı & Durak, 2023; Dilekçi & Karatay, 2023). These phenomena indicate that the type of instructional media used is a crucial factor in shaping students' levels of participation. PowerPoint presentations continue to dominate instructional practices, students demand more interactive learning experiences (Carless & Winstone, 2022). Students need innovative digital learning media that facilitate conceptual exploration, self-reflection, and collaboration within authentic contexts (Dang et al., 2024; López-Crespo et al., 2022). This need is particularly relevant in Plant Physiology courses, which require the visualization of complex biological processes to facilitate the understanding of abstract concepts through representations of real phenomena (Ayun et al., 2024; Wynn et al., 2017; Nisaa & Anugrah, 2024).

These challenges in the utilization of instructional media highlight the urgency of conducting a needs analysis prior to designing educational technology innovations. Media needs analysis is a critical stage for identifying gaps between current instructional practices and the ideal learning conditions expected (Wang et al., 2023). Therefore, there are needs assists educators in determining effective media design strategies that align with student characteristics (Dang et al., 2024). Consequently, the findings of a needs analysis provide an empirical basis for developing learning media that support conceptual understanding and foster higher-order thinking skills in science education contexts (Avcı & Durak, 2023).

The implementation of needs analysis findings becomes more effective when combined with learning approaches that emphasize deep cognitive engagement (Sukackė et al., 2022). Such strategies can optimize learning processes by actively involving students in concept exploration, reflective learning experiences, and the application of knowledge in contextual situations (Arsyad, 2024). Deep Learning and

Problem-Based Learning (PBL) are effective in increasing student engagement, as both approaches require investigation of specific problems and encourage students to construct meaning independently (Chueh & Kao, 2024; Tamami, 2025).

The application of Deep Learning and PBL approaches encourages students to think critically, explore information independently, and reflect on learning experiences within real-world contexts relevant to Plant Physiology topics. The integration of these approaches also contributes to strengthening learning ownership and developing creative thinking skills, as students are provided with opportunities to design problem-solving strategies and evaluate their own learning progress (Yang & McDonnell, 2024). Digital educational technologies, such as interactive simulations and learning analytics systems, support the implementation of Deep Learning and Problem-Based Learning (PBL) by facilitating reflection, collaboration, and systematic documentation of learning processes (López-Crespo et al., 2022, Mahardika et al., 2024).

Therefore, this study aims to analyze the needs for digital learning media in the Plant Physiology course in order to identify existing barriers, needs, and student preferences. The results analysis are expected to provide a conceptual foundation for the development of relevant digital learning media that enhance conceptual understanding, strengthen learning ownership, and improve students' creative thinking skills.

## METHOD

This study used a descriptive mixed-method design to analyze learning media needs in the Plant Physiology course as a basis for developing digital learning media that support deep learning. The design aimed to describe learning conditions, media use, and student characteristics related to learning ownership and creative thinking skills. Data were collected through questionnaires, interviews, and document analysis to ensure data triangulation.

### Sample

Participants of this study are undergraduate students who have completed the Plant Physiology course. Purposive sampling was applied to select participants with relevant learning experience. The sample consisted of 42 students and four lecturers. Students completed questionnaires, while lecturers participated in semi-structured interviews. Participation was voluntary.

### Instrument

The research instruments included structured questionnaires, semi-structured interview guidelines, and document analysis sheets. Learning ownership was measured using a 20-item questionnaire measured on a five-point Likert scale and adapted from Conley & French (2014), encompassing the indicators of motivation and engagement, goal orientation and self-direction, self-efficacy and self-confidence, metacognition and self-monitoring, and persistence.

Besides learning ownership, this research also analyzes creative thinking. Creative thinking skills which are assessed using a 16-item questionnaire measured on

a five-point Likert scale and adapted from Greenstein (2012). The questionnaire consists of indicators of curiosity, fluency, originality, elaboration, flexibility, divergent thinking, risk taking, and working with others.

Prior to data collection, the questionnaires were tested for validity and reliability using IBM SPSS Statistics. Item validity was analyzed using the Pearson Product–Moment correlation (Corrected Item–Total Correlation). An item was considered valid if the correlation coefficient exceeded the r-table value at a significance level of 0.05. The results indicated that all questionnaire items met the validity criteria. The correlation coefficients for the learning ownership instrument ranged from 0.421 to 0.781, while those for the creative thinking instrument ranged from 0.396 to 0.742, indicating that all items were valid and suitable for data collection. The summary of the instrument validity results is presented in Table 1.

**Table 1.** Summary of Instrument Validity Test

| Variable | Number of Items | Range of Pearson Correlation | Interpretation |
|---|---|---|---|
| Learning Ownership | 20 | 0.357 – 0.841 | All items valid |
| Creative Thinking Skills | 16 | 0.318 – 0.779 | All items valid |

Instrument reliability was assessed using Cronbach's Alpha coefficient. The learning ownership instrument produced a Cronbach's Alpha value of 0.903, indicating very high internal consistency. Meanwhile, the creative thinking skills instrument yielded a Cronbach's Alpha value of 0.817, which indicates high reliability. Since both values exceed the recommended threshold of 0.70, the instruments were considered reliable. The reliability test results are shown in Table 2.

**Table 2.** Reliability Test Results

| Instrument | Number of Items | Cronbach's Alpha | Reliability Category |
|---|---|---|---|
| Learning Ownership | 20 | 0.903 | Very High |
| Creative Thinking Skills | 16 | 0.817 | High |

Semi-structured interviews were conducted to explore lecturers' perspectives on instructional challenges and learning media use, while document analysis of lesson plans (RPS and SAP) was employed to examine the alignment between instructional planning and implementation.

**Data Collection Procedure**

Data were collected by distributing questionnaires to students who had completed the Plant Physiology course. In addition, semi-structured interviews were conducted with four Plant Physiology lecturers, and document analysis was carried out concurrently to support and contextualize the survey data.

**Data Analysis**

Quantitative data obtained from the questionnaires were analyzed using descriptive statistics with the assistance of IBM SPSS Statistics. The analysis was conducted through several steps: (1) calculating the total score for each indicator of learning ownership and creative thinking skills, (2) converting the scores into percentages to facilitate interpretation, and (3) summarizing the results using frequencies, means, standard deviations, and percentages to describe patterns of learning ownership, creative thinking skills, and the use of learning media in the Plant Physiology course. The percentage scores were calculated by dividing the obtained score by the maximum possible score and multiplying by 100%. The percentage scores were calculated using the formula 1 by Sulisetijono (2018),

$$Percentage = \frac{Obtained\ Score}{Maximum\ Score} \times 100\% \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Interpretation of the questionnaire results used categorical criteria. Learning ownership levels were classified into five categories adapted from Sulisetijono (2018), while creative thinking skills were categorized into four levels adapted from Greenstein (2012). The classification criteria are presented in Table 3 and 4.

**Table 3.** Category for Learning Ownership

| Category | Percentage (%) |
|---|---|
| Excellent | $X \geq 85.94$ |
| Proficient | $71.88 \leq X < 85.94$ |
| Moderate | $57.81 \leq X < 71.88$ |
| Low | $43.75 \leq X < 57.81$ |
| Very Low | $X < 43.75$ |

**Table 4.** Category for Creative Thinking Skills

| Category | Percentage (%) |
|---|---|
| Exemplary | $X \geq 81.25$ |
| Proficient | $62.50 \leq X < 81.25$ |
| Basic | $43.75 \leq X < 62.50$ |
| Novice | $X < 43.75$ |

Data related to the availability and use of instructional media were analyzed descriptively using frequency and percentage distributions. Low availability and limited variation of instructional media indicated a higher need for the development of additional learning media in the Plant Physiology course. Qualitative data obtained from semi-structured interviews were analyzed using thematic analysis involving several stages: (1) data reduction, (2) coding and categorization, and (3) theme identification to identify recurring patterns related to instructional challenges, assessment practices, and learning media utilization in the Plant Physiology course.

Integration of quantitative and qualitative data was conducted through triangulation by comparing the questionnaire results with interview findings and

document analysis of lesson plans (RPS and SAP). Consistent patterns across the three data sources were used to strengthen the interpretation of learning media needs in the Plant Physiology course.

## RESULT AND DISCUSSION

### Availability and Use of Learning Media

The results indicate that the availability of instructional materials in the Plant Physiology course, particularly on the topic of Plant–Water Relations, remains limited. Questionnaire data show that 47.6% of students reported rarely receiving instructional materials, while only 28.6% stated that they frequently obtained them. The most commonly used learning media were PowerPoint presentations (58.6%), followed by teaching modules (21.4%) and instructional videos (15.7%). Scientific articles were used by only a small proportion of students (4.3%), as illustrated in Figure 1.

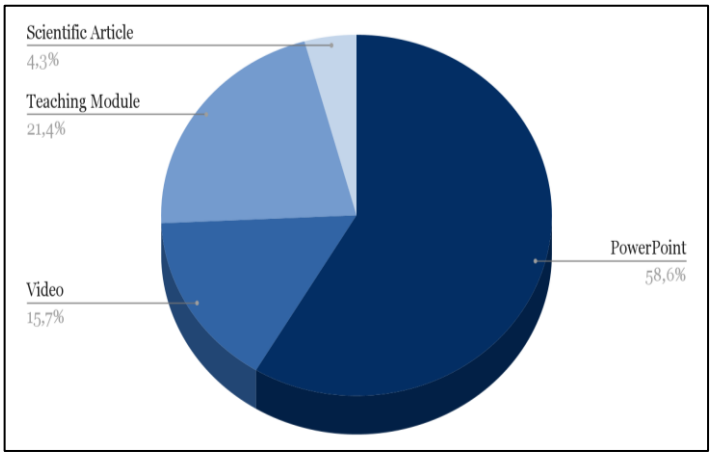


**Figure 1**. Percentage of Learning Media Use in the Plant Physiology Course

Figure 1 shows that learning activities are still predominantly dominated by the use of presentation-based instructional media that are primarily informative in nature. This type of media tends to emphasize one-way delivery of concepts from lecturers to students, thereby limiting students' active interaction and conceptual exploration (Bavishi, 2022). These limitations contribute to a low level of students' learning ownership, as students are less likely to feel responsible for and engaged in their own learning processes (Kozanitis & Nenciovici, 2023). Furthermore, the limited opportunities for reflection, collaboration, and application of concepts in real-world contexts restrict students' development of essential 21st-century thinking skills, such as creativity, problem-solving, and critical thinking (Sayadi & Pangandaman, 2025).

Interviews with four lecturers further reinforced these findings. The lecturers indicated that learning activities in the topic of Plant–Water Relations remain insufficiently structured to facilitate reflective and investigative learning processes. Although course documents such as the Semester Learning Plan (RPS) and Lesson Plan (SAP) are available, the instructional sequence does not explicitly guide students to document their thinking processes or to evaluate their understanding in a step-by-step manner. One lecturer noted that "*the learning activities remain linear, moving from*

*theory to assignments, without strategies that guide students to reflect on their understanding progressively*."

An analysis of the RPS and SAP documents reveals that although the learning objectives emphasize creative thinking skills and learner autonomy, the learning activities designed to achieve these competencies remain limited. This condition highlights the need for interactive and reflective digital learning media that enable students to document their learning processes, engage in self-reflection, and gradually strengthen their conceptual understanding. The use of technologies such as e-portfolios is considered particularly relevant, as they can integrate reflection, collaboration, and continuous learning awareness (Pospíšilová, 2023). Previous studies have demonstrated that the implementation of e-portfolio-based learning can enhance students' active engagement and promote critical thinking and self-evaluation, thereby making learning experiences more meaningful and in-depth (Rahmawati et al., 2023; Zainuddin, 2026).

**Assessment in Learning**

The results show that the most frequently used form of assessment in the Plant Physiology course was written examinations (22.8%), followed by individual assignments (21.7%) and group assignments (20.6%). Other assessment forms, such as presentations (15.6%), projects (15.0%), portfolios (2.2%), reflective journals (1.7%), and laboratory practicals (0.6%), were used to a lesser extent, as presented in Figure 2.

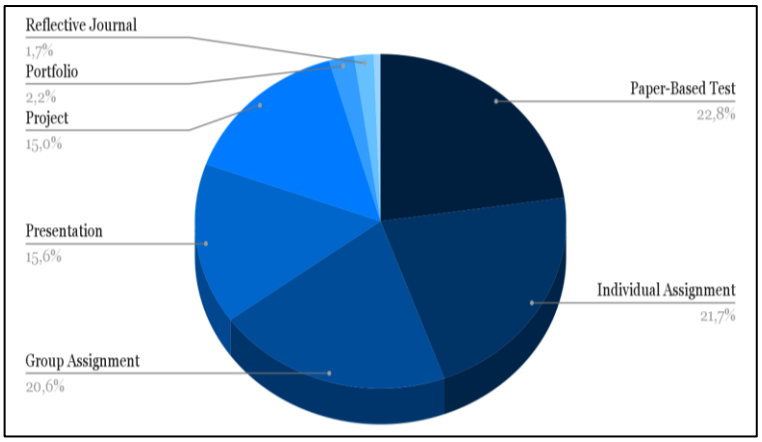


**Figure 2**. Proportion of Assessment Forms in the Plant Physiology Course

Figure 2 indicates that the assessment system remains focused on summative outcomes, such as paper-based tests and assignments, while process-oriented assessments, including portfolios and reflective journals, have not been implemented. As a result, assessment practices primarily emphasize students' cognitive achievement. Affective engagement and metacognitive awareness related to learning ownership receive limited attention because they are not explicitly assessed.

Lecturer interviews revealed that reflective assessment has not been widely implemented in the Plant Physiology course. This limitation is largely attributed to high administrative workloads and the absence of instructional media that can efficiently facilitate the documentation of students' learning processes. One lecturer

noted that "*assessment is still centered on final outcomes because there is no platform that supports continuous monitoring of student progress*." This finding underscores the need for digital assessment tools that can reduce lecturers' administrative burden while enabling ongoing and process-oriented evaluation.

Our findings suggest the need for a transformation of assessment systems toward process-oriented assessment. Particularly, the approach is to ensure that students focus not only on grades but also on self-understanding and learning strategies. The implementation of digital media based on e-portfolios show significant solution, as it allows students to document learning progress, reflect on experiences, and conduct self-assessment (Lam, 2022; Chang, 2022). Eventually, assessment can function formatively to foster learning ownership and enhance students' creative thinking skills (Yadav, 2014; Walland & Shaw, 2022).

**Media Needs to Improve Learning Ownership**

Questionnaire results indicate that students' learning ownership reached an average score of 78.4%, categorized as good. High scores on the indicators of Persistence (84.1%) and Motivation and Engagement (81.1%) reflect students' enthusiasm in completing challenging tasks and maintaining learning commitment despite difficulties (Howard et al., 2001). This condition suggests the presence of intrinsic motivation and a sense of responsibility toward the learning process, particularly through active participation in ongoing learning activities (Russell, 2022). Detailed results are presented in Table 5.

**Table 5.** Students' Learning Ownership Levels

| No | Indicator | Total Score | Maximum Score | SD | Percentage (%) | Category |
|---|---|---|---|---|---|---|
| 1 | Motivation and Engagement | 545 | 672 | 7.41 | 81.10 | Proficient |
| 2 | Goal Orientation and Self-Direction | 468 | 672 | 9.83 | 69.60 | Moderate |
| 3 | Self-Efficacy and Self-Confidence | 545 | 672 | 7.21 | 81.10 | Proficient |
| 4 | Metacognition and Self-Monitoring | 512 | 672 | 8.12 | 76.19 | Proficient |
| 5 | Persistence | 565 | 672 | 6.94 | 84.10 | Proficient |
| | **Mean** | **527.0** | **672** | **7.90** | **78.40** | **High** |

The indicator of Goal Orientation and Self-Direction (69.6%) was categorized as moderate. This indicates that some students were not yet fully capable of setting clear learning goals and independently directing their learning strategies. This finding highlights that students need media to plan, monitor, and reflect on their learning processes (Nicol, 2021). Specifically, the media provide opportunities for students to set learning targets, document learning activities, and conduct self-reflection on achieved outcomes (Babaee et al., 2021; Aflalo et al., 2024).

Lecturer interviews supported these findings by indicating that most learning activities remained lecturer-directed and that opportunities for students to plan, monitor, and evaluate their own learning were limited. Lecturers reported that students tended to wait for explicit instructions and were not accustomed to independently regulating their learning strategies. This dependency underscores the need for adaptive and reflective learning media that structurally facilitate self-monitoring and guide students in utilizing learning resources more effectively according to their learning needs (Ifenthaler et al., 2020; Jivet et al., 2020).

Analysis of the RPS and SAP documents further indicated that while learning outcomes emphasized autonomy and reflective learning, practical strategies to develop self-direction and metacognitive skills remained limited. A comparison between the intended learning outcomes and the learning activities implemented in the course is presented in Table 6.

**Table 6.** Comparison between Learning Outcomes and Learning Activities in the Plant Physiology Course

| No | Learning Outcomes | Learning Activities | Analysis | Implication |
|---|---|---|---|---|
| 1 | Students demonstrate learning autonomy | Group discussion and problem solving (PBL) | PBL has been implemented, but it has not yet systematically facilitated self-directed learning | Digital learning media are needed to support independent learning and learning management |
| 2 | Students conduct learning reflection | Presentation and discussion of results | Reflective activities are not explicitly facilitated | Learning media are needed to facilitate reflection and documentation of the learning process |
| 3 | Students analyze plant physiology problems | Case analysis and discussion | Supports conceptual understanding, but the development of metacognitive skills remains limited | Digital learning media are needed to support problem analysis and thinking skills development |

Students require digital learning media that support conceptual reflection, systematic documentation of learning steps, and structured progress monitoring (Ciesielkiewicz, 2019). The use of e-portfolios represents a relevant alternative, as they facilitate the integration of reflective thinking and self-regulation within problem-based learning contexts (Marinho, 2021).

**Media Needs to Enhance Students' Creative Thinking Skills**

The findings show that students' creative thinking skills were categorized as proficient, with an average score of 76%. This score indicates that students were generally able to generate ideas, solve problems, and engage in open-ended thinking processes. The indicator *With Others* achieved the highest score (85%), reflecting strong

collaborative abilities in teamwork and group contribution. Detailed results are presented in Table 7.

**Table 7.** Students' Creative Thinking Skills Levels

| No. | Indicator | Total Score | Maximum Score | SD | Percentage (%) | Category |
|---|---|---|---|---|---|---|
| 1 | Curiosity | 259 | 336 | 8.42 | 77.1 | *Proficient* |
| 2 | Fluency | 263 | 336 | 7.89 | 78.3 | *Proficient* |
| 3 | Originality | 240 | 336 | 8.97 | 71.4 | *Proficient* |
| 4 | Elaboration | 234 | 336 | 9.23 | 69.6 | *Proficient* |
| 5 | Flexibility | 267 | 336 | 7.54 | 79.5 | *Proficient* |
| 6 | Divergent | 251 | 336 | 8.10 | 74.7 | *Proficient* |
| 7 | Risk Taking | 251 | 336 | 8.10 | 74.7 | *Proficient* |
| 8 | With Others | 287 | 336 | 6.92 | 85.4 | *Exemplary* |
| | **Mean** | **256.5** | **336** | **8.15** | **76.0** | ***Proficient*** |

High collaborative ability suggests that students have gained experience in effective teamwork. These skills developed as problem-based learning activities encouraged social interaction, group discussion, and balanced responsibility sharing (Lee & Jung, 2025). Such activities allow students to exchange ideas and integrate diverse perspectives into shared solutions (Chang et al, 2022).

The lowest score was observed in the Elaboration indicator (69.6%). This result indicates that students experienced difficulties in expanding, detailing, and deepening their ideas or solutions. This limitation may result from learning activities that have not fully provided opportunities for ideas development or in-depth documentation of thinking processes. Also, task-oriented learning often emphasizes outcomes rather than gradual idea development (Jarutkamolpong, 2025).

Lecturer interviews further revealed that while students demonstrated strong collaboration skills, they were less guided in creatively exploring ideas and reflecting on their understanding of Plant–Water Relations concepts. Consequently, students' creative potential has not been optimally developed (Kim, 2019). Although the RPS and SAP emphasize problem-based learning models oriented toward collaboration, they provide limited space for systematic individual documentation and reflection activities (Chen, 2020). Structured reflection is essential to help students reassess thinking processes, identify strengths and weaknesses in ideas, and refine problem-solving strategies for the lecture (Carless & Winstone, 2022).

Therefore, students require learning media that facilitate idea expression, visualization of plant water physiology concepts, and documentation of both individual and group contributions. The media should be designed to support creative thinking through open and collaborative exploration (Henriksen, 2021). Learning environments supported by reflective and activity-based media can help students

demonstrate creativity authentically and internalize more meaningful and sustainable thinking processes (Yuan & Hu, 2024).

The findings reveal several gaps in the current learning process. Learning media in the Plant Physiology course remain limited and are mainly dominated by PowerPoint presentations, while reflective digital media are rarely used. Assessment practices also tend to focus on cognitive outcomes rather than process-oriented evaluation related to learning ownership. The results show that the lowest dimension of learning ownership is goal orientation and self-direction, while the lowest dimension of creative thinking skills is elaboration. These findings indicate the need for digital learning media that facilitate reflection, documentation of learning processes, and independent learning, such as an e-portfolio integrated with a deep learning approach and problem-based learning (PBL).

## CONCLUSION

This study concludes that the existing instructional structure in the Plant Physiology course has not yet sufficiently supported reflective learning activities and systematic documentation of students' learning processes, which are necessary to improve learning ownership and creative thinking skills. The needs analysis identifies a clear gap between the intended learning outcomes and current instructional practices, particularly in supporting self-directed learning and reflective engagement. Based on these findings, the development of digital learning media based on e-portfolios is necessary for future instruction in Plant Physiology. E-portfolio–based learning media are expected to improve students' ability to document their learning processes, reflect on conceptual understanding, collaborate with peers, and systematically monitor their learning progress. This study has several limitations, as it was conducted in a single course with a limited number of participants and focused primarily on needs analysis rather than testing the effectiveness of the developed media. Nevertheless, the findings contribute to strengthening the theoretical foundation of digital learning and provide opportunities for further research on the effectiveness of e-portfolios integrated with a deep learning approach and problem-based learning (PBL) in improving conceptual understanding, learning ownership, and creative thinking skills in higher education.

## ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to the Institute for Research and Community Service (LPPM), Universitas Negeri Malang, for the financial and facilitation support provided in the implementation of this research based on Decree No. 24.2.821/UN32.14.1/LT/2025.

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**How To Cite This Article, with *APA style* :**
Karimah, L., Balqis, B., & Susilo, H. (2026). Digital Learning Media Needs Analysis of Plant Physiology to Improve Learning Ownership and Creative Thinking Skills at Universitas Negeri Malang. *Jurnal Pembelajaran dan Biologi Nukleus*, *12*(1), 64-78. https://doi.org/10.36987/jpbn.v12i1.8854

**Conflict of interest :** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

**Author contributions :** All authors contributed to the study's conception and design. Material preparation, data collection and analysis were performed by all authors. The first draft of the manuscript was submited by [**Luffi Karimah**]. All authors contributed on previous version and revisions process of the manuscript. All authors read and approved the final manuscript.