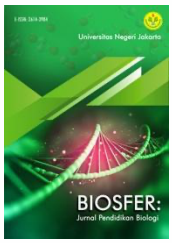
Biosfer: Jurnal Pendidikan Biologi

Journal homepage: http://journal.unj.ac.id/unj/index.php/biosfer



Implementation of an E-learning prototype for studying 21st-century learning models for prospective biology teachers

Eva Nurul Malahayati[1*], Ida Putriani[2], Marinda Sari Sofiyana[1]

[1] Biology Education, Faculty of Teacher Training and Education, Universitas Islam Balitar, Indonesia
[2] Primary Education, Faculty of Teacher Training and Education, Universitas Islam Balitar, Indonesia

*Corresponding author: malahayatieva488@gmail.com

ARTICLE INFO

Article history
Received: 18 October 2024
Revised: 18 December 2024
Accepted: 25 December 2024

Keywords:
DARP Approach
E-Learning Prototype
Learning Models

ABSTRACT

The need to master 21st century skills demand preservice teachers to have pedagogical competencies that are adaptive to change, especially in terms of implementing 21st century learning models and integrating technology into learning. One solution to meet the demands of preservice teachers is e-learning, a flexible, adaptive and interactive learning that allows users to access content anywhere, following structured stages. The success of e-learning depends on the effectiveness of implementing an approach such as DARP (Discuss, Archive, Reflect, and Prepare). This approach ensures that the e-learning platform is interactive, reflective and evaluative. The aim of this research is to examine the response of users of e-learning prototypes of 21st century learning models designed with a reflective and interactive approach. This initial prototype was developed to meet user needs and align with the intended goals, using a usability questionnaire for evaluation. The method used in this research is SDLC (System Development Life Cycle) which consists of five stages, namely planning, analysis, design, implementation and testing. This research involved 30 students and 2 lecturers, and the usability of the e-learning platform was assessed using the USE Questionnaire. The development of this prototype received positive feedback from both students and lecturers, this shows that DARP-based e-learning can be further developed as a learning platform to support improving the pedagogical competence of 21st century preservice teacher.

INTRODUCTION

The fast-paced development of technology brings new challenges to education. One of the main challenges today is preparing the younger generation for the demands of 21st-century skills, which go beyond basic knowledge. Students now need to develop critical thinking, creativity, collaboration, and communication skills. 21st-century education focuses on a more interactive and participatory approach, encouraging students to take an active role in their learning process.

21st-century skills are essential for prospective educators. Future teachers must be able to adapt to a globalized world. Teacher preparation programs should provide opportunities to learn, develop, and practice skills in creativity, critical thinking, communication, and collaboration. These skills are crucial for preparing students to meet the challenges of the modern world (Urbani, 2017). By enhancing these abilities, a generation that is intelligent, critical, and has strong integrity can be cultivated.

Biology students who are interns at school still need to improve their pedagogical skills in planning learning media, managing learning, and preparing assessment plans (Malahayati, 2020). Prospective biology teachers who are interns generally want to cover as much material as possible, this causes the chosen method to be more dominant in lectures, questions and answers, discussions, and no practical learning experience. This fact is in line with the results of research (Anggraeni, 2009), which explains that prospective biology teachers tend to emphasize factual and conceptual knowledge rather than scientific processes and problem-solving, which shows a lack of alignment with the nature of science in their lesson plans. In the context of 21st-century learning, teachers are required to not only teach biological concepts but also empower students with science process skills, such as observing, classifying, interpreting data, and designing and implementing experiments. (Irawati & Ma'rifah, 2022) stated that although students generally perform well in lesson planning, challenges remain in determining competency achievement indicators, choosing the right learning model, and designing assessment instruments.

To enhance 21st-century skills, one effective approach is integrating technology into various aspects of skill development. Blended learning, which combines traditional methods with e-learning, can promote more purposeful learning and strengthen the connection between theoretical knowledge and practical competencies for teachers (Kupetz, 2005). In 21st-century education, the focus goes beyond mastering content; it also includes developing soft skills that enable students to adapt to global needs and challenges.

To help prospective teachers develop 21st-century skills, it is essential to provide technology-based learning resources. One effective method is offering an interactive e-learning platform that enhances both hard and soft skills. E-learning platforms allow students to access lecture materials anytime and anywhere, giving them the flexibility to learn at their own pace (Rusman, 2012). In traditional classroom settings, limited face-to-face time can hinder students' full understanding of the material. With e-learning, students can review content, deepen their understanding, and explore independently. E-learning in higher education also brings changes in technology and pedagogy, fostering critical thinking and advanced learning through networked interactions(Garrison, 2007).

E-learning aimed at developing 21st-century skills must go beyond just appearance and design; it also needs to be interactive. Current e-learning platforms often fall short in supporting 21st-century learning because they still rely on one-way, less interactive methods of delivering material that do not cater to individual student needs. Therefore, an e-learning platform that provides measurable feedback is essential. Continuous professional development and reflective teaching practices are highly effective in enhancing 21st-century teaching skills, especially for prospective teachers. Tools that focus on teaching practices and processes can offer valuable feedback and support reflection (Kim et al., 2019). Learning activities that emphasize feedback enable prospective teachers to conduct self-evaluations and reflect on their teaching methods.

E-learning with a reflective approach promotes independence and long-term learning for both students and teachers. One effective model for designing such e-learning is the DARP approach, which stands for Discuss, Archive, Reflect, and Prepare. This approach emphasizes mentoring throughout the learning process, with reflection as the key component that benefits both mentors and mentees (Tisdell & Shekhawat, 2019). DARP also fosters interaction and learning between mentors and mentees during discussions (Nelly, Situmorang, et al., 2022). In the Discuss stage, students and teachers engage in conversations about the material, comparing their understanding. The Archive stage involves creating

or saving summaries and outcomes from these discussions, helping both parties track their progress. The Reflect stage allows participants to review and identify strengths and areas for improvement based on the previous stages. Finally, the Prepare stage focuses on planning and setting goals for future discussions, building on the insights gained from the Reflect stage.

The novelty of this study lies in the learning experience presented in E-Learning with the Discuss, Archive, Reflect, and Prepare model approach. In the Discuss stage, students explore, understand, and analyze learning materials in depth through class discussions, where students exchange ideas, ask critical questions, and provide feedback. Group discussion methods can improve students' ability to understand and analyze learning materials in depth (Isnaini, 2020). The material is presented in PDF presentations, videos, and case studies to encourage relevant discussions. Students need digital teaching materials based on case studies to promote independent thinking (Syafril & Rahmi, 2023), including the use of PDF presentations, videos, and case studies can encourage relevant discussions (Susilawati & Yasir, 2021). This stage aims to build collaborative understanding, train critical thinking skills, and broaden students' perspectives through constructive interactions. The archive stage focuses on documenting and storing learning outcomes as a form of learning track record that can be reaccessed. Activities at this stage involve students compiling and storing notes, summaries, mind maps, and so on to archive materials in an organized and easily accessible manner. This stage aims to ensure that students have structured reference sources that can be used for further learning or evaluation. A web-based archiving system can improve document management skills (Amrullah et al., 2020). Digital archives facilitate access to the latest information to support the learning process (Putra, 2021). In addition, the archiving process also trains information management skills and promotes continuous learning. In the reflection stage, students are encouraged to evaluate the extent to which learning objectives have been achieved and how the learning can be applied in real contexts. Students are asked to write a reflection sheet based on feedback provided by the lecturer to identify what has been learned, challenges faced, and strategies that can be improved.

Feedback from lecturers is very important in encouraging the reflection process and helping students learn from their experiences (Meidianawaty, 2019). The Reflection stage is designed to encourage students to evaluate their learning experiences critically and deeply. The Prepare stage is to confirm students' understanding of key concepts. Understanding concepts is an important aspect of student learning, especially for preservice teachers (Suhendar & Ekayanti, 2018a); (Susiloningsih, 2020). Good conceptual understanding allows students to connect various concepts and solve related problems(Adhani et al., 2020). Students are also given assignments to apply the material to real situations or case studies as a form of demonstration of understanding. To improve students' conceptual understanding by getting students used to finding, developing, and applying concepts through solving real problems (Suhendar & Ekayanti, 2018b). Conceptual understanding is influenced by the complexity of the material, academic ability, and learning process (Adhani et al., 2020). This stage aims to strengthen mastery of the material while measuring students' readiness to apply the knowledge they have acquired. The development of E-learning learning media with the Discuss, Archive, Reflect and Prepare model approach actively involves students in designing learning and its implementation in new situations

The development of prototypes using the DARP approach can enhance both the interaction within the learning process and the competence of prospective teachers. The DARP-based mentoring model has been shown to improve teachers' pedagogical skills, with positive outcomes experienced by both mentors and mentees (Nelly et al., 2022). For effective implementation of e-learning, several key factors must be considered: the underlying learning theory, learning principles, and the use of appropriate resources (Soler et al., 2017). The aim of this study is to create an e-learning prototype of 21st-century models designed with a reflective and interactive approach. This initial prototype was developed to meet user needs and align with the intended objectives, using a usability questionnaire for evaluation.

METHODS

Research Design

This study follows the System Development Life Cycle (SDLC) method, which consists of five key phases: planning, analysis, design, implementation, and testing (Hossain, 2023). The diagram illustrating the research method is shown in Figure 1.

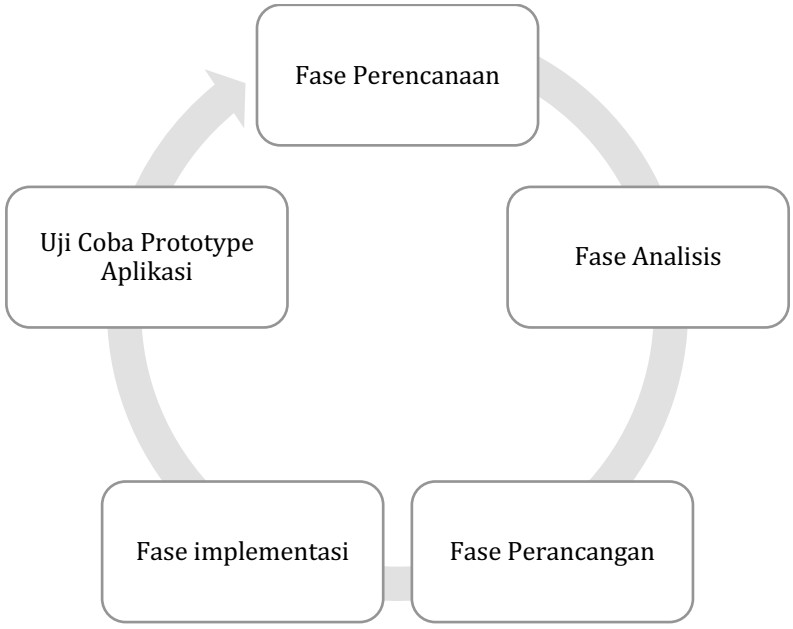


Figure 1. Diagram of Prototype Design

Population and Samples

The population in this study included lecturers and students from the Biology Education program. A purposive sampling technique was employed to select the participants. The criteria for inclusion were that the lecturers and students must be currently enrolled in the teaching and learning strategies course. This resulted in the selection of Class B of the Biology Education program at UIN Sayyid Rahmatullah, Tulungagung amount of 30 students dan 2 lecturers as the participants.

Instrument

The instrument used in this study was a questionnaire designed to gather responses from both students and lecturers regarding the e-learning prototype. The questionnaire aimed to collect data on the usability of the platform, which incorporates the DARP approach. The key indicators in the questionnaire included: (1) usefulness, (2) ease of use, and (3) ease of learning.

Table 1.
The USE-based questionnaire.

	Statements
Usefulness	
Q1.	Nextped helps me be more effective.
Q2	Nextped helps me be more productive.
Q3	Nextped is useful.
Q4	Nextped gives me more control over the activities in my life.
Q5	Nextped makes the things I want to accomplish easier to get done.
Q6	Nextped saves me time when I use it.
Q7	Nextped meets my needs.
Q8	Nextped does everything I would expect it to do.
Ease of Use	
Q1	Nextped is easy to use.
Q2	Nextped is simple to use.
Q3	Nextped is user-friendly.
Q4	Nextped requires the fewest steps possible to accomplish what I want to do with it.
Q5	Nextped is flexible.
Q6	Using Nextped is effortless.
Q7	I can use Nextped without written instructions.
Q8	I don't notice any inconsistencies as I use Nextped.

	Statements
Usefulness	
Q9	Both occasional and regular users would like Nextped.
Q10	I can recover from mistakes quickly and easily.
Q11	I can use it successfully every time.
Ease of Learning	
Q1	I learned to use Nextped quickly.
Q2	I easily remember how to use Nextped.
Q3	Nextped is easy to learn to use it.
Q4	I quickly became skillful with Nextped.

Procedure

Based on the SDLC (Software Development Life Cycle) method, the research procedures are as follows: Planning, In this phase, the concept for the application is planned, including determining the necessary software and hardware. Information is gathered from various sources related to e-learning. Users and developers collaborate to analysing the software requirements for the application. Analysis, In this phase, the creation and functionality of the application are analysing. Reference materials are studied to help in building a prototype, and the required devices for the application are also identified. Design, During this phase, the initial design of the e-learning prototype is developed. The designer creates an e-learning system for studying 21st-century learning models using the DARP approach. This design is then continued to the creation of system prototype that is adjusted to meet user needs. Key design elements include the navigation structure, UML (Unified Modelling Language), and interface design. Implementation, in this phase, is when the programming is done, and 3D designs are incorporated into the e-learning application. In the Prototype Testing Phase, the e-learning prototype is tested to evaluate its performance and identify any errors. The goal is to determine if the application functions correctly and is suitable for further use. This testing process uses the USE Questionnaire to gather feedback.

Data Analysis Techniques

The data from the questionnaire is processed and presented on a five-point rating scale. Each point on the scale represents a different level of agreement with the statements. The results from this analysis serve as the foundation for revising the e-learning development.

Table 2.
Likert Scale

No	Answer	Point
1	Strongly agree	5
2	Agree	4
3	Neutral	3
4	Disagree	2
5	Strongly Disagree	1

The percentage results obtained from the calculations above are then interpreted according to Sugiyono (2014) categories, which are shown in Table 3.

Table 3.
User satisfaction

No	Percentages	Categories
1	>80%	Ready, and can be continued
2	61%-80%	Ready, but needs little improvement
3	41%-60%	Not ready, needs little improvement
4	20%-40%	Not ready, needs lots of improvement
5	<20%	Not ready at all

RESULTS AND DISCUSSION

The research and development of e-learning for studying 21st-century learning models using the DARP approach yielded the meaningful result, that is, the creation of a prototype. The process of creating the prototype involved three key activities: analysis user needs, designing the prototype, and testing it. During the need analysis, it was found that users require tools that can help them both learn about 21st-century learning models and engage in direct reflection on those models. As a result, the e-learning model developed is specifically designed to meet these needs, incorporating the DARP approach.

During the design and development phase of the prototype using the DARP approach, the researchers conducted web design by creating a Data Flow Diagram (DFD) of the e-learning. The designed Data Flow Diagram (DFD) is used as a guide in identifying data flows and processes that occur in the system. This process includes analysis user needs, designing interactive interfaces, and developing key features that support 21st century learning models. With the DARP approach, the development of this design is focused on ensuring that E-learning applications are able to provide effective, collaborative, and innovative learning experiences according to user needs in the digital era. Figure 2 illustrates the DFD of the system.

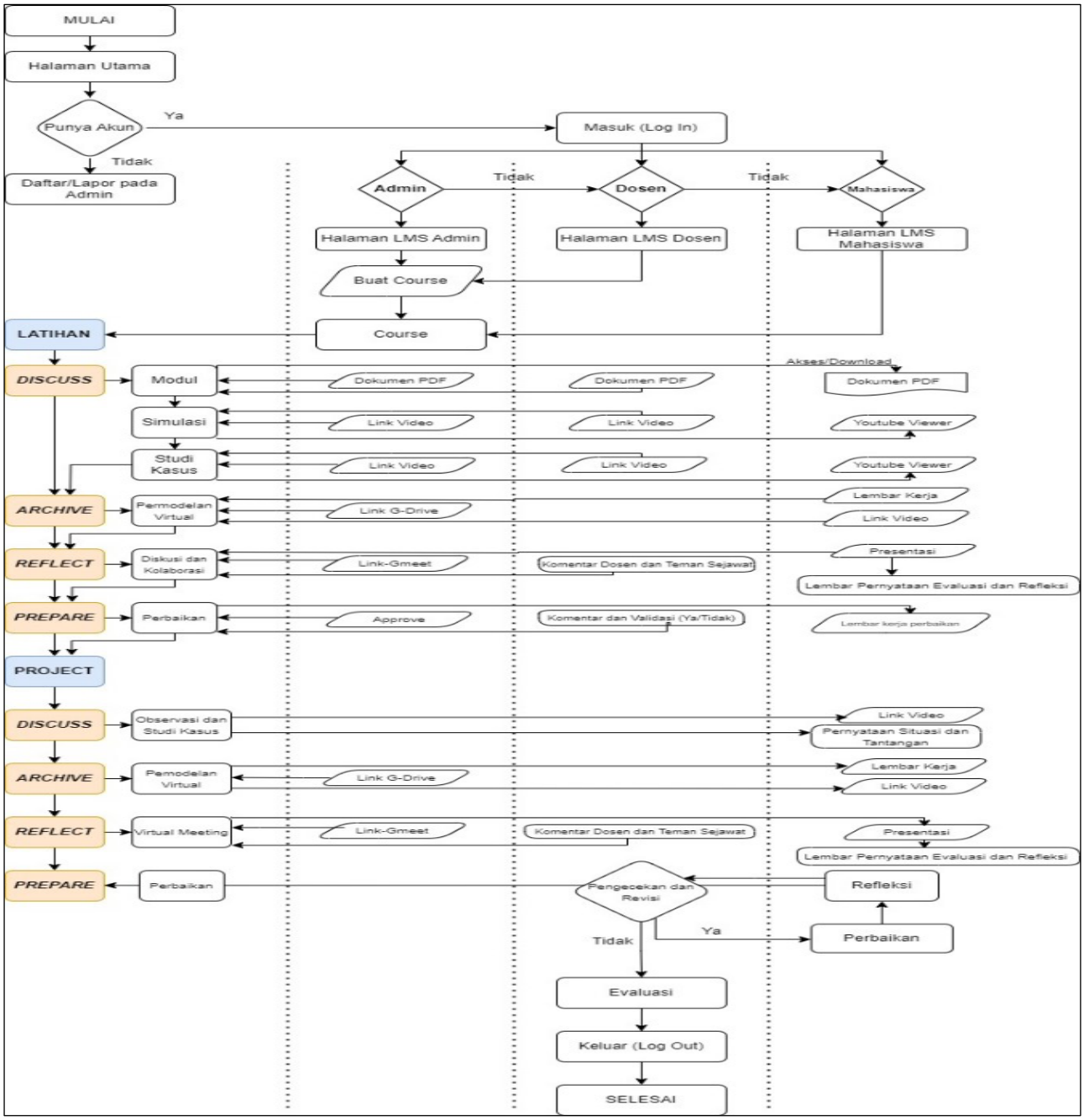


Figure 2. Data Flow Diagram.

The data flow diagram includes comprehensive information about the users of the e-learning platform, specifically admins, lecturers, and students. As a result, the prototype that would be developed has different interfaces tailored for each user type. Additionally, the diagram illustrates the implementation of the DRAP approach in the e-learning system being developed. Based on this data flow diagram, the initial design for the e-learning using the DRAP approach has been created. Below is the design for the e-learning module that incorporates the DRAP approach.

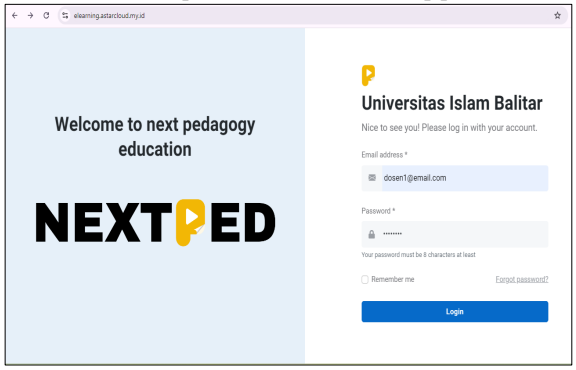


Figure 3. The Interface of Login Page for Students and Lecturers

Figure 3 shows the main page of the platform, which is the first screen users see when they access it. This main page is displayed for both students and lecturers. From here, users can log in to their accounts using the login menu. Both students and lecturers can log in with their registered emails and passwords.

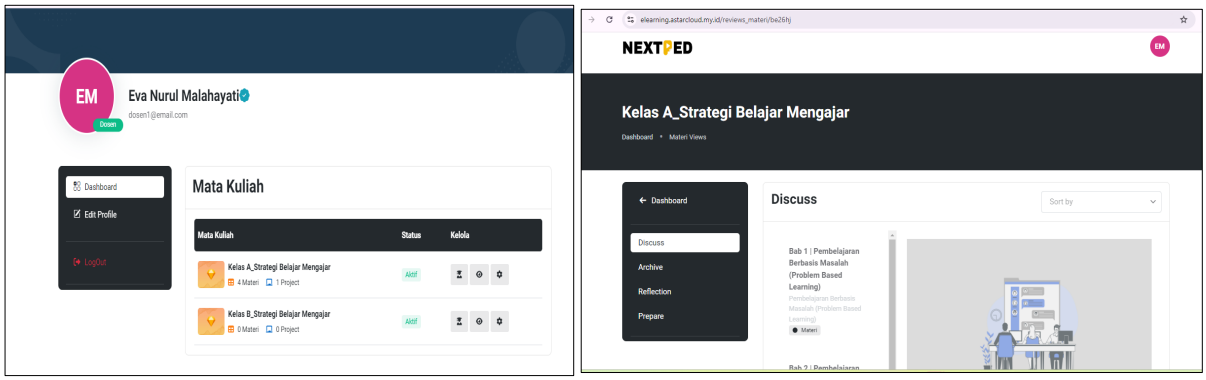


Figure 4. The Lecturer Dashboard

Figure 4 displays the lecturer dashboard page. On this page, lecturers can easily view and add classes as needed. It also provides tools for managing course materials. A detailed menu is available for adding materials and assignments following the DARP approach.

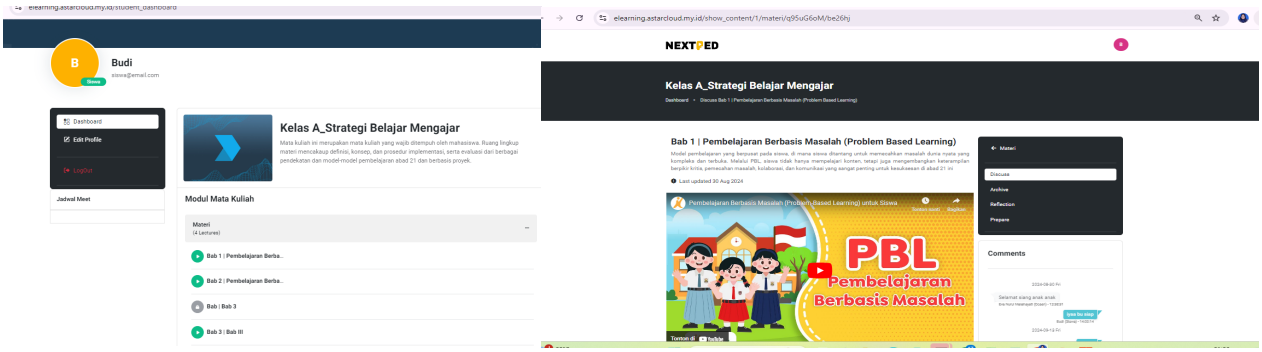


Figure 5. The Student Dashboard

Figure 5 shows the student dashboard page, where students can view all the materials that have been shared with them. The Discuss menu displays all the available materials for access. The Archive menu helps students complete their assignments, while the Reflect menu allows them to improve upon

their evaluated assignments. Lastly, the Prepare menu is designed for organizing materials and working on upcoming assignments.

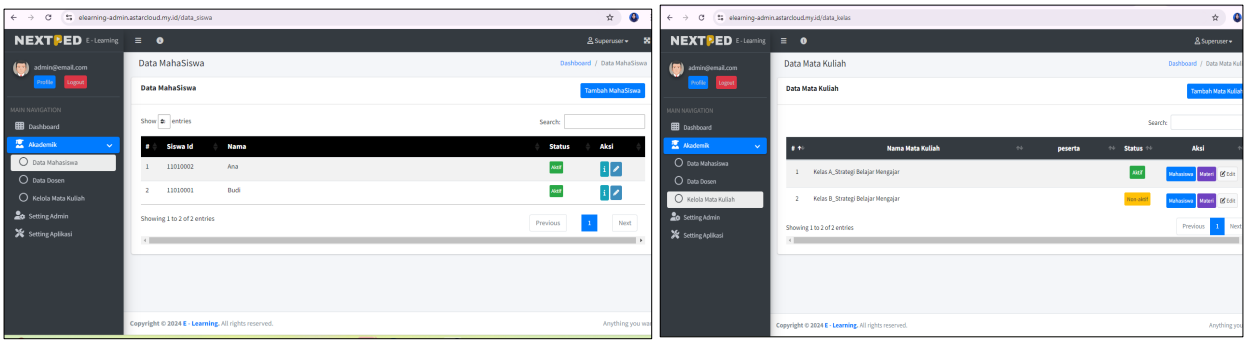


Figure 6. The Admin Dashboard

Figure 6 shows the e-learning admin dashboard. This dashboard includes several menus that help manage the e-learning system. The admin can add lecturers and students, allowing them to access the e-learning platform after registering their email.

The next stage of prototype testing involved administering a questionnaire to users of the e-learning. This stage included 32 respondents, comprising 30 students and 2 lecturers from UIN Sayyid Ali Rahmatullah, Tulungagung. The purpose of the questionnaire is to assess the usability and ease of use of the e-learning platform. The average results of the usability indicators for the developed e-learning system are presented Figure 7.

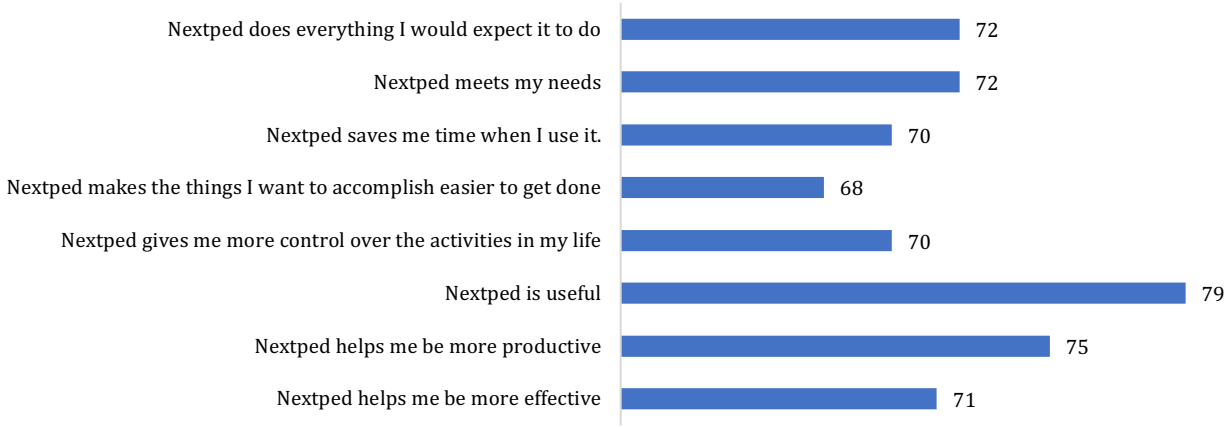


Figure 7. Percentage of Usefulness Indicators from Students

Based on Figure 7, in the context of usefulness aspect, 79% of the students rated e-learning as very useful. The e-learning system, developed as an initial prototype, significantly helped students understand the material using the DARP approach. This aligns with Suharyanto, (2016), who stated that e-learning has a positive and crucial impact on the quality of student learning. The more frequently e-learning is used, the easier it becomes for students to master the provided competencies. However, the lowest percentage (68%) in the usefulness aspect was found in the statement, "Nextped makes the things I want to accomplish easier to get done." This suggests that improvements are needed, particularly in providing clearer instructions for each step of the DARP approach within the e-learning platform. As noted by (Al-Fraihat, 2020), the success of e-learning depends on several factors, including the quality of the technical system, information, services, support, as well as the capabilities of both students and educators, and the perceived benefits of the system.

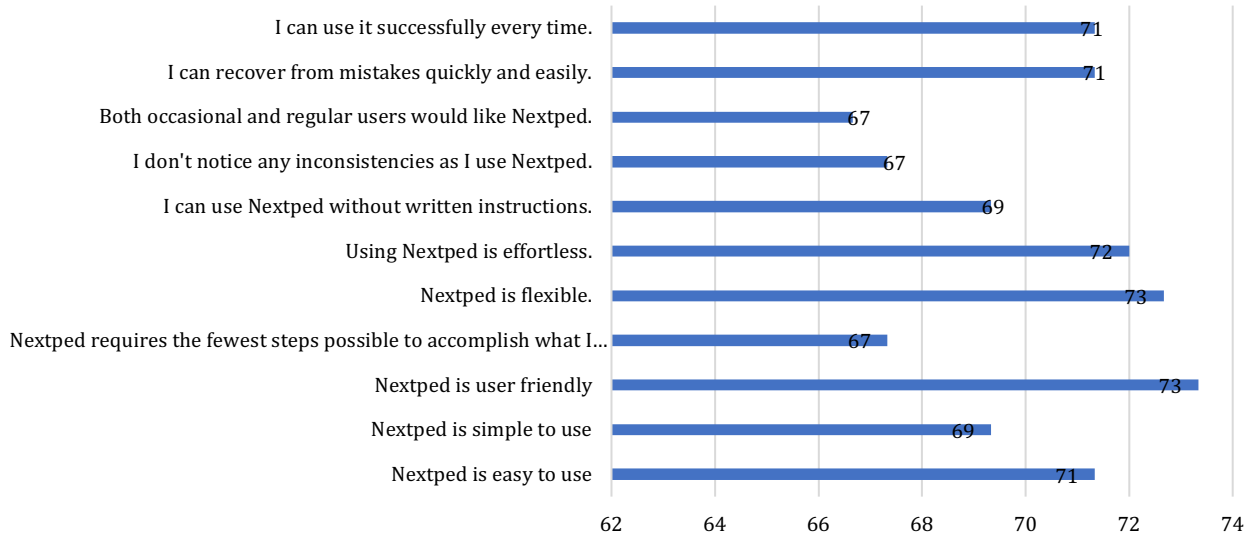


Figure 8. Percentage of Ease of Use Indicators from Students

Figure 8 shows that the highest percentage in the ease of use category (73%) comes from users finding the e-learning platform very user-friendly and flexible. This percentage suggests that the platform is ready for use, though some improvements are still needed in certain areas. The e-learning system is considered user-friendly because its menu and dashboard provide clear information, allowing users to navigate and operate it easily on their own.

The ease of use aspect that received a relatively low score (67%) is the complexity of the steps. This indicates that improvements are needed, particularly in the steps required for each DARP menu within the e-learning platform. A significant portion of students (67%) reported that the platform involves too many steps, making it difficult for new users to navigate and potentially leading to obstacles in usage. The primary area for improvement is the platform's interface and user experience, which should be more user-friendly. When developing e-learning media, several key factors should be taken into consideration. These include (1) identifying the knowledge and skills of both students and teachers; (2) ease of evaluation and assessment, (3) the level of interaction between lecturers and students; (4) learning strategies; (5) the complexity of the material; and (6) the dynamics of content changes. By focusing on these areas, the e-learning platform can better facilitate the delivery of content (Tafqihan, 2011).

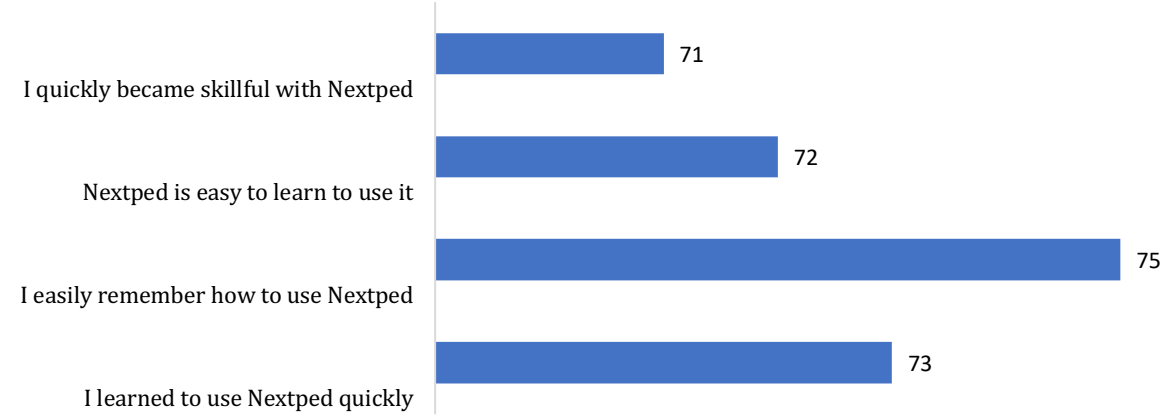


Figure 9. Percentage of Ease of Learning Indicators from Student

Based on Figure 9, the highest percentage in the ease of learning aspect was seen in the indicator of helping users remember the DARP stages in the e-learning, with 75% of students agreeing. In this area, users found it easy to navigate and operate the menus on the e-learning platform. All menu functions worked as intended, supporting the purpose of the prototype. The ease and usefulness of the

e-learning system positively impacted the users' intention to use it effectively and consistently (Moreno, 2017).

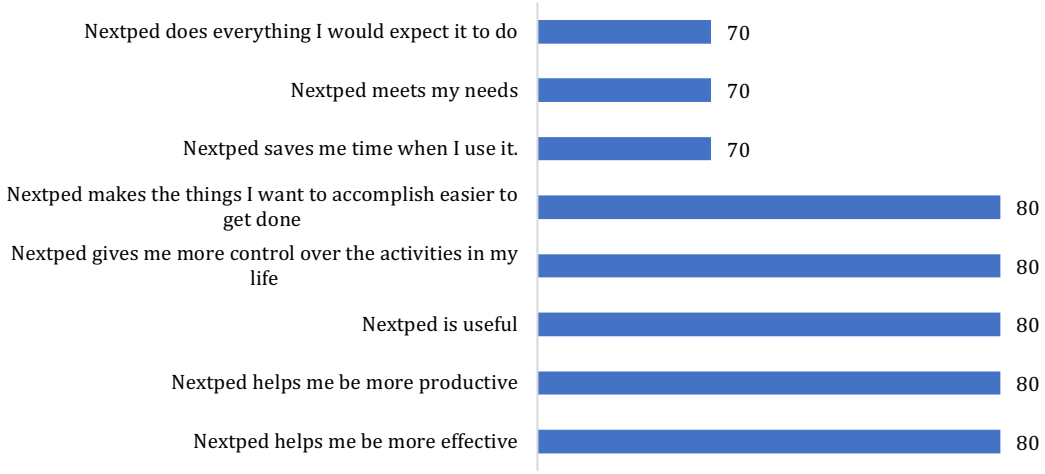


Figure 10. Percentage of Usefulness Indicators from Lecturers

Based on Figure 10, the result indicated that the highest percentage in the usefulness aspect came from the indicator of helping educators become more productive, effective, and facilitated, while meeting their goals of teaching 21st-century learning models. This is supported by an 80% feasibility rating. The e-learning prototype, using the DRAP approach, is considered practical for students, making it easier for them to reflect and practice effectively through the platform. (Almazroa & Alotaibi, 2023) also highlight that teaching and training in 21st-century skills are more effective when supported by suitable pedagogical tools, resources, and peer-based learning.

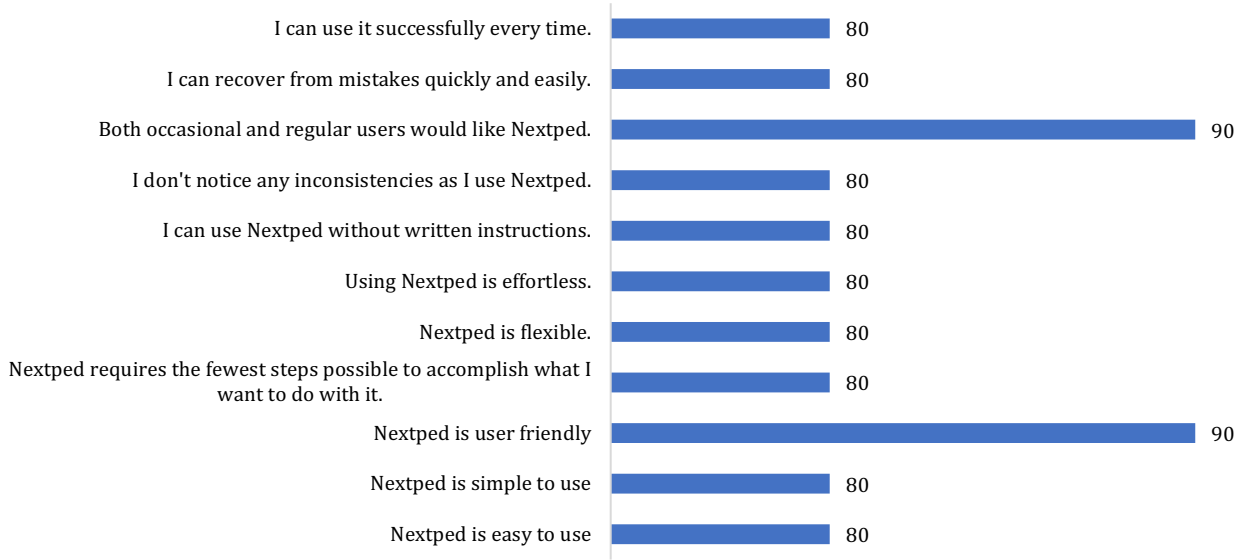


Figure 11. Percentage of Ease of Use Indicators from Lecturers

As Figure 11 displays, the highest percentage is in the ease of use aspect, according to the lecturers, is that the developed prototype is highly user-friendly, making it accessible to all types of users with ease. This is reflected by a percentage of 90%, indicating that the prototype is highly feasible for further development without the need for major improvements. For educators, the e-learning platform is easy to learn and use. It allows them to share materials, facilitate discussions, and conduct evaluations within a single platform. This aligns with the findings of (Setiaji & Dinata, 2020), who stated that the effectiveness of e-learning depends on users' ability to adapt, adopt, and accept new knowledge. Therefore, the introduction of this new platform, with its innovative features, represents a form of adaptation by educators in the learning process.

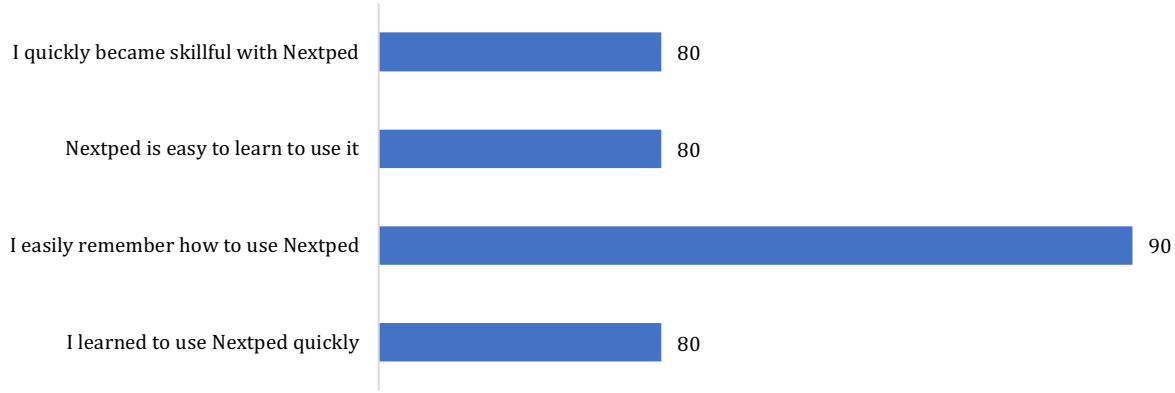


Figure 12. Percentage of Ease of Learning Indicators from Lecturers

Figure 12 shows that the highest percentage in the ease of learning aspect among lecturer respondents is related to the practicality of the platform in the learning process, particularly in terms of ease of access, remembering menu options, and getting familiar with the e-learning interface. A 90% rating for ease of use indicates that the platform is highly suitable for further development. These results suggest that web-based or e-learning technology provides valuable experience and convenience for prospective teachers, especially in understanding learning models. Previous studies have also shown that well-designed e-learning platforms are very effective, with 89.2% of students strongly agreeing (Setiadi & Bramastia, 2021). E-learning media is very valid, practical, and effective in improving student learning outcomes (Fransisca, 2017). E-learning platforms offer many advantages, including easy access to up-to-date information, flexibility in learning time and location, and opportunities for students to engage with experts in their fields of interest (Islahulben & Widayati, 2021). As (Shadiev & Wang, 2022) noted, effective teacher education programs should emphasize skill development through tasks, training, and peer learning.

This study aims to develop an E-learning prototype that integrates 21st-century learning models to support the learning process for prospective Biology teachers. This development focuses on improving 21st-century skills, namely creativity, collaboration, communication, and problem-solving (4C), which are facilitated through E-learning. E-learning is a web-based learning method that utilizes technology that can be accessed remotely so that learning is carried out not only in the classroom and at certain hours but can still be done anywhere and anytime (Nadhiroh, 2017). The results of the study indicate that the design of the E-learning prototype has been to the needs of users, namely lecturers and students of Biology Education. Based on the initial needs analysis, students need an Interactive and flexible learning platform access, facilitating online collaboration and discussion, integrating multimedia and simulations to deepen their understanding of the material. The resulting prototype meets these needs by providing features such as materials, discussion forums, assignments, learning videos, and virtual meetings. This platform makes it easier for them to deliver material systematically and supports project-based learning and group discussions. This is by the results of previous studies that there is a significant correlation between Usefulness and Ease of Use, where increasing usefulness affects the Ease of Use scale and vice versa. Meanwhile, both dimensions affect Satisfaction. For specific situations, items on Ease of Use can be separated into two dimensions, Ease of Use and Ease of Learning, where both are highly correlated (Lund, 2001). The prototype developed has important implications in supporting the readiness of prospective Biology teachers to adopt technology in learning. The use of this prototype not only helps students understand the material better but also trains technological skills that will be useful in future teaching practices. The use of E-learning properly will help the implementation of learning carried out in real learning activities and accordance with students' preferences and learning stylesn (Hariyanto et al., 2020).

CONCLUSION

The e-learning prototype of 21st-century learning models with the DARP approach is deemed suitable for further development and implementation. The factors that contribute to its suitability include usefulness, ease of use, and ease of learning. In terms of usefulness, the e-learning prototype is

user-friendly and accessible for its intended users. In the context of ease of use, e-learning facilitates easy access and interaction during activities. Furthermore, dealing with ease of learning, users find it simple to remember and learn from the materials presented in the e-learning platform. Additionally, there is a need for further evaluation to enhance the quality of the content and the clarity of instructions for each stage of the DARP approach. The results of these evaluations will inform future improvements to the e-learning platform. Overall, this study provides valuable insights for decision-making regarding the integration of interactive web-based technology in education, particularly for prospective teachers.

ACKNOWLEDGMENT

This research is funded by the Directorate of Research, Technology, and Community Service (DRTPM) of the Ministry of Education, Culture, Research, and Technology for the 2024 funding year number 0459/E5/PG.02.00/2024. The authors also express gratitude to Balitar Islamic University for their support throughout the research process.

REFERENCES

Adhani, A., Rupa D. (2020). Analisis Pemahaman Konsep Mahasiswa Pendidikan Biologi pada Matakuliah Fisiologi Tumbuhan. *Quantum: Jurnal Inovasi Pendidikan Sains*, *11*(1), 18-26. http://dx.doi.org/10.20527/quantum.v11i1.8035.

Al-Fraihat, D., J. M., M. R., & S. J. (2020). Evaluating E-Learning Systems Success: An empirical study. *Comput. Hum. Behav*, *102*, 67–86. https://doi.org/10.1016/J.CHB.2019.08.004.

Almazroa, H., & Alotaibi, W. (2023). Teaching 21st Century Skills: Understanding the Depth and Width of the Challenges to Shape Proactive Teacher Education Programmes. In *Sustainability (Switzerland)* (Vol. 15, Issue 9). MDPI. https://doi.org/10.3390/su15097365

Amrullah, A., Makhrus, M., Hadisaputra, S., Ilhamdi, M. L., & Sujana, I. M. (2020). Pelatihan Sistem Pengarsipan Data Berebasis WEB pada Tenaga Admin Fakultas Keguruan dan Ilmu Pendidikan Universitas Mataram. *Jurnal Pengabdian Masyarakat Sains Indonesia*, *2*(1). https://doi.org/10.29303/jpmsi.v2i1.9

Anggraeni, S. (2009). *Sudahkah calon guru biologi merencanakan pembelajaran biologi yang sesuai dengan hakekat sains?* 340–348.

Fransisca, M. (2017). *Journal homepage: jurnal.untirta.ac.id/index*. *2*(1), 17–22.

Garrison, D. R. & A. T. (2007). E- learning in the 21st century. *British journal of educational technology*, *38*(4), 755–775. https://sid.ir/paper/561965/en

Hariyanto, D., Triyono, M. B., & Köhler, T. (2020). Usability evaluation of personalized adaptive e-learning system using USE questionnaire. *Knowledge Management and E-Learning*, *12*(1), 85–105. https://doi.org/10.34105/j.kmel.2020.12.005

Hossain, M. I. (2023). Software Development Life Cycle (SDLC) Methodologies for Information Systems Project Management. *International Journal for Multidisciplinary Research*, *5*(5). https://doi.org/10.36948/ijfmr.2023.v05i05.6223

Irawati, H., & Ma'rifah, D. R. (2022). Potret Keterampilan Penyusunan RPP Kurikulm 2013 Calon Guru Biologi. *Jurnal Ilmiah Profesi Pendidikan, 7*(1), 47–52. https://doi.org/10.29303/jipp.v7i1.342

Islahulben, I., & Widayati, C. C. (2021). *Peran Multimedia Dalam Perkuliahan E-Learning: Kajian Penerapan Dalam Proses Pembelajaran Di Perguruan Tinggi*. *2*(4). https://doi.org/10.31933/jemsi.v2i4

Isnaini, H. S. ,Saddam. (2020). Pengembangan Inovasi Pembelajaran Pada Mata Kuliah Ilmu Alamiah Dasar Dengan Metode Diskusi Kelompok. *IJTIMAIYA: Journal of Social Science Teaching*, *4*(1), 18–26. http://dx.doi.org/10.21043/ji.v4i1.7205

Kim, S., Raza, M., & Seidman, E. (2019). Improving 21st-century teaching skills: The key to effective 21st-century learners. *Research in Comparative and International Education*, *14*(1), 99–117. https://doi.org/10.1177/1745499919829214

Kupetz, R. , & Z. B. (2005). Blended learning in a teacher training course: Integrated interactive e-learning and contact learning. . *ReCALL*, *17*(2), 179–196. https://doi.org/10.1017/S0958344005000327

Lund, A. (2001). Measuring Usability with the USE Questionnaire. *Usability Interface*, *8*(2), 3–6. https://www.researchgate.net/publication/230786746

Malahayati, E. N. (2020). Anaysis Of Pedagogic Abilities of Preservice Teachers. . *SEMNAS Bio-Edu 2020*,

22–36.
Meidianawaty, V. (2019). *Refleksi Diri dalam Pendidikan Kedokteran*. *2*.
Moreno, V. , C. F. , & A. I. (2017). Explaining university students' effective use of e-learning platforms. *Br. J. Educ. Technology*, *48*(4), 995–1009. https://doi.org/10.1111/bjet.12469.
Nadhiroh, F. (2017). Analisa Efektifitas Sistem Pembelajaran Berbasis E-Learning. *Journal of Computer Science and Visual Communication Design*, *2*(1), 1–14. https://journal.unusida.ac.id/index.php/jik/article/view/28/19
Nelly, Situmorang, R., & Iriani, T. (2022). E-mentoring: Alternatif Peningkatkan Kompetensi Pedagogik Guru. *KONSTELASI: Konvergensi Teknologi Dan Sistem Informasi*, *2*(1), 217–228. https://doi.org/10.24002/konstelasi.v2i1.5619
Nelly, Situmorang, R., & Iriani, T. (2022). Pengembangan Media Berbasis Web pada Program E-Mentoring Kompetensi Pedagogik Guru. *Jurnal Basicedu*, *6*(6), 10152–10163. https://doi.org/10.31004/basicedu.v6i6.3996
Putra, I. W. M. , & M. N. P. E. (2021, May). *Peran Arsip Digital Dalam Mendukung Proses Pembelajaran*. https://prosiding.iahntp.ac.id
Rusman. (2012). *Belajar dan Pembelajaran Berbasis Komputer Mengembangkan Profesionalisme Abad 21.* . Alfabeta.
Setiadi, G., & Bramastia, B. (2021). Persepsi Mahasiswa Pascasarjana terhadap Pembelajaran Daring pada Masa Pandemi Covid-19. *EDUKATIF : Jurnal Ilmu Pendidikan*, *4*(1), 715–722. https://doi.org/10.31004/edukatif.v4i1.1676
Setiaji, B., & Dinata, P. A. C. (2020). Analisis kesiapan mahasiswa jurusan pendidikan fisika menggunakan e-learning dalam situasi pandemi Covid-19. *Jurnal Inovasi Pendidikan IPA*, *6*(1). https://doi.org/10.21831/jipi.v6i1.31562
Shadiev, R., & Wang, X. (2022). A Review of Research on Technology-Supported Language Learning and 21st Century Skills. In *Frontiers in Psychology* (Vol. 13). Frontiers Media S.A. https://doi.org/10.3389/fpsyg.2022.897689
Soler, R., Soler, J. R., & Araya, I. (2017). Diagnosis of Educational Needs for the Implementation of Blended Courses Based on the Blended Learning Model. The Case of the Social Sciences Faculty of the National University of Costa Rica. *Procedia - Social and Behavioral Sciences*, *237*, 1316–1322. https://doi.org/10.1016/j.sbspro.2017.02.216
Sugiyono. (2014). *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D.* Alfabeta.
Suharyanto, & M. A. B. (2016). Penerapan E Learning Sebagai Alat Bantu Mengajar dalam Dunia Pendidikan. *Jurnal Ilmiah Widya. 3 (4), 17-21*, *3*(4), 17–21.
Suhendar, U., & Ekayanti, A. (2018b). Problem based learning sebagai upaya peningkatan pemahaman konsep matematis mahasiswa. *JDPP: Jurnal Dimensi Pendidikan Dan Pembelajaran*, *6*(1). https://doi.org/10.24269/dpp.v6i1.815
Susilawati, & Yasir, M. (2021). Transformasi Media Pembelajaran Di Masa Pandemi Covid-19. *Literasi: Jurnal Pengabdian Pada Masyarakat*, *1*(2), 263–272. https://doi.org/10.58466/literasi.v1i2.1283
Susiloningsih, Wahyu. (2020). Analisis Pemahaman Konseptual Mahasiswa PGSD pada Mata Kuliah Perencanaan dengan pendekatan Saintifik. *Jurnal BASICEDU*, *4*(1), 1. https://doi.org/10.31004/basicedu.v4i1.270
Syafril, S., & Rahmi, U. (2023). Kebutuhan Bahan Ajar Digital Berbasis Studi Kasus di Perguruan Tinggi; Upaya Implementasi Merdeka Belajar. *Pedagogi: Jurnal Ilmu Pendidikan*, *23*(1), 93–98. https://doi.org/10.24036/pedagogi.v23i1.1553
Tafqihan, Z. (2011). Karakteristik dan pemilihan media pembelajaran dalam E-learning. *Jurnal Kependidikan Dan Kemasyarakatan*, *9*(2), 142. https://doi.org/10.21154/cendekia.v9i2.871
Tisdell, C. C., & Shekhawat, G. (2019). An Applied e-Mentoring Model For Academic Development, Reflection And Growth. *International Journal for the Scholarship of Teaching and Learning*, *13*(2). https://doi.org/10.20429/ijsotl.2019.130206
Urbani, J. , R. S. , M. R. , & T. E. (2017). Developing and Modeling 21st-Century Skills with Preservice Teachers. *Teacher Education Quarterly*, *44*(4), 27–50. https://www.jstor.org/stable/90014088