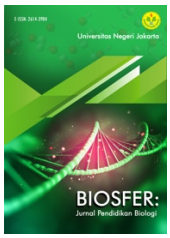
Biosfer: Jurnal Pendidikan Biologi

Beranda jurnal: http://journal.unj.ac.id/unj/index.php/biosfer



The development of elema 2.0 for the invertebrate zoology course on the phylum arthropoda topic

Chaidir Adam, Agus Haryono*, Elga Araina, Shanty Savitri

Biology Education Program, Faculty of Teacher Training and Education, University of Palangka Raya, Palangka Raya, Indonesia

*Corresponding author: agus.haryono@fkip.upr.ac.id

ARTICLE INFO

Article history
Received: 21 January 2024
Revised: 05 October 2024
Accepted: 11 October 2024

Keywords:
Biology Education
Digital Learning
eLEMA
Learning Materials

ABSTRACT

Currently, technology has become an inseparable part of education and learning. Various digital learning tools have been developed and widely used in the classroom. eLEMA (electronic learning materials) was developed as a mobile application that supports learning in the Invertebrate Zoology courses at the Biology Education Program, University of Palangka Raya. At that time, eLEMA was developed to meet the need for electronic learning materials for online learning during the COVID-19 pandemic. Along with the rapid development of technology in recent years, eLEMA needs to be developed further for updates. This research aims to develop eLEMA 2.0 for the Invertebrate Zoology course. This study is a research and development (R & D) using Hannafin & Peck development model to develop eLEMA 2.0 for the Invertebrate Zoology course on the Phylum Arthropoda topic. The development product is the eLEMA 2.0 application for lectures on the Phylum Arthropoda topic in the Invertebrate Zoology course with improvements to the user interface and additional features that support participatory learning and student-centered learning. The results of trials and validation show that all pages and content in this application were successfully opened without any disturbing errors. These results indicate that the development product is feasible to be implemented in the classroom.

INTRODUCTION

Science and technology are an integrated part of modern life and have developed rapidly, and have almost reached all aspects of human life, including education. Currently, technology has become an inseparable part of education and learning (Bulman & Fairlie, 2016; Büyükbaykal, 2015; Haleem et al., 2022; Hamidi et al., 2011; Keengwe & Bhargava, 2014; Rogers, 2000). Most educational institutions worldwide, especially in developed countries, use digital systems in their management, including learning management systems (LMS). LMS can facilitate and support the academic activities of teachers and students, especially in the learning process (Balkaya & Akkucuk, 2021; Bradley, 2021; Furqon et al., 2023; Gunawan et al., 2024; Jamal & Shanaah, 2011). Through LMS, teachers can monitor student progress with learning history and record study results stored in the system. Technology has transformed traditional education with its sophistication and convenience into futuristic education (Djafri et al., 2024; McCarthy et al., 2023; Mondragon-Estrada et al., 2023; Muir-Herzig, 2004). Technology has changed traditional education (Pendy, 2023; Yarychev & Mentsiev, 2020) with its sophistication and convenience into futuristic education. The learning process can no longer only be done face-to-face, it can now be done using distance learning. Visualization of abstract concepts is now more realistic with technology that can help teachers convey them to students, and students are helped to gain a better understanding.

In learning, various digital tools have been developed and are widely used in classrooms to improve student learning processes (Arif et al., 2023; Haryono et al., 2021; Hillman, 2014; Reichert-Schlax et al., 2023) including digital instruments in educational testing (Gierl et al., 2023). Effective use of digital learning tools can improve learning achievement, increase student engagement, enhance pedagogical practice, and facilitate optimized learning (Carle et al., 2009; D'Angelo, 2018; Ekanayake & Wishart, 2014; Lai & Bower, 2019; Mazer, 2013; Muir-Herzig, 2004; Schindler et al., 2017). Digital learning tools as a part of the integration of technology in education can help facilitate the knowledge-constructed classroom (Buckingham, 2003; Guzman & Nussbaum, 2009; Muir-Herzig, 2004).

Haryono et al. (2021) have developed eLEMA (electronic learning materials), a mobile application that supports learning in Invertebrate Zoology courses at the Biology Education Program, University of Palangka Raya. At that time, eLEMA was developed to meet the need for electronic learning materials for online learning during the COVID-19 pandemic. The content provided in this application consists of offline content that can be accessed by students without an internet connection and online content. In addition, Haryono et al. (2021) outlined the advantages of eLEMA as a digital learning tool, i.e., (1) Mobile, can be installed on Android smartphones without minimum specification requirements; (2) Has a content navigation menu that makes it easy to use; (3) Providing offline content that can be accessed by students without an internet connection; and (4) Its use can be combined with other online learning platforms, such as Google Classroom, Zoom Meeting, etc. Apart from the Invertebrate Zoology course, eLEMA has also been developed and adopted for other courses, e.g., the Peatland Ecology course (Araina et al., 2021).

Along with the rapid development of technology in recent years, eLEMA needs to be developed further for updates. Based on user feedback, several suggestions can be considered for further development of eLEMA, especially regarding user interfaces that are not eye friendly. This research aims to develop eLEMA 2.0 for the Invertebrate Zoology course as an upgraded version of previous eLEMA.

METHODS

Research Design

This study is a research and development (R & D) using the Hannafin & Peck development model (Hannafin & Peck, 1988) to develop eLEMA 2.0 for the Invertebrate Zoology course on the Phylum Arthropoda topic. The Hannafin & Peck development model was chosen due to its compatibility and simplicity compared to the ADDIE development model. The Hannafin & Peck development model consists of three main phases, i.e., Needs Assessment, Design, and Develop or Implement which are evaluated and revised at each phase (Figure 1).

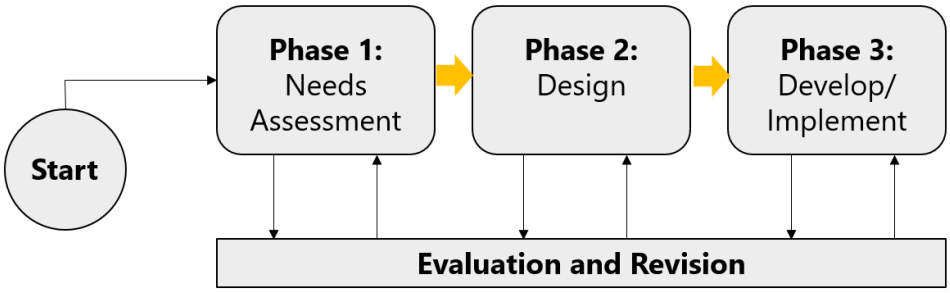


Figure 1. Hannafin & Peck Development Model (Hannafin & Peck, 1988)

Application developers, graphic designers and content developers are involved in this development. Application developers are responsible for designing flowcharts and building the app. Graphic designers are responsible for designing graphic content such as logos, headers, and user interface layouts. Content developers are responsible for collecting and reviewing content related to Invertebrate Zoology that will be included in the application.

Procedure

Details of the procedure are explained as follows:

Needs Assessment

Needs assessment is the phase where requirements and problems are analyzed. In this study, the previous version of eLEMA (Haryono et al., 2021) was analyzed to gather information regarding the requirements of the product development. Other information was collected from the analysis of learning needs, especially in the Invertebrate Zoology course in the Biology Education Program, at the University of Palangka Raya, Indonesia.

Design

In this phase, the product design is created based on the results of the needs analysis in the previous phase, including flowcharts and graphic components (icons, logos, headers, layouts, etc.). The graphical components of the product are designed using Adobe Photoshop CC® (Adobe Inc., 2019).

Develop

The product begins to be developed in this phase based on the flowchart design that has been created which describes how the application runs. The product was developed using MIT App Inventor 2, a visual programming website, to build fully functional apps for smartphones, especially Android. Google Form services are also used to create several features in products such as Tests, Project Submissions, and Feedback.

Trial and Validation

The testing phase is carried out by distributing the product to volunteer users to use and validate whether all features work properly. Six participants were involved in this trial. The developed product is run-tested and validated using the Black-box testing method. Black-box testing is a method of software functional testing without checking the internal structures (Beizer & Wiley, 1996).

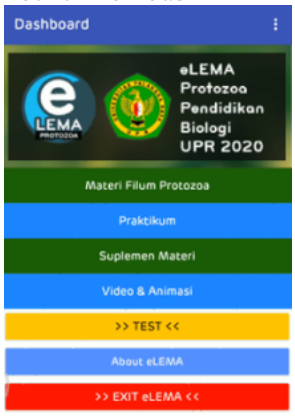
RESULTS AND DISCUSSION

The development product is the eLEMA 2.0 application for lectures on the Phylum Arthropoda topic in the Invertebrate Zoology course with improvements to the user interface and additional features that support participatory learning and student-centered learning. This new feature contains guidelines for student activities in attending lectures, i.e., Discussion Guides and Project Assignment Guides. With this new feature, it is hoped that students will gain meaningful learning experiences independently even in distance learning, as stated by Kerimbayev et al. (2023). The detailed development results are explained as follows:

Analysis Results

The previous version of eLEMA (Haryono et al., 2021) was analyzed to serve as a basis for the development of eLEMA 2.0. Various aspects are reviewed including user interface (visual aspects) and features. The analysis results are summarized in the following Table 1.

Table 1
Analysis Results

No.	Aspects	Results	Follow-Up
1.	User-Interface (Visual Aspect)	The user interface is not eye-friendly; the color composition is not harmonious.  eLEMA Previous Version	Redesign the user interface with a more harmonious color composition to produce an eye-friendly appearance.
2.	Features	The feature only provides study materials and test instruments. Unavailability of features that support participatory learning and student-centered learning.	Add new features that support participatory learning and student-centered learning.

Developed Product

General Specification

eLEMA (electronic learning materials) is an Android-based learning application developed for learning activities in the Biology Education Study Program as electronic teaching materials. The product developed is eLEMA version 2.0 which was created using the visual programming method using MIT App Inventor 2. The updates to eLEMA 2.0 include the addition of a new menu that supports student discussion activities, i.e., the Student Activity menu. Detailed eLEMA 2.0 specifications are presented as follows:

App Name : *eLEMA (Electronic Learning Materials)*
Version : *2.0*
Build : *2209*
Code Name : *Arthropods*
Release Date : *September 9th, 2023*
Extension : *.apk*
Size : *17.7 MB*
System Requirement : *Android 5+*
Content Availability : *Online and Offline*

Design: Icon & Flowchart

The application icon based on the new eLEMA main logo was designed using Adobe Photoshop CC® with blue as the dominant color. The new eLEMA main logo was previously released on the eLEMA official website (link). The details of each component on the logo are presented in the following Figure 2. The flowchart (Figure 3) illustrates in general how the eLEMA 2.0 application works. Based on the flowchart presented in Figure 2, this application works simply to make it easier for users to operate it.

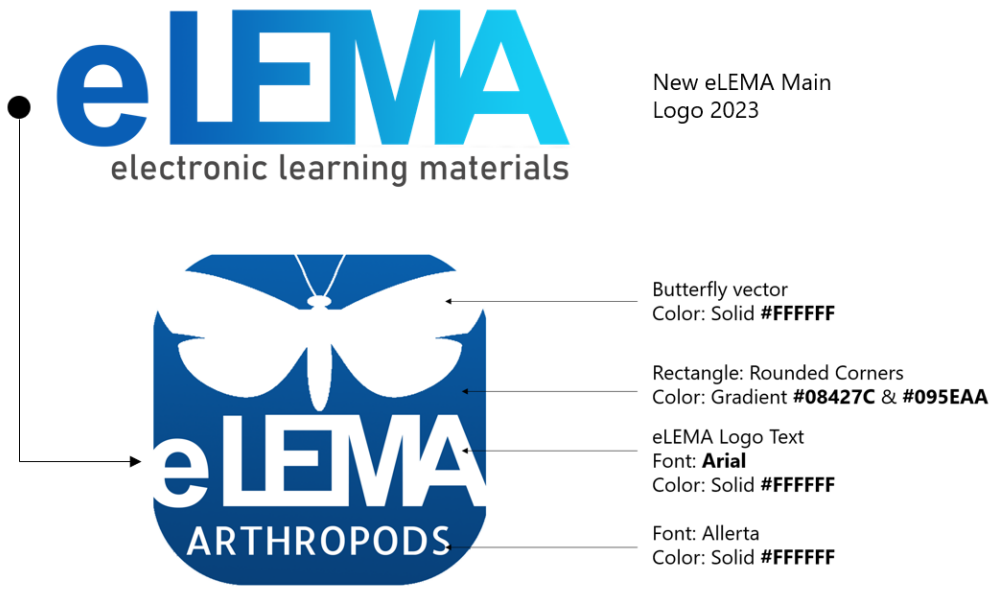


Figure 2. eLEMA 2.0 Arthropods Icon Design

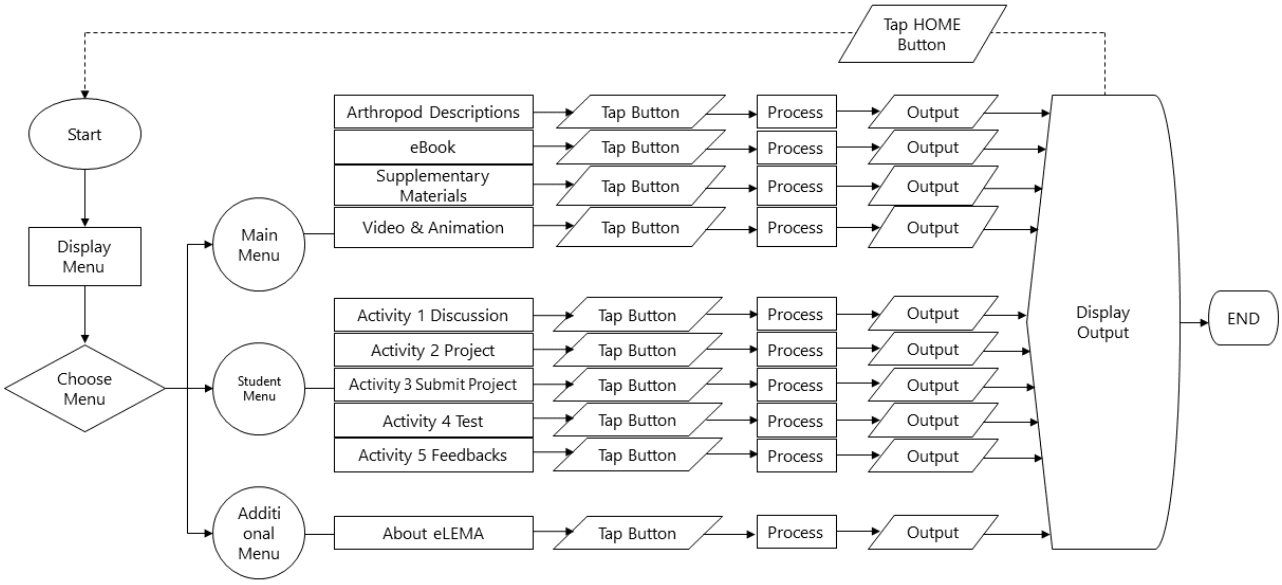


Figure 3. The Flowchart of eLEMA 2.0

Design: User Interface (UI)

The interface (UI) is designed to be simple with a dominant flat blue color (Figure 4 and 5). For instance, as shown in Figure 3, the home layout consists of two main sections, a header at the top section and buttons at the bottom section.

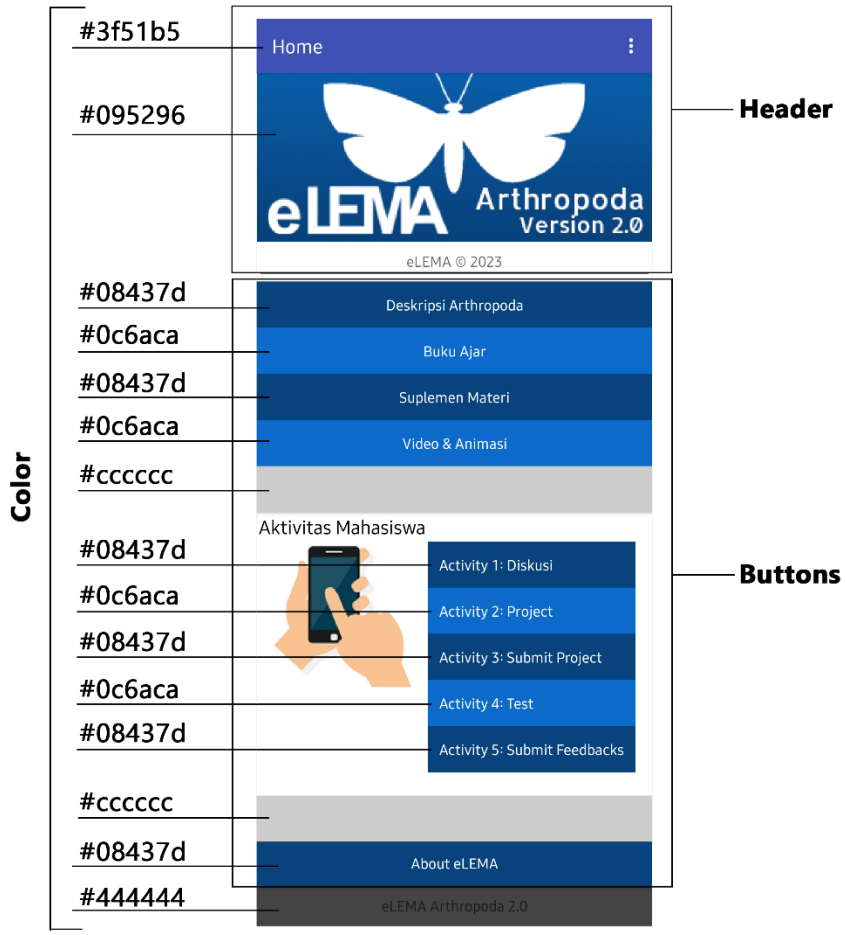


Figure 4. eLEMA 2.0 User-Interface (UI): Home Layout

Features

The developed eLEMA 2.0 has 2 main menus and 1 additional menu as presented in the following Table 2. The features available in eLEMA 2.0 support the lecture process for Invertebrate Zoology courses, especially on the topic of Phylum Arthropoda, by providing adequate reading materials and learning media. In addition, a special feature (Student Activities) provides guidance on student activities such as discussions and project assignments to support participatory and student-centered learning.

Table 2
eLEMA 2.0 Features

No.	Menu	Sub Menu	Description
1	Main Menu	a. Arthropod Descriptions (Deskripsi Arthropoda) b. eBook (Buku Ajar Elektronik) c. Supplementary Materials (Suplemen Materi) d. Video & Animation (Video dan Animasi)	a. Arthropod Descriptions: This sub menu contains a general description of the Phylum Arthropoda as introductory material b. eBook: This sub menu provides an electronic textbook which contains complete material about the Phylum Arthropoda which consists of 4 main classes, i.e., Insecta, Arachnida, Myriapoda, and Crustacea. c. Supplementary Materials: This sub menu provides supplementary material in the form of articles and textbooks related to the Phylum Arthropoda.

			d. Video & Animation: This sub menu provides videos and animations as supporting media in learning.
2	Student Menu: Student Activities	a. Activity 1 Discussion b. Activity 2 Project c. Activity 3 Submit Project d. Activity 4 Test e. Activity 5 Feedback	In general, this sub-menu contains guidelines for student activities in attending lectures, i.e., Discussion Guides and Project Assignment Guides.
3	Additional Menu: About eLEMA	-	In this additional menu general information about eLEMA 2.0 is available, i.e., application version, developer and official website.

Trial and Validation

Trial and validation aim to test the features of the eLEMA 2.0 application that have been developed to work properly before being implemented in lectures. All volunteers involved in this trial reported their experiences while using the app. All usage reports are then summarized as Black-box test results which are presented in detail in following Table 3. Based on these results, all eLEMA 2.0 features generally function well. All pages and content in this application were successfully opened without any disturbing errors. These results indicate that the development product is feasible to be implemented in the classroom.

Table 3
Black-box test results

No.	Features	Expected Result	Actual Result	Validation
Main Menu				
1	Button 1 Arthropod Descriptions (Deskripsi Arthropoda)	**Action:** Tap the button **Output:** displays a page containing a general description of arthropods	the page containing a general description of arthropods is displayed successfully	Valid
2	Button 2: eBook (Buku Ajar)	**Action:** Tap the button **Output:** displays a page containing the Arthropoda electronic textbook PDF file	the page containing the Arthropoda electronic textbook PDF file is displayed successfully	Valid
3	Button 3: Supplementary Materials (Suplemen Materi)	**Action 1:** Tap the button **Output 1:** displays a page that lists supplementary material with a link to open the document	the page that lists supplementary material with a link to open the document is displayed successfully	Valid
		Action 2: Tap each button on the Supplementary Materials Page **Output 2:** displays PDF files	PDF files are displayed successfully	Valid
4	Button 4: Video & Animation (Video dan Animasi)	**Action 1:** Tap the button **Output:** displays the page containing the video player	the page containing the video player is displayed successfully	Valid

		Action 2: Tap the play button on each video **Output 2:** Play video	Videos are played successfully	Valid
Student Menu: Student Activities				
5	Button 5: Activity 1 Discussion	**Action:** Tap the button **Output:** displays a page containing the discussion guide	the page containing the discussion guide is displayed successfully	Valid
6	Button 6: Activity 2 Project	**Action:** Tap the button **Output:** displays a page containing the project assignment guide	the page containing the project assignment guide is displayed successfully	Valid
7	Button 7: Activity 3 Submit Project	**Action:** Tap the button **Output:** displays a page containing the project submission form	the page containing the project submission form is displayed successfully	Valid
8	Button 8: Activity 4 Test	**Action:** Tap the button **Output:** displays a page containing 2 test options, i.e., Pretest & Posttest	the page containing 2 test options is displayed successfully	Valid
9	Button 9: Activity 5 Submit Feedbacks	**Action:** Tap the button **Output:** displays a page containing the feedback submission form	the page containing the feedback submission form is displayed successfully	Valid
Additional Menu				
10	Button 10: About eLEMA	**Action:** Tap the button **Output:** displays a page containing eLEMA 2.0 application information	the page containing eLEMA 2.0 application information is displayed successfully	Valid

Figure 5. eLEMA 2.0 main features

CONCLUSION

The development product is the eLEMA 2.0 application for lectures on the Phylum Arthropoda topic in the Invertebrate Zoology course with improvements to the user interface and additional features that support participatory learning and student-centered learning. The results of trials and validation show that all pages and content in this application were successfully opened without any disturbing errors. These results indicate that the development product is ready to be implemented in the classroom.

ACKNOWLEDGEMENT

This project is supported by the Faculty of Teacher Training and Education, University of Palangka Raya, Indonesia. We would like to express our gratitude and appreciation to all members of

the eLEMA 2.0 research and development team and to other parties who have supported this project.

REFERENCES

Adobe Inc. (2019). *Adobe Photoshop* [Computer software]. https://www.adobe.com/products/photoshop.html

Araina, E., Savitri, S., Mashabhi, S., & Pratama, F. P. (2021). Pengembangan Bahan Ajar Digital Berbasis eLEMA pada Materi Interaksi Mahluk Hidup dengan Lingkungan Ekosistem Gambut: Development of eLEMA-Based Digital Teaching Materials on the Interaction of Living Things with Peatland Ecosystem Environment. *BiosciED: Journal of Biological Science and Education*, *2*(2), 66–76. https://doi.org/10.37304/bed.v2i2.3746

Arif, M. Z., Nurdin, D., & Sururi, S. (2023). Mapping the use of digital learning tools and methods for increasing teachers' digital competence. *JURNAL PENDIDIKAN GLASSER*, *7*(2), Article 2. https://doi.org/10.32529/glasser.v7i2.2528

Balkaya, S., & Akkucuk, U. (2021). Adoption and Use of Learning Management Systems in Education: The Role of Playfulness and Self-Management. *Sustainability*, *13*(3). https://doi.org/10.3390/su13031127

Beizer, B., & Wiley, J. (1996). Black Box Testing: Techniques for Functional Testing of Software and Systems. *IEEE Software*, *13*(5), 98. https://doi.org/10.1109/MS.1996.536464

Bradley, V. M. (2021). Learning Management System (LMS) use with online instruction. *International Journal of Technology in Education*, *4*(1), 68–92. https://doi.org/10.46328/ijte.36

Buckingham, D. (2003). *Media Education: Literacy, Learning, and Contemporary Culture*.

Bulman, G., & Fairlie, R. W. (2016). Chapter 5—Technology and Education: Computers, Software, and the Internet. In E. A. Hanushek, S. Machin, & L. Woessmann (Eds.), *Handbook of the Economics of Education* (Vol. 5, pp. 239–280). Elsevier. https://doi.org/10.1016/B978-0-444-63459-7.00005-1

Büyükbaykal, C. I. (2015). Communication technologies and education in the information age. *Procedia-Social and Behavioral Sciences*, *174*, 636–640. https://doi.org/10.1016/j.sbspro.2015.01.594

Carle, A. C., Jaffee, D., & Miller, D. (2009). Engaging college science students and changing academic achievement with technology: A quasi-experimental preliminary investigation. *Computers & Education*, *52*(2), 376–380. https://doi.org/10.1016/j.compedu.2008.09.005

D'Angelo, C. (2018). *The Impact of Technology: Student Engagement and Success*. https://pressbooks.pub/techandcurriculum/chapter/engagement-and-success/

Djafri, N., Pramesworo, I. S., Khasanah, Widodo, M., & Setiawan, M. N. A. (2024). Digital Transformation in Education: Facing the Technology Age. *International Journal of Teaching and Learning*, *2*(3), Article 3. https://injotel.org/index.php/12/article/view/109/138

Ekanayake, S. Y., & Wishart, J. (2014). Mobile phone images and video in science teaching and learning. *Learning, Media and Technology*, *39*(2), 229–249. https://doi.org/10.1080/17439884.2013.825628

Furqon, M., Sinaga, P., Liliasari, L., & Riza, L. (2023). The Impact of Learning Management System (LMS) Usage on Students. *TEM Journal*, *12*, 1082–1089. https://doi.org/10.18421/TEM122-54

Gierl, M. J., Shin, J., & Firoozi, T. (2023). Automatic item generation. In R. J. Tierney, F. Rizvi, & K. Ercikan (Eds.), *International Encyclopedia of Education (Fourth Edition)* (pp. 193–200). Elsevier. https://doi.org/10.1016/B978-0-12-818630-5.10026-0

Gunawan, R. D., Sutisna, A., & Ana, E. F. (2024). Literature review: The role of learning management system (LMS) in improving the digital literacy of educators. *Jurnal Inovasi Teknologi Pendidikan*, *11*(2), Article 2. https://doi.org/10.21831/jitp.v11i2.56326

Guzman, A., & Nussbaum, M. (2009). Teaching competencies for technology integration in the classroom. *Journal of Computer Assisted Learning*, *25*(5), 453–469. https://doi.org/10.1111/j.1365-2729.2009.00322.x

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, *3*, 275–285. https://doi.org/10.1016/j.susoc.2022.05.004

Hamidi, F., Meshkat, M., Rezaee, M., & Jafari, M. (2011). Information technology in education. *World Conference on Information Technology*, *3*, 369–373. https://doi.org/10.1016/j.procs.2010.12.062

Hannafin, M. J., & Peck, K. L. (1988). *The Design Development and Evaluation of Instructional Software.* Macmillan. Publishing Company.

Haryono, A., Basuki, B., Adam, C., Savitri, S., Araina, E., & Fahrina, R. (2021). The Development of eLEMA-SCL Protozoa for Invertebrate Zoology Courses. *International Conference on Elementary Education*, *3*(1), Article 1. http://proceedings2.upi.edu/index.php/icee/article/view/1465/1336

Hillman, T. (2014). Finding space for student innovative practices with technology in the classroom. *Learning, Media and Technology*, *39*(2), 169–183. https://doi.org/10.1080/17439884.2013.803256

Jamal, H., & Shanaah, A. (2011). *The role of learning management systems in educational environments: An exploratory case study*.

Keengwe, J., & Bhargava, M. (2014). Mobile learning and integration of mobile technologies in education. *Education and Information Technologies*, *19*, 737–746. http://dx.doi.org/10.1007/s10639-013-9250-3

Kerimbayev, N., Umirzakova, Z., Shadiev, R., & Jotsov, V. (2023). A student-centered approach using modern technologies in distance learning: A systematic review of the literature. *Smart Learning Environments*, *10*(1), 61. https://doi.org/10.1186/s40561-023-00280-8

Lai, J. W. M., & Bower, M. (2019). How is the use of technology in education evaluated? A systematic review. *Computers & Education*, *133*, 27–42. https://doi.org/10.1016/j.compedu.2019.01.010

Mazer, J. P. (2013). Associations Among Teacher Communication Behaviors, Student Interest, and Engagement: A Validity Test. *Communication Education*, *62*(1), 86–96. https://doi.org/10.1080/03634523.2012.731513

McCarthy, A. M., Maor, D., McConney, A., & Cavanaugh, C. (2023). Digital transformation in education: Critical components for leaders of system change. *Social Sciences & Humanities Open*, *8*(1), 100479. https://doi.org/10.1016/j.ssaho.2023.100479

Mondragon-Estrada, E., Kirschning, I., Nolazco-Flores, J. A., & Camacho-Zuñiga, C. (2023). Fostering digital transformation in education: Technology enhanced learning from professors' experiences in emergency remote teaching. *Frontiers in Education*, *8*. https://www.frontiersin.org/journals/education/articles/10.3389/feduc.2023.1250461

Muir-Herzig, R. G. (2004). Technology and its impact in the classroom. *Computers & Education*, *42*(2), 111–131. https://doi.org/10.1016/S0360-1315(03)00067-8

Pendy, B. (2023). From Traditional to Tech-Infused: The Evolution of Education. *BULLET : Jurnal Multidisiplin Ilmu*, *2*(3), 767–777.

Reichert-Schlax, J., Zlatkin-Troitschanskaia, O., Frank, K., Brückner, S., Schneider, M., & Müller, A. (2023). Development and Evaluation of Digital Learning Tools Promoting Applicable Knowledge in Economics and German Teacher Education. *Education Sciences*, *13*(5). https://doi.org/10.3390/educsci13050481

Rogers, P. L. (2000). Barriers to adopting emerging technologies in education. *Journal of Educational Computing Research*, *22*(4), 455–472. https://files.eric.ed.gov/fulltext/ED429556.pdf

Schindler, L. A., Burkholder, G. J., Morad, O. A., & Marsh, C. (2017). Computer-based technology and student engagement: A critical review of the literature. *International Journal of Educational Technology in Higher Education*, *14*(1), 25. https://doi.org/10.1186/s41239-017-0063-0

Yarychev, N. U., & Mentsiev, A. U. (2020). Impact of digital education on traditional education. *Journal of Physics: Conference Series*, *1691*(1), 012132. https://doi.org/10.1088/1742-6596/1691/1/012132