Proceeding of International Joint Conference on UNESA
Homepage : https://proceeding.unesa.ac.id/index.php/pijcu
ISSN : 3032-3762

PIJCU, Vol. 3, No. 1, Desember 2023
Page 747 – 757

Preliminary Study: ELISA (Electronic Learning in Simulation Application) as a Recommended Media to Improve Students' Physics Problem Solving Skills

Rahmatta Thoriq Lintangesukmanjaya[1], Dwikoranto[1*], Adrian Bagas Damarsha[1], Azar Zakaria[1], Dedy Aufansyah Putra[1], Rahyu Setiani[2], Lindsay N. Bergsma[3]
[1*] Universitas Negeri Surabaya, Surabaya, Indonesia
[2]Bhinneka University PGRI, Tulungagung, Indonesia
[3]Tilburg University, Tilburg, Netherlands

Keywords:
Digital Media
ELISA
Learning
Physics
Problem Solving

ABSTRACT

The purpose of this study was to identify the profile of problem-solving skills while analyzing the needs of appropriate digital learning media that can improve students' skills. The study was conditioned in the form of quantitative descriptive research with a research sample of 68 students from East Java High School, Indonesia. The results obtained that the profile of students' problem-solving skills in physics learning is still relatively low. Based on the results of the problem-solving skills test, an average of 44.52 was obtained where students had difficulty solving problems, especially in carrying out problem solving that requires logical and structural thinking skills. ELISA (Electronic Learning In Simulation Application) as a recommendation for digital learning media designed with the advantages of efficient accessibility, 3D virtual simulation, integrated problem-based learning models can be an alternative media idea that is worth developing. However, on the other hand, the limitations of the study are the questions given and the number of students as research samples are limited so that they cannot be analyzed more deeply and more broadly. It is recommended to continue future research in developing and implementing ELISA into a feasible digital-based learning media product.

INTRODUCTION

Towards the industrial revolution 5.0 in the 21st century in a sustainable technological balance where collaboration between humans and machines will never be separated (Gamberini & Pluchino, 2024; Martín-Gómez et al., 2024). Its impact on several global sectors including education which is never separated from the use of modern technology. One of them is the implementation of digital learning which is currently a challenge as well as an innovation that must be mastered globally. Digital learning is a form of modern learning that integrates with the era of technology adoption (Ali et al., 2024; Prahani et al., 2025). Digital learning is relevant in efforts to improve 21st century skills.

21st Century Skills consisting of 6C (Critical, Creativity, Collaboration, Communication, Citizenship, and Character) are mandatory for the current generation (Inganah et al., 2022; Lintangesukmanjaya, Prahani, et al., 2024). In developing 21st century skills, maximum problem-solving skills are needed. Problem-solving skills as the ability to analyze, identify and evaluate solutions practically and effectively (Dwikoranto, 2022; Lintangesukmanjaya et al., 2025). Problem solving as the basis of each 21st century skill, where each skill requires good problem-solving solution analysis.

International research reality finds that problem solving is very important (Samadun & Dwikoranto, 2022; Hasanah & Arsyad, 2024; Shofiyah et al., 2024). This is related to the

skills that must be possessed to compete in a complex global world. However, not a few international findings that problem solving in the current young generation is still low (Abrar et al., 2025; Promma et al., 2025). Especially in high school students who basically need maximum problem solving skills. Low problem solving skills affect other skills and abilities. Students will have difficulty learning if they are unable to solve school problems or daily life problems. Especially in physics learning which is one of the science learning with a level of difficulty above the average of other learning (Safarati & Zuhra, 2023; Sunarti et al., 2024).

Physics learning requires maximum problem-solving skills, especially in identifying and analyzing abstract and mathematical problems. Problem-solving innovation can actually be improved through the implementation of relevant media and learning models. However, because the characteristics of each school are different, currently not many people know what alternative media and relevant learning models are like. The offer of digital learning media is the best solution (Lintangesukmanjaya, Prahani, et al., 2024; Gerlich, 2025; Promma et al., 2025). Digital learning media also supports the development of digitalization in education (Saraswati et al., 2021; Sepasgozar, 2021). Many types of digital media are currently developing, so it is important to adjust the appropriate media according to the characteristics and desires of students.

The purpose of this study is to identify the profile of problem-solving skills while analyzing the needs of appropriate digital learning media that can improve students' skills. By knowing the identification of problem-solving skills, appropriate solutions can be found. This study is also in line with the development and planning of innovative digital-based learning.

RESEARCH METHOD

The research was conditioned in the form of quantitative descriptive research. Through numerical analysis and relevant studies, generalization of findings was obtained (Hidayat & Aripin, 2023; Khonamri et al., 2024). The research was designed in the form of a preliminary study to determine the profile of students' problem-solving skills. The following is the research flow used (Adhelacahya et al., 2023),

Figure 1. Research flow

The research obtained through data analysis is adjusted to the identification of research objectives in determining problem-solving skills and analyzing students' media needs.

Population and Sample

The study was conducted in one of the high schools in East Java, Indonesia. The research sample was taken using purposive sampling technique (Ismawati et al., 2023). 68 students were obtained in one school as research samples.

Data Analysis Techniques

The technique in data collection is adjusted to the type of research used. In addition, data analysis is also obtained through the results obtained from the research instruments used (Creswell, 2009). There are 2 types of research instruments used as follows,

Table 1. Research Instrument

No	Instrument Type	Measurement Indicator	Analysis Techniques
1	Test Instrument	Problem Solving Skills	Descriptive Statistics and Indicator Analysis
2	Questionnaire Instrument	Responses and Recommendations for Learning Media	Likert Scale Analysis and Indicator Analysis

In the test instrument used to measure problem-solving skills, 4 indicators were used according to Polya (Maulyda et al., 2019; Jahudin & Siew, 2024). All indicators used to complete problem-solving skills are integrated into each question. With a total of 5 questions given, the following is a description of the indicators given in each question,

Table 2. Troubleshooting Indicators

No	Indicator	Information
1	Understanding the Problem	Determining the main idea of the problem
2	Make a Plan	Create a design based on a problem solving plan
3	Implementing the Plan	Implement problem solving solutions systematically
4	crosscheck	Conduct evaluation of decision results

The results of the scores obtained on the test instruments given to students are adjusted to the objectives of the desired research. The analysis is carried out by comparing each skill indicator to determine the location of student difficulties (Hidayat & Aripin, 2023). Meanwhile, the student questionnaire is given to evaluate skills and find out recommendations for learning models and media desired by students. The response questionnaire includes students' willingness to use digital-based learning media, especially in supporting the development of ELISA (Electronic Learning In Simulation Application) in the future.

RESULTS AND DISCUSSION

The results and discussion in this study were obtained based on the results of problem-solving skills tests and student responses.

Results

Based on the test instrument provided with 4 indicators of problem-solving skills against 5 questions, the results of the student problem-solving skills profile were as follows.,

Table 3. Descriptive quantitative

N	Average	Median	Max Value	Min Value	Std. Error	Std. Dev
60	44.52	48	78	10	2.08	16.23
Average Score of Problem Solving Skills			Understanding the Problem	Make a Plan	Implementing the Plan	Check Back
			11.3	12.3	8.5	12.42

The results show that students' problem-solving skills are in an average score of 44.52 which is categorized as low. This low problem-solving skill is relevant to the standard deviation in Table 3, where the relatively small standard deviation indicates that the distribution of this data is not far from the average value (Widyaningsih et al., 2021). As for finding out the comparison of the results on each indicator, it can be seen through the following diagram,

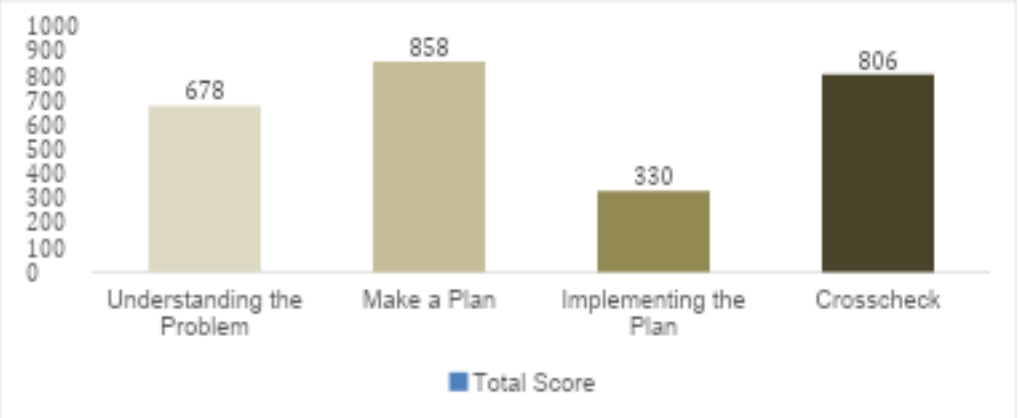

Figure 2. Problem solving indicator score difference diagram

The results show that the values for each indicator are relatively low and not yet optimal. In the physics learning given, students are less able to describe the steps systematically (Karim & Saleh, 2025; Promma et al., 2025). This can be seen from the score of the indicator implementing the plan which is the indicator with the lowest score. As for knowing the difficulties experienced by students and recommendations for subsequent learning, the following is a mapping of the results of the student questionnaire.

Table 4. Student questionnaire results

Aspect	Statement	Persetujuan (%)
Problem Solving Skills	Feel confident with the problem ideas written down	68
	Feel confident with the plans and problem solving written down	60
	Feel that the questions given have a high level of difficulty	88

Digital Learning Media	Digital learning media is currently important to implement in physics learning.	
	The implementation of digital learning media based on simulations and phenomena is very interesting	100
	Digital learning media is more interesting if it is equipped with assessments and learning materials.	98
	Visualization of attractive learning media is very important	100
Learning model	Experience-based learning models are more interesting	88
	Project or task-based learning models are more interesting	78
	Phenomenon-based learning models are more interesting	98

The results of the questionnaire can be used as an analysis of student problems and recommendations for future learning and teaching media.

Based on the analysis of Table 3, it is known that the average problem-solving skills of students are still relatively low. The low problem-solving skills of students are most likely caused by the lack of habit of students in solving problems systematically and the difficulty of students in dealing with questions (Jiang et al., 2023; David et al., 2024). If seen in Figure 2, each indicator in student problem solving has a different value, although the difference is not too large. If observed, students tend to have difficulty in carrying out problem solving due to the lack of systematic explanation and lack of understanding of basic concepts (Dwikoranto, 2022; Promma et al., 2025).

Understanding basic concepts is influenced by logical and structural thinking. Currently, in physics learning that emphasizes abstract concepts and contextual phenomena, students need visualization and practice in the learning process (Doyan et al., 2021; Prahani et al., 2023). This triggers the development of cognitive abilities that support problem solving. So to strengthen this argument, an analysis of the results of the response questionnaire was carried out. The results of the response questionnaire consisting of aspects of problem-solving skills, media and digital learning models found that students needed the implementation of digital integrated learning media (Darmayanti et al., 2022; Hoerudin et al., 2023). So that in accordance with the recommendations of the questionnaire produced, it is necessary to design a media that is able to have solutions in attractive visualizations such as ELISA (Electronic Learning In Simulation Application). ELISA as a digital media designed with mobile application specifications provides advantages in problem-based learning such as PBL, PjBL and Inquiry.

Figure 3. ELISA draft specification

The design and specifications of ELISA are tailored to students' needs, such as recommendations from the questionnaire results. ELISA provides convenience in experiential learning on physics material with attractive visualizations (Budi et al., 2021). The following are the advantages and relationships of ELISA to problem-solving skills.

1. Efficient Accessibility
   ELISA (Electronic Learning In Simulation Application) learning media is designed in the form of a mobile application that can be used without time and facility limitations, this is a form of digitalization of learning (Saraswati et al., 2021). In addition, ELISA is designed with materials, questions and student worksheets according to questionnaire recommendations where students need efficient learning media..
2. Virtual Simulation 3D
   ELISA is equipped with a 3D simulation design as seen in Figure 3, where ELISA maximizes the virtual display so that students are interested and do not get bored in learning physics (Collins et al., 2021; Lintangesukmanjaya et al., 2024).
3. Integrated Problem Based Learning Model and Simulation
   In an effort to improve problem-solving skills, ELISA was developed with PBL (Problem Based Learning) syntax that is adjusted to the 3D virtual simulation display. The goal is to train students in solving problems and support experiential or problem-oriented learning (Norwich et al., 2025).

Based on all of that, the compilation of ELISA (Electronic Learning In Simulation Application) obtained from the results of the study of low problem-solving skills profiles and analysis of students' media needs can be developed. The limitations of this study are the questions given and the number of students as research samples are limited so that they cannot be analyzed more deeply and more broadly. Recommendations as a preliminary study for further research are research on the development of learning products or media in accordance with the results of the analysis of media recommendations desired by students.

CONCLUSION

The profile of students' problem-solving skills in physics learning is still relatively low. Based on the results of the problem-solving skills test, an average of 44.52 was obtained where students had difficulty solving problems, especially in carrying out problem solving that requires logical and structural thinking skills. Students need digital-based learning media that can improve problem-solving skills. ELISA (Electronic Learning In Simulation Application) as a recommendation for digital learning media designed with the advantages of efficient accessibility, 3D virtual simulation, integrated problem-based learning models can be an alternative media idea that is worth developing. However, on the other hand, the limitations of the study are the questions given and the number of students as research samples are limited so that they cannot be analyzed more deeply and more broadly. It is recommended to continue future research in developing and implementing ELISA into a feasible digital-based learning media product.

ACKNOWLEDGEMENTS (OPTIONAL)

Thank you to DRTPM (Directorate of Research, Technology, and Community Service) in 2025 the Ministry of Higher Education, Science, and Technology of the Republic of Indonesia for funding fundamental research with research funding number SP DIPA-139.04.1.693320/2025.

REFERENCES

Abrar, F., Baig, U. K., Rafique, Z., & Abbas, M. (2025). Cognitive development in the age of ai how ai tools influence problem solving and creativity in psychological terms. *Review of Applied Management and Social Sciences*, *8*(1), 237–249. https://doi.org/10.47067/ramss.v8i1.452

Adhelacahya, K., Sukarmin, S., & Sarwanto, S. (2023). Impact of problem-based learning electronics module integrated with STEM on students' critical thinking skills. *Jurnal Penelitian Pendidikan IPA*, *9*(7), 4869–4878. https://doi.org/10.29303/jppipa.v9i7.3931

Ali, M., Aini, M. A., & Alam, S. N. (2024). Integrating technology in learning in madrasah: Towards the digital age. *Indonesian Journal of Education (INJOE)*, *4*(1), 290–304.

Budi, A. S., Sari, S. W., Sanjaya, L. A., Wibowo, F. C., Astra, I. M., Puspa, R. W., Misbah, M., Prahani, B. K., & Pertiwi, W. A. (2021). PhET-assisted electronic student worksheets of physics (eSWoP) on heat for inquiry learning during covid. *Journal of Physics: Conference Series*, *2104*(1), 12030. https://doi.org/10.1088/1742-6596/2104/1/012030

Clark, Vicki L. Creswell, J. W. (2009). *The Mixed Method Reader* (J. W. Clark, Vicki L. Creswell (ed.). Sage.

Collins, J., Chand, S., Vanderkop, A., & Howard, D. (2021). A review of physics simulators for robotic applications. *IEEE Access*, *9*(1), 51416–51431. https://doi.org/10.1109/ACCESS.2021.3068769

Darmayanti, R., Sugianto, R., Baiduri, B., Choirudin, C., & Wawan, W. (2022). Digital comic learning media based on character values on students' critical thinking in solving mathematical problems in terms of learning styles. *Al-Jabar : Jurnal Pendidikan Matematika*, *13*(1), 49–66. https://doi.org/10.24042/ajpm.v13i1.11680

David, L., Biwer, F., Crutzen, R., & de Bruin, A. (2024). The challenge of change: Understanding the role of habits in university students' self-regulated learning. *Higher Education*, *88*(5), 2037–2055. https://doi.org/10.1007/s10734-024-01199-w

Doyan, A., Susilawati, Makhrus, M., & Zamrizal, W. (2021). Development of modern physics learning devices using inquiry learning model assisted with virtual media to improve student cognitive learning result. *Proceedings of the 5th Asian Education Symposium 2020 (AES 2020)*, *566*(Aes 2020), 213–216. https://doi.org/10.2991/assehr.k.210715.047

Dwikoranto, D. (2022). Using Toulmin's argument pattern on problem solving model to improve problem-solving analysis ability: Learning alternatives during the covid-19 pandemic. *IJORER : International Journal of Recent Educational Research*, *3*(2), 200–209. https://doi.org/10.46245/ijorer.v3i2.211

Gamberini, L., & Pluchino, P. (2024). Industry 5.0: A comprehensive insight into the future of work, social sustainability, sustainable development, and career.

Australian Journal of Career Development, *33*(1), 5–14. https://doi.org/10.1177/10384162241231118

Gerlich, M. (2025). AI tools in society: Impacts on cognitive offloading and the future of critical thinking. *Societies*, *15*(1), 1–28. https://doi.org/10.3390/soc15010006

Hasanah, N., & Arsyad, N. (2024). Improving mathematical problem-solving skills : The roles of reasoning, connections , communication , and students ' self-efficacy. *Jurnal Ilmiah Pendidikan MIPA*, *14*(148), 531–546.

Hidayat, W., & Aripin, U. (2023). How to develop an e-lkpd with a scientific approach to achieving students' mathematical communication abilities? *Infinity Journal*, *12*(1), 85–100. https://doi.org/10.22460/infinity.v12i1.p85-100

Hoerudin, C. W., Syafruddin, S., Mayasari, A., Arifudin, O., & Lestari, S. (2023). E-learning as a learning media innovation islamic education. *QALAMUNA: Jurnal Pendidikan, Sosial, Dan Agama*, *15*(1), 723–734. https://doi.org/10.37680/qalamuna.v15i1.4466

Inganah. (2022). Problems, solutions, and expectations: 6C Integration of 21 st Century education into learning mathematics. *E-Journal.Unipma.Ac.Id*, *11*(1), 220–238. http://e-journal.unipma.ac.id/index.php/JEMS/article/view/14646

Ismawati, E., Hersulastuti, Amertawengrum, I. P., & Anindita, K. A. (2023). Portrait of Education in Indonesia: Learning from PISA Results 2015 to Present. *International Journal of Learning, Teaching and Educational Research*, *22*(1), 321–340. https://doi.org/10.26803/ijlter.22.1.18

Jahudin, J., & Siew, N. M. (2024). The effects of Polya'S problem solving with digital bar model on the algebraic thinking skills of seventh graders. *Problems of Education in the 21st Century*, *82*(3), 390–409. https://doi.org/10.33225/pec/24.82.390

Jiang, D., Dahl, B., & Du, X. (2023). A Systematic review of engineering students in intercultural teamwork: characteristics, challenges, and coping strategies. *Education Sciences*, *13*(6). https://doi.org/10.3390/educsci13060540

Karim, N., & Saleh, S. F. (2025). Profile of students ' critical thinking skills in solving mathematical problems reviewed from the learning style of grade IV students of SD Inpres Teamate, Pattallassang District, Gowa Regency. *International Journal on Science and Technology (IJSAT)*, *16*(1), 1–6.

Khonamri, F., Podpera, R., Kurilenko, V., & Shakhlo Obloberdiyevna, D. (2024). The predictive role of teaching experience in teachers' implementation of metacognitive knowledge. *Journal of Education Culture and Society*, *15*(2), 237–247. https://doi.org/10.15503/jecs2024.2.237.247

Lintangesukmanjaya, R. T., Prahani, B. K., Marianus, M., Wibowo, F. C., Costu, B., & Arymbekov, B. (2024). Profile of students' critical thinking skills in 3D module learning material on gas kinetic theory with inquiry model. *Jurnal Pendidikan Sains Indonesia*, *12*(1), 77–94. https://doi.org/10.24815/jpsi.v12i1.33877

Lintangesukmanjaya, R. T., Prahani, B. K., Suliyanah, Sunarti, T., & Saphira, H. V. (2024). Profile of critical thinking skills of senior high school students in physical wave material. *Journal of Physics: Conference Series*, *2900*(1). https://doi.org/10.1088/1742-6596/2900/1/012030

Lintangesukmanjaya, R. T., Ramadhana, D., & Zsa, Z. (2025). Bibliometric analysis of physics learning studies : Focus on differentiation and problem solving strategies. *JOLABIS*, *1*(1), 1–9.

Martín-Gómez, A. M., Agote-Garrido, A., & Lama-Ruiz, J. R. (2024). A Framework for sustainable manufacturing: Integrating Industry 4.0 technologies with Industry 5.0 Values. *Sustainability (Switzerland)*, *16*(4). https://doi.org/10.3390/su16041364

Maulyda, M. A., Hidayati, V. R., Rosyidah, A. N. K., & Nurmawanti, I. (2019). Problem-solving ability of primary school teachers based on Polya's method in Mataram City. *Pythagoras: Jurnal Pendidikan Matematika*, *14*(2), 139–149. https://doi.org/10.21831/pg.v14i2.28686

Norwich, B., Baumfield, V., Dimitrellou, E., Katene, W., & Koutsouris, G. (2025). Exploring reflective practice through lesson study in the school-based practices of PGCE primary and secondary student teachers in a UK ITE programme. *Reflective Practice*, *00*(00), 1–17. https://doi.org/10.1080/14623943.2025.2459435

Prahani, B. K., Dawana, I. R., & Sujarwanto. (2025). Exploring the potential of technology in physics education: current research and innovation trends to support 21st century skills. *Perspektivy Nauki i Obrazovania*, *73*(1), 349–361. https://doi.org/10.32744/pse.2025.1.23

Prahani, B. K., Imah, E. M., Maureen, I. Y., Rakhmawati, L., & Saphira, H. V. (2023). Trend and visualization of artificial intelligence research in the last 10 Years. *TEM Journal*, *12*(2), 918–927. https://doi.org/10.18421/TEM122-38

Promma, W., Imjai, N., Usman, B., & Aujirapongpan, S. (2025). The influence of AI literacy on complex problem-solving skills through systematic thinking skills and intuition thinking skills: An empirical study in Thai gen Z accounting students. *Computers and Education: Artificial Intelligence*, *8*(January), 100382. https://doi.org/10.1016/j.caeai.2025.100382

Safarati, N., & Zuhra, F. (2023). Use of problem-solving based physics comic media on global warming material in increasing learning motivation and students' understanding concept. *Jurnal Penelitian Pendidikan IPA*, *9*(11), 9193–9199. https://doi.org/10.29303/jppipa.v9i11.4828

Samadun, S., & Dwikoranto, D. (2022). Improvement of student's critical thinking ability sin physics materials through the application of problem-based learning. *IJORER : International Journal of Recent Educational Research*, *3*(5), 534–545. https://doi.org/10.46245/ijorer.v3i5.247

Saraswati, D. L., Mulyaningsih, N. N., Asih, D. A. S., Ardy, V., & Dasmo. (2021). Development of learning media-based digital book on modern physics learning. *512(Icoflex 2019)*, 338–343. https://doi.org/10.2991/assehr.k.201230.063

Sepasgozar, S. M. E. (2021). Differentiating digital twin from digital shadow: Elucidating a paradigm shift to expedite a smart ,. *Sustainable Built Environment*, *11*(151), 1–16.

Shofiyah, N., Suprapto, N., Prahani, B. K., Jatmiko, B., Anggraeni, D. M., & Nisa', K. (2024). Exploring undergraduate students' scientific reasoning in the force and motion concept. *Cogent Education*, *11*(1). https://doi.org/10.1080/2331186X.2024.2365579

Sunarti, T., Suprapto, N., Prahani, B. K., Satriawan, M., & Rizki, I. A. (2024). Online problem-based learning and 3D digital books to improve pre-service teachers' scientific literacy. *International Journal of Evaluation and Research in Education*, *13*(5), 3139–3150. https://doi.org/10.11591/ijere.v13i5.29835

Widyaningsih, S. W., Yusuf, I., Prasetyo, Z. K., & Istiyono, E. (2021). The development of the hots test of physics based on modern test theory: Question modeling through

e-learning of moodle lms. *International Journal of Instruction, 14*(4), 51–68. https://doi.org/10.29333/iji.2021.1444a