Multirepresentation Learning Models in the Digital Age to Improve Students' Conceptual Understanding

Roslina[1*], Restiyanita[1], Verawati[1], Hesti Apala[1], Larasati[1], Anugerah Hisam Safa'at[1], Rahmat Hidayat[1], Dina Martha Fitri[1]
[1]Universitas Lampung, Indonesia
**Corresponding author: Roslina (rlina846@gmail.com)*

Received: 9 October 2025
Received in revised form: 1 November 2025
Accepted: 15 November 2025
Published: 18 December 2025

ABSTRACT

This study analyzes the integrated multi-representation learning model based on digital technology to improve students' conceptual understanding. The main problem in this study is students' difficulty in understanding abstract and complex concepts. This is especially evident in science and mathematics education, where many concepts are abstract and difficult to visualize. Another problem in education is the gap between students' abilities, where some students may excel in verbal understanding, while others may excel in visual or mathematical understanding. This study aims to analyze the development of a multi-representation learning model in the digital era as an alternative effective learning model to improve students' conceptual understanding and higher-order thinking skills. Through a qualitative approach using a literature review method, this study analyzes various multi-representation learning models that have been developed and the integration of digital technology in their implementation. Data were obtained from a review of relevant journal articles related to the research topic conducted by previous researchers. The results of the study indicate that a multi-representation learning model integrated with digital technology can facilitate students' understanding of complex concepts through interactive verbal, visual, graphic, and mathematical representations. The application of this model has proven effective in improving students' multi-representation skills, problem solving, conceptual understanding, and creativity.

Keywords
Learning model; Multirepresentation; Digital age; Concept understanding

Introduction

The digital age has brought about significant changes in various aspects of life, including education. The rapid development of information and communication technology has created opportunities and challenges for the world of education to adapt to the needs and characteristics of 21st century learning. Today's students, who are digital natives, have different learning styles than previous generations. They tend to access information quickly, prefer interactive learning processes, and have the ability to process multiple pieces of information simultaneously. This situation requires innovation in learning models that can accommodate the characteristics of students in the digital age. One of the main challenges of education in the digital age is how to ensure that the learning process is not just a transfer of knowledge, but also develops critical thinking, creativity, collaboration and communication skills in students. Education in the digital age is not just about integrating technology into learning, but also about how technology can be used effectively to improve the quality and outcomes of learning.

Responding to the challenges of education in the digital age requires innovative learning models that not only use technology as a tool, but also consider how the learning process can be designed to develop higher-order thinking skills in students. Traditional learning models, which tend to be teacher-centered and emphasize content mastery alone, are considered irrelevant to the learning needs of the digital age. More adaptive, flexible learning models that can accommodate the diversity of learning styles of learners are needed. A good learning model in the digital age should be able to integrate digital technology with effective pedagogical principles to create meaningful and relevant learning experiences for students. In addition, learning models must be designed to develop students' digital literacies so that they are not only consumers of technology, but also able to use technology critically and creatively in the learning process. Another challenge in developing learning models in the digital age is how to balance the use of technology with social interaction and the development of interpersonal skills among students.

e-ISSN 2600-8572 | DOI: https://doi.org/10.11113/itlj.v9.199

One potential learning model to be developed in the digital age is the multirepresentation learning model. Multirepresentation is a learning strategy that combines different forms and methods such as writing, numbers, diagrams, and visuals to explain a particular concept in detail (Masrifah et al., 2020). This learning model allows students to understand concepts from different perspectives and in different ways, thereby accommodating the diversity of students' learning styles and abilities. In the digital age, which is characterized by an abundance of information in different forms, the ability to understand and use different forms of representation is becoming increasingly important. Multirepresentation skills are not only in the context of formal learning, but also as part of the digital literacy needed in everyday life. By developing a model for multirepresentation learning in the digital age, it is hoped that students will be better prepared to deal with the increasing complexity of information and knowledge.

Multirepresentation learning is learning that provides students with multiple opportunities to represent the same concept using different forms or types of representation. Forms and types of representation can include verbal, graphic, tabular, experimental, mathematical, pictorial, kinaesthetic, and visual (Waldrip et al., 2006). In multirepresentational learning, students are encouraged not only to understand concepts from a single form of representation, but also to be able to transform and connect different forms of representation to build a richer and deeper understanding. Multi-representational learning is also consistent with Howard Gardner's theory of multiple intelligences, which states that each individual has eight different types of intelligence, and that effective learning should accommodate this diversity of intelligence.

As a complement, multirepresentation serves to provide additional information that cannot be accommodated by a single form of representation. And as a builder of deeper understanding, multirepresentation encourages students to abstract, generalize, and relate concepts. By observing the relationships between different forms of representation, learners can identify patterns and structures underlying a concept, thereby building a deeper and more meaningful understanding. In the context of learning in the digital age, these functions of multiple representations can be optimized with the help of digital technology, which allows for more dynamic, interactive, and adaptive representations.

One of the most common problems in education today is the difficulty students have in understanding abstract and complex concepts. This is especially true in science and mathematics, where many concepts are abstract and difficult to visualize. The use of multiple representations can sharpen and strengthen students' understanding of concepts and reduce their difficulty in understanding them. This is because the meaning of a concept becomes clearer when it is presented in different representations. Another problem in education is the gap between students' abilities, where some students may excel in verbal understanding, while others may excel in visual or mathematical understanding (Suhandi and Wibowo, 2012). Learning with a single-representation approach tends to benefit students with certain learning styles and disadvantage students with different learning styles. A multi-representation learning model can be a solution to address this gap by presenting concepts in different forms of representation, thereby accommodating the diversity of students' learning styles.

The primary goal of developing a multi-representation learning model in the digital age is to improve the effectiveness and quality of learning, especially in helping students understand complex and abstract concepts. Digital technology allows for more dynamic and interactive representations, such as simulations, animations, and 3D visualizations, which are difficult to achieve in traditional learning. In addition, the development of multi- representation learning models in the digital age aims to equip students with multi-representation skills, which include the ability to understand, analyze, and use different forms of representation to solve problems. This skill is critical in the digital age, which is characterized by an abundance of information in multiple forms. Learners with strong multirepresentational skills will be more adaptable to different situations and problems, both in academic contexts and in everyday life. The development of multirepresentational learning models also aims to accommodate the diversity of learning styles and abilities of learners, thereby creating more inclusive and effective learning for all learners. This model of learning can also help educators to accommodate the diversity of students, thereby creating more inclusive learning. For the education system as a whole, the development of a multi-representation learning model in the digital age can be part of efforts to transform education to meet the challenges and opportunities of the digital age. Based on the background and problems described above, the research questions in this study are What is the form of multi-representation learning model development in the digital age, and how can digital technology be integrated into multi-representation learning models? By answering these questions, it is hoped that this study can make a significant contribution to the development of learning models that can improve the quality of education in the digital age.

e-ISSN 2600-8572 | DOI: https://doi.org/10.11113/itlj.v9.199

Literature Review

Table 1 shows the overview of previous research.

Table 1. Overview of Previous Research

Research Title	Researchers	Year of Publications	Research Methods	Research Findings
Improving Students' Conceptual Understanding Through Media Kit Covalent Creator Based On Multirepresentation	Hidayat et al.	2022	Quasi- Experimental	The results of the study showed that the experimental class using KIT C2 experienced a significant increase with an average post-test score of 75.74, compared to the control class using LKPD (60.63). KIT C2 was successful in connecting three levels of representation, namely macroscopic, submicroscopic, and symbolic, and was able to actively involve students, according to Edgar Dale's theory.
The Use of Multi-Representation Learning Models Supported by Educational Games on Conceptual Understanding Ability	Masrifah et al.	2020	Quasi-Experimental	Multi-representation learning strategies are well suited for use in science education because they can overcome students' difficulties in understanding concepts.
Using a problem-based learning model with a multi-representation approach	Taufiq	2010	Pre-experimental	There was an increase of 52.38% in the average percentage of students' multi-representation ability after using the PBL model with a multi-representation approach.
Multirepresentasi sebagai Alternatif Pembelajaran dalam Fisika	Irwandani	2014	Literature study	Multirepresentation can be an alternative learning method that facilitates students with different abilities and effectively improves conceptual understanding.
Students' Multirepresentation Ability in Completing Physics Evaluation Problems	Theasy	2018	Qualitative descriptive	Multi-representation skills help students solve physics problems more comprehensively.
The Effect of Multimedia-Based Multi-Representation Learning on Changes in Students' Representation Types	Susilo	2018	Experiment	There were changes in the types and quality of student representations after learning with multimedia-assisted multirepresentation.

e-ISSN 2600-8572 | DOI: https://doi.org/10.11113/itlj.v9.199

Multi-Representative Learning Module in Geometry Course to Improve Creative Thinking Skills	Anita et al.	2021	Research & Development	The use of multi-representation based geometry modules is more effective in encouraging student creativity.
Implementation of a guided discovery learning model accompanied by multi-presentation worksheets based on problem solving.	Puspitasari	2018	Experiment	Using different representations to explain a concept helps students understand the concept more easily.
The Effectiveness of the Multi-Representation Approach in Problem-Based Learning to Improve Conceptual Understanding	Putri et al.	2020	Experiment	Multi-representation learning is effective in improving students' conceptual understanding in problem solving.
Develop multi-representation virtual lab modules to increase student interest	Rahman et al.	2024	Research & Development	PhET based virtual practice module using multiple representations of interests developed in the very positive category
A Study of multirepresentation approaches in the context of physics learning	Alatas	2021	Literature study	The multirepresentation approach can be integrated into various physics learning models to improve cognitive performance
The role of representation in students' access to mastery of physics concepts	Murtono et al.	2014	Qualitative descriptive	Good representation skills correlate with better mastery of physics concepts.
Development of multi-representation based physics teaching materials to improve analytical thinking skills	Harti	2022	Research & Development	Multirepresentation-based physics teaching materials effectively improve analytical thinking skills
Analysis of students' multi-representation abilities in solving uniformly accelerated motion problems	Prakoso et. al.	2019	Qualitative descriptive	Multi-representation skills help students solve physics problems more comprehensively.
Multi-representation learning to improve conceptual understanding and critical thinking skills	Lestari	2015	Quasi experimental	Multi-representation learning effectively improves students' conceptual understanding and critical thinking skills.

Multirepresentation

Multirepresentation is a learning strategy that combines different forms and methods such as writing, numbers, diagrams, and visuals to explain a particular concept in detail (Masrifah et al., 2020). Multirepresentation serves as a supplement, interpretation limiter, and deep understanding builder. In the digital context, technology extends these functions through interactivity, such as virtual labs for chemical experiments that are too dangerous to perform in person. Multirepresentation in learning has three main functions, namely as a supplement, an interpretation limiter, and a deep understanding builder (Ainsworth, 1999).

e-ISSN 2600-8572 | DOI: https://doi.org/10.11113/itlj.v9.199

Multirepresentation is rooted in theories that further inform its role in technology integration, where learners actively construct knowledge by exploring representations. Tools such as GeoGebra and MATLAB facilitate independent experimentation, consistent with the effectiveness of multimodality in science learning (Waldrip et al., 2006). By combining the power of multirepresentation with advances in digital technology, it is hoped that a richer, more interactive, and meaningful learning experience can be created for students.

Methods

This study uses a qualitative approach with a literature review method to explore and develop a multirepresentation learning model in the digital age. The qualitative approach was chosen because this study aims to understand phenomena and concepts in depth, as well as explore different perspectives and interpretations regarding thedevelopment of multirepresentation learning models in the digital age. Literature review is a research method that involves the process of collecting, evaluating, and analyzing various literature sources relevant to the research topic in order to gain a deeper and more comprehensive understanding.

In the context of this study, a literature review was conducted to examine various multi-representation learning models that have been developed and how these models can be integrated with digital technology to create a more effective and meaningful learning experience. In conducting the literature review, the researcher focused not only on concepts and theories, but also on empirical evidence from previous studies on the effectiveness of multi- representation learning models in improving learning outcomes and student skills.

Data Analysis

The data collection process in this study was conducted through searching and analyzing various literature sources relevant to the research topic, especially those related to multirepresentation learning models and the use of digital technology in learning. The literature sources used in this study include scientific journal articles, books, conference proceedings, dissertations, and other credible sources published within the last 10 years. Literature review was conducted through academic databases such as Google Scholar, Scopus, Science Direct, and ERIC using keywords such as "multirepresentation," "multirepresentation learning," "multirepresentation learning models," "digital technology in learning," "learning in the digital age," and other relevant keyword combinations. To ensure the quality and relevance of the literature sources, the researcher established several inclusion and exclusion criteria. The inclusion criteria include: literature sources published within the last 10 years, literature sources that examine multirepresentation learning models or the use of digital technology in learning, literature sources with clear and valid research methodologies, and literature sources published in indexed journals or by credible publishers. Exclusion criteria include: literature sources that are not relevant to the research topic, literature sources with unclear or weak research methodologies, and literature sources not published in indexed journals or by credible publishers.

Results

The results of the literature review indicate that the development of multirepresentation learning models in the digital age must pay attention to several important components that are integrated with each other. Multi-representation learning models in the digital age are an advancement of conventional multi-representation learning models by integrating digital technology as a medium to facilitate different forms of representation. Based on the results of analyzing various literatures, it was found that multirepresentation learning models in the digital age ideally have the following characteristics: (1) based on constructivist principles that allow learners to actively construct their own understanding through various forms of representation, (2) integrating digital technology as a medium to facilitate more dynamic and interactive representations, (3) learner-centered, providing opportunities for learners to choose and use forms of representation that suit their learning styles and needs, (4) collaborative, encouraging interaction and discussion among learners in constructing shared understanding, and (5) adaptive, able to adapt to individual learners' needs and abilities. The development of a multirepresentation learning model in the digital age also needs to pay attention to good learning design principles, such as clear learning objectives, relevant and meaningful learning activities, and assessment that can

e-ISSN 2600-8572 | DOI: https://doi.org/10.11113/itlj.v9.199

comprehensively measure learners' understanding.

The components of a multi-representation learning model in the digital age include several important and interrelated elements. Based on the results of a literature review, these components include: (1) clear, specific, and measurable learning objectives that focus not only on mastery of content but also on the development of students' multirepresentation skills, (2) learning content presented in various forms of representation, such as verbal, visual, graphical, mathematical, and digital simulations, (3) learning activities that encourage students to use, analyze, and transform various forms of representation, (4) digital learning media and resources that allow for dynamic and interactive representations, such as simulations, animations, and videos, (5) Learning strategies that encourage students to be active in the learning process, such as problem-based learning, project-based learning, and inquiry- based learning, (6) The role of teachers as facilitators who help students develop their multirepresentation skills, and (7) Assessments that can comprehensively measure students' conceptual understanding and multirepresentation skills. These components do not stand alone, but are interrelated and integrated into a holistic learning system. For example, learning objectives determine the content and learning activities to be undertaken, as well as the types of assessments to be used to measure the achievement of these objectives

Discussions

The integration of digital technology into multi-representation learning models is a crucial aspect that distinguishes this model from conventional multi-representation learning models. Based on the results of a literature review, digital technology can be integrated into multirepresentation learning models in several ways: (1) the use of interactive multimedia that can present content in different forms of representation simultaneously, such as text, images, audio, video, and animation, (2) the use of simulations and virtual labs that allow students to explore phenomena and concepts virtually, especially for concepts that are difficult to observe directly, (3) the use of specialized applications and software designed to facilitate specific representations, such as graphics software, mathematics software, and so on, such as graphics software, mathematical software, and modeling software, (4) the use of online learning platforms (e-learning) that allow access to various multirepresentational learning resources anytime and anywhere, and (5) the use of augmented reality (AR) and virtual reality (VR) technologies that can provide a more immersive and interactive learning experience. The integration of digital technologies into multi-representation learning models not only enriches the forms of representation that can be used, but also enables more dynamic, interactive, and personalized representations according to the needs and abilities of the learners. However, it is important to remember that digital technology is only a tool to facilitate learning and its use must always be based on good pedagogical principles and clear learning objectives.

The stages of implementing a multi-representation learning model in the digital age, based on the results of an analysis of various literature, can be developed into five main stages. The first stage is orientation, where the teacher presents students with a problem or question related to the concept or material and communicates the learning objectives. In this stage, the teacher can use digital media such as videos, animations, or images to attract students' attention and get them interested in the topic to be studied. The second stage is inquiry, where students try to solve problems or answer questions through observation, reading information from various digital learning resources, and collaborative discussion. Digital technologies such as the Internet, e-books, and online databases can be used at this stage to facilitate access to different sources of information. The third stage is multi-representation presentation, where students present their answers to problems using a concept in different forms of representation (visual, symbolic, verbal, mathematical). At this stage, digital software and applications such as graphing tools, simulations, and presentation applications can be used to help students create and present different forms of representation. The fourth stage is implementation, where students use different forms of representation to solve other, more complex problems or in different contexts. Digital educational games, simulations, and virtual labs can be used at this stage to provide a more interactive and engaging application experience. The fifth stage is assessment, where teachers and students reflect on the learning process and outcomes, and measure the achievement of learning objectives. Digital assessments in various forms, such as online quizzes, e-portfolios, and performance-based assessments with electronic rubrics, can be used at this stage.

The impact of implementing a multi-representation learning model in the digital age on students' learning outcomes and skills has proven to be very positive based on the results of the studies that have been analyzed. Multi- representation learning strategies are very suitable for use in science learning because they are able to overcome students' difficulties in understanding concepts (Masrifah et al., 2020). This is supported by a study (Taufiq, 2010) that found that the average percentage of students' multi-representation ability increased by 52.38% after using a PBL model with a multi-

e-ISSN 2600-8572 | DOI: https://doi.org/10.11113/itlj.v9.199

representation approach. (Susilo, 2018) also stated that there was a change in the type and quality of students' representations after learning with multimedia-assisted multirepresentation, where the percentage of students who created representations using three models changed from 3.5% to 47.4%. In the context of higher- order thinking skills, multirepresentation-based learning is effective in improving students' conceptual understanding and critical thinking skills (Lestari, 2015). Furthermore, the use of multi-representation-based geometry modules is more effective in enhancing students' creativity, with the mean post-test score of the experimental class (73.89) being significantly higher than that of the control class (50.04) (Anita et al., 2021). Positive effects are also evident in terms of interest and motivation to learn, as the PhET-based multi-representation virtual lab modules can increase students' interest, with an average score covering all indicators of 82% in the "very positive" category (Rahman et al., 2024). Overall, the research results consistently show that the multirepresentation learning model in the digital age has a significant positive impact on various aspects of learning, ranging from concept understanding, critical and creative thinking skills, problem solving skills, to students' interest and motivation to learn.

Although the multi-representation learning model in the digital era has many advantages, its implementation also faces various challenges and constraints. Based on the literature analysis, some of the major challenges and constraints in implementing the multirepresentation learning model in the digital era include: (1) limited technological resources, such as hardware, software, and adequate Internet connectivity, especially in schools in remote areas or schools with limited budgets, (2) lack of digital literacy among teachers in using and integrating digital technology in learning, resulting in suboptimal use of technology, (3) digital divide among students, where not all students have equal access to digital technology, both at school and at home, (4) the complexity of designing and developing high-quality multirepresentational learning content that is appropriate to students' needs and characteristics, (5) the difficulty of conducting assessments that can comprehensively measure students' multirepresentational skills, (6) the resistance to change on the part of teachers, students, and the educational system as a whole, which tends to perpetuate conventional learning practices, and (7) the tendency of students to rely on digital technologies and representations that are easiest for them, without trying to develop their ability to use other representations. These challenges and barriers need to be overcome to ensure that the implementation of multirepresentation learning models in the digital age can be effective and provide optimal benefits to students.

Comprehensive and systematic strategies are needed to overcome the challenges and obstacles in implementing multirepresentation learning models in the digital age. Based on the results of the literature review, several strategies that can be applied include: (1) investment in technological infrastructure and digital access, both in schools and in communities, to ensure that all students have equal access to digital technology, (2) professional development and in-service training for teachers in the integration of digital technology and multirepresentational approaches to learning, so that teachers have adequate competencies to implement this learning model effectively, (3) collaboration among teachers, content developers, and educational technology experts in the development of quality multirepresentational learning content and materials that meet the needs of students, (4) adoption of a blended learning approach that combines face-to-face learning with online learning so that it can address access limitations and barriers to learning, and (5) the use of technology to improve the quality of learning, (5) Developing rubrics and assessments that can comprehensively measure students' multirepresentation skills, not just focus on one form of representation, (6) Providing policy support and leadership to schools and educational authorities to encourage innovation and change in learning practices, and (7) Creating a community of practice where teachers and educational practitioners can share experiences, best practices, and resources in implementing the multirepresentation learning model in the digital age. By implementing these strategies in an integrated and sustainable manner, it is hoped that the challenges and barriers to implementing the multirepresentation learning model in the digital age can be overcome, thereby providing optimal benefits for the development of students' skills.

Conclusion

Based on the results of a literature review on the development of multirepresentation learning models in the digital age, it can be concluded that this learning model is an effective alternative for improving the quality of learning in the digital age. Multirepresentation learning models in the digital age integrate different forms of representation (verbal, visual, graphical, mathematical) with digital technology to create a richer, more interactive and meaningful learning experience for students. The development of this learning model takes into account the principles of constructivism, learner-centeredness, collaboration, and adaptability, and integrates digital technology as a medium to facilitate more dynamic

e-ISSN 2600-8572 | DOI: https://doi.org/10.11113/itlj.v9.199

and interactive representations. The components of the Multi-Representation Learning Model in the Digital Age include learning objectives, learning content, learning activities, digital media and learning resources, learning strategies, the role of the teacher, and assessment. The implementation of this learning model consists of five main stages, namely orientation, inquiry, multi-representation presentation, implementation, and evaluation, with the integration of digital technology in each stage. Digital technology can be integrated into the multi-representation learning model through the use of interactive multimedia, simulations and virtual laboratories, special applications and software, online learning platforms, as well as augmented reality and virtual reality technologies.

The results of the analysis show that the application of the multi-representation learning model in the digital age has a significant positive impact on various aspects of learning. This learning model has proven to be effective in improving concept understanding, critical and creative thinking skills, problem solving skills, as well as students' interest and motivation to learn. Despite its many benefits, the implementation of multi-representation learning models in the digital age also faces various challenges and obstacles, such as limited technological resources, lack of digital literacy among teachers, digital divide among students, complexity in designing learning content, difficulties in conducting assessments, resistance to change, and the tendency of students to become dependent on technology.

To optimize the implementation of the multi-representation learning model in the digital age, comprehensive and systematic strategies are needed, ranging from investment in technological infrastructure, professional development for teachers, collaboration in content development, adoption of blended learning approaches, development of comprehensive assessments, policy support and leadership, to the creation of communities of practice. The development of the multi-representation learning model in the digital age must continue, taking into account technological developments and future learning needs. Thus, the development of multi-representational learning models in the digital age can not only improve the quality of current learning, but also prepare students for the increasingly complex and dynamic challenges and opportunities of the future. The development of these learning models is part of the effort to transform education to meet the challenges and opportunities of the digital age and to equip students with the skills needed in the 21st century.

Limitations and Future Studies

The development of a multi-representation learning model in the digital age has several limitations and constraints that need to be considered. First, this study uses a qualitative approach with a literature review method, so the empirical validation of the proposed model has not been extensively conducted in different educational contexts. This limits the generalizability of the research findings.

Second, the implementation of multi-representation learning models in the digital age faces structural challenges in the form of limited technological resources, especially in schools located in remote areas or with limited budgets. The digital divide between students from different socio-economic backgrounds is also a significant limitation to the equitable and inclusive implementation of this learning model.

Third, the complexity of designing and developing high-quality, multi-representational learning content tailored to the needs and characteristics of learners remains a technical constraint that has not been fully addressed. Difficulties in conducting assessments that can comprehensively measure learners' multirepresentation skills are also a limitation of this study.

Fourth, the varying digital capacity and competence of teachers is a limitation in the implementation of this model. Without adequate competence, the use of digital technology in multirepresentation learning cannot be optimal, so its potential benefits are not fully realized.

Based on the limitations and findings of this study, several directions for further research can be suggested:

1. Development and validation of multirepresentation assessment instruments.
2. Comparative effectiveness studies.
3. Development of teacher training models.
4. Longitudinal impact studies to analyze the impact of multi-representation learning models in the digital age on the development of students' cognitive, metacognitive, and self-regulated learning skills.
5. Develop adaptive learning content that can be tailored to the needs, learning styles, and individual ability levels of students.
6. Explore blended learning models that integrate face-to-face and online learning within a multi-

e-ISSN 2600-8572 | DOI: https://doi.org/10.11113/itlj.v9.199

representation approach.
7. Implementation studies in different socio-economic contexts.
8. Development of a community of practice as a forum for collaboration and sharing of experiences among educators in implementing multi-representation learning models in the digital age.

With further research in these areas, it is hoped that the obstacles and challenges in implementing multirepresentation learning models in the digital age can be overcome, thereby providing optimal benefits for the development of students' skills to meet the challenges of 21st century education.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Acknowledgment

First and foremost, we would like to thank Allah SWT who has given us the favour of health and guidance in the process of writing this article. We would like to thank the lecturers of the Master of Educational Technology (MTP) programme at the University of Lampung for their knowledge and guidance, which motivates us to keep trying. We express our appreciation to all the authors and researchers whose work is an important reference and contributes greatly to the development of this research. We also thank our classmates and friends who have provided input, shared experiences, and supported us both academically and emotionally. Finally, we hope that this paper can make a useful contribution to the world of education.

References

Ainsworth, S. (1999). *The functions of multiple representations. Computers & Education*, *33*(2-3), 131-152.

Alatas, F. (2021). Kajian pendekatan multirepresentasi dalam konteks pembelajaran fisika. *Jurnal Pendidikan Inspiratif Fisika*, *1*(2), 45-56. https://doi.org/10.52434/jpif.v1i2.1449

Anita, R., Sahwahita, S., & Cahyono, E. (2021). Modul pembelajaran berbasis multi representative pada mata kuliah geometri untuk meningkatkan kemampuan berpikir kreatif. *Jurnal Dedikasi Pendidikan, 13*(2), 173-185. https://doi.org/10.69866/dp.v13i2.73

Harti, N. D. (2022). Pengembangan materi ajar fisika berbasis multirepresentasi untuk meningkatkan kemampuan berpikir analisis peserta didik. *Jurnal Pendidikan Fisika*, *10*(2), 187-199.

Hidayat, A., Enawaty, E., & Hadi, L. (2022). Peningkatan pemahaman konsep peserta didik melalui media KIT Covalent Creator berbasis multirepresentasi. *Jurnal Pendidikan dan Pembelajaran Khatulistiwa*, *11*(7), 616-622. https://doi.org/10.26418/jppk.v11i7.56193

Irwandani, I. (2014). Multi representasi sebagai alternatif pembelajaran dalam fisika. *Jurnal Ilmiah Pendidikan Fisika Al-BiRuNi*, *3*(1), 39-48.

Lestari, P. (2015). Pembelajaran berbasis multirepresentasi untuk meningkatkan pemahaman konsep dan kemampuan berpikir kritis. *Jurnal Pendidikan Fisika*, *6*(1), 45-57.

Masrifah, M., Setiawan, A., & Sinaga, P. (2020). Penggunaan model pembelajaran multi representasi berbantuan game edukasi terhadap kemampuan pemahaman konsep. *JIPF (Jurnal Ilmu Pendidikan Fisika), 5*(3), 135-142.

Murtono, M., Setiawan, A., & Rusdiana, D. (2014). Fungsi representasi dalam mengakses penguasaan konsep fisika mahasiswa. *Jurnal Pendidikan Fisika dan Keilmuan*, *1*(2), 80-84.

Prakoso, B. E., Djudin, T., & Hamdani, H. (2019). Analisis kemampuan multirepresentasi peserta didik dalam mengerjakan soal gerak

lurus berubah beraturan di SMA. *Jurnal Pendidikan dan Pembelajaran Khatulistiwa*, *8*(6), 1-10.

Puspitasari, V. (2018). Implementasi model guided discovery learning disertai LKS multirepresentasi berbasis pemecahan masalah untuk meningkatkan pemahaman konsep siswa. *Jurnal Pendidikan Fisika*, *7*(2), 89-101.

Putri, A. H., Sutrisno, S., & Chandra, D. T. (2020). Efektivitas pendekatan multirepresentasi dalam pembelajaran berbasis masalah untuk meningkatkan pemahaman konsep siswa SMA pada materi gaya dan gerak. *Journal of Natural Science and Integration*, *3*(2), 205-214.

Rahman, A., Mardiana, N., & Rizal, S. (2024). Pengembangan modul praktikum virtual berbasis multirepresentasi untuk meningkatkan minat siswa. *Jurnal Sains Dan Edukasi Sains, 7*(1), 37-44. https://doi.org/10.24246/juses.v7i1p37-44

Susilo, S. (2018). Pengaruh pembelajaran multirepresentasi berbantuan multimedia terhadap perubahan jenis representasi siswa. *JPPIPA (Jurnal Penelitian Pendidikan IPA)*, *2*(1), 11-18. https://doi.org/10.26740/jppipa.v2n1.p11-18

Taufiq, M. (2010). Penggunaan model problem based learning dengan pendekatan multirepresentasi untuk meningkatkan kemampuan representasi siswa. *Jurnal Pendidikan*, *5*(3), 35-47.

Theasy, Y. (2018). Multi-representation ability of students on the problem solving physics. *Journal of Physics: Conference Series*, *983*(1), 012005.

Waldrip, B., Prain, V., & Carolan, J. (2006). Learning junior secondary science through multi-modal representations. *Electronic Journal of Science Education*, *11*(1), 87-107.