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Educational Revolution : Digital Project-Based Rotation Learning (DPBRL) Model to Improve Students' Critical Thinking Skills

Dydik Kurniawan[1]*, Siti Masitoh[2], Bachtiar Sjaiful Bachri[3], Taufik Hidayat[4], Tri Wahyuningsih[5],
[1*,2,3,4,5]Faculty of Teacher Training and Education, Universitas Negeri Surabaya,
[4,5]Universitas Mulawarman, Indonesia.
*Corresponding Author. Email: dydik.22010@mhs.unesa.ac.id

Abstract: The research aimed to develop and assess the effectiveness of the Digital Project-Based Rotation Learning (DPBRL) model in enhancing students' critical thinking skills. The study employed a research and development method, using a non-equivalent control group design during the pilot phase, a research method used to describe and measure the characteristics of populations or phenomena systematically using numerical data, involving 83 undergraduate students from Mulawarman University Guidance and Counseling Study Program, divided into two heterogeneous classes. Validation of the DPBRL model was conducted by experts in learning model design, materials, and media, with data collected through validation sheets, interviews, document analysis, questionnaires, observation, and documentation. The data was analyzed using descriptive technique and Independent Samples t-test. The results demonstrated that the DPBRL model effectively improved students' critical thinking skills and digital literacy, particularly through the use of digital modules with Flipbook Maker. The model's rotation structure and presentation stage provided a structured learning approach, highlighting the importance of feedback. The study concluded that integrating technology and collaboration in project-based learning through the DPBRL model significantly benefited students' critical thinking, digital literacy, and teamwork, offering a comprehensive and effective learning experience.

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Introduction

Education has evolved rapidly along with the integration of digital technology. Traditional educational approaches often focus on memorization and passive learning, which may not adequately prepare students for the complex challenges they will face in the 21st century (Alharthi et al., 2023; Sharma & Shree, 2023). In response to this, there is an increasing emphasis on developing critical thinking skills among university students to equip them with the tools necessary for success in an increasingly digital and interconnected world (Serkina et al., 2023).

Digital Project is an alternative in the learning process because students will not only get material from one source, but materials from various sources selected through the stage of student needs analysis (Huang et al., 2023). The position of the media is certainly very important because the media functions as an intermediary, so it will be able to cover the lack of teacher delivery in learning (Golinelli et al., 2020). Therefore, educators are expected to be able to select media appropriately, develop digital media, and apply digital media in the learning process.

Blended learning is an approach that combines traditional face-to-face instruction with online learning activities (Chamo & Biberman-shalev, 2023; Haryono & Hamzah, 2023). *In a blended learning environment, students engage in a mix of direct interaction with lecturers and peers, as well as virtual activities through digital platforms* (Antonis et al., 2023). The goal of blended learning is to take advantage of the benefits of traditional and online methods, offering a more flexible and personalized learning experience (Nuryadin, 2023). This dive is in the lecture process which is carried out offline and conventionally, but in 2020 when the covid 19 pandemic occurred (Changes & Education, 2023).

The Rotation Model is a model in which students take turns between different modalities, usually between face-to-face teaching and online learning. This can include stations or laboratories where students take turns doing various activities. The blended learning rotation model offers a balanced approach that combines the benefits of face-to-face instruction with the flexibility and individualization opportunities provided by online learning. By implementing this model, educators can create a dynamic learning environment that meets the diverse needs of students and encourages deeper engagement and understanding of the curriculum (Kömür et al., 2023)

Critical thinking is the ability to analyze, evaluate, and interpret information and arguments logically and systematically (Mohseni et al., 2020; Reynders et al., 2020). It involves questioning assumptions, considering alternative perspectives, and making judgments based on evidence and reasoning (Heydarnejad et al., 2021). Critical thinking can be defined as a deliberate, self-regulated assessment of a person's actions and thoughts, which involves verification, investigation, judgment, and inference (Horn, 2019). Critical thinking consists of cognitive, dispositional, motivational, behavioral, and metacognitive functions Critical thinking is characterized by the ability to analyze, judge, make logical decisions, and it requires acknowledging assumptions and providing justifications for ideas and actions (Almeida & Franco, 2011; Arends, 2012; Barrow, Lyte, & Butterworth, 2002; Spuzic et al., 2016). Based on some of the opinions above, it can be concluded that, Critical thinking is a fundamental cognitive skill that involves the systematic analysis, evaluation, and interpretation of information and arguments.

The Digital Project Base Rotation Model Learning (DPBRL) framework emerged as a potential solution to address this need. DPBRL combines elements of project-based learning with a rotational model, utilizing digital tools, and resources to increase student engagement and collaboration. By immersing students in an authentic project-based learning experience and providing opportunities for hands-on exploration and experimentation (Antonis et al., 2023)(Obeidat & Yaqbeh, 2023), DPBRL aims to foster critical thinking skills in a dynamic and interactive learning environment.

Design projects within the framework of DPBRL that require students to define problems, conduct research, and develop solutions. This hands-on approach encourages critical thinking, educators can create a dynamic learning environment that enhances students' critical thinking abilities and equips them with the skills necessary to effectively address real-world challenges. The latest technology includes digital learning tools, pedagogical models, and approaches to critical thinking in education. The novelty of this research lies in the specific integration of the DPBRL framework and its potential to offer unique benefits in enhancing these skills among students. In addition, this research may contribute to the development of new evaluation metrics and cross-disciplinary applications.

The DPBRL model is new due to its unique syntax and integrated digital technology, which emphasizes digital-based projects, blended learning environments, and a focus on developing 21st-century skills, and providing an authentic learning experience. This

innovative approach to education has great potential to empower students to become lifelong learners, critical thinkers, and active participants in an increasingly digital and interconnected world. The research aims to contribute to the educational revolution by providing an innovative learning model that enhances critical thinking students, preparing them for the complexities of the 21st century. The expectations for this research include demonstrating that the DPBRL model can significantly improve students' critical thinking skills, providing educators with a scalable and adaptable framework for modern teaching, and ultimately contributing to the ongoing transformation of education in the digital age.

Research Method

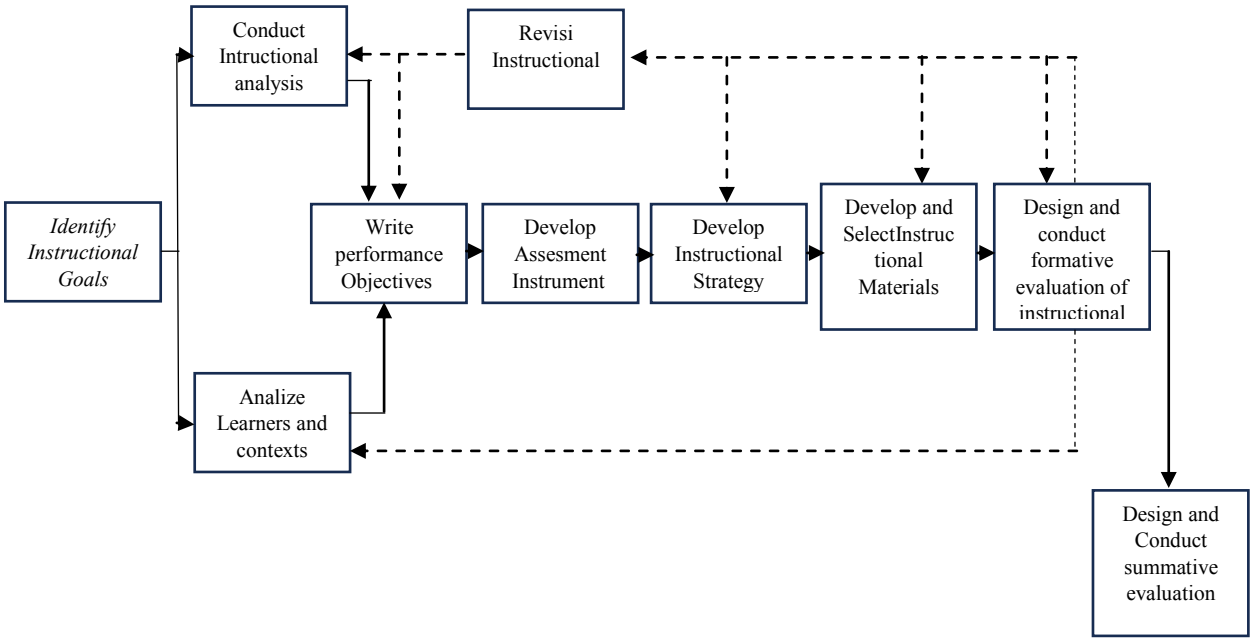

Figure 1. Development Design Dick and Carey (2015) (Abbie & Timothy, 2016; Dick and Carey, 2015; L.Gustafson, 2002)

Based on the Ten Stages of the Dick and Carey Model (2015), it creates a structured framework for systematic learning design, emphasizing careful analysis, clear goals, thoughtful material development, and continuous evaluation to create impactful and meaningful learning experiences. The trial of the development model of the Digital Rotation Based Blended Learning (DRBBL) development model was carried out with a plan for seven meetings in one semester. The trial was carried out in two stages. The first stage is to test the validity and reliability of the instrument made with related experts. The second stage is a target trial, which is in the form of the implementation of the Digital Rotation Based Blended Learning (DRBBL) development model that has been prepared. During the trial, the researcher conducted observation and monitoring to obtain data that could be used to improve the learning model.

The purpose of the expert trial is to validate or assess the feasibility of the Digital Rotation Based Blended Learning (DRBBL) model and all its learning tools. The feasibility test of Digital Rotation Based Blended Learning (DRBBL) was carried out with learning design experts to see in terms of the accuracy of the learning process, the accuracy of the material by material experts, and the accuracy of the actual conditions in the field of employment with design industry experts (practitioners). This evaluation aims to get academic and professional input to make revisions to the design of the learning model made.

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Instrument trials are carried out to determine the validity and reality of an instrument. Design of research and development trials in broad trials using research designs nonequivalent control group design, Sugiyono (2021, p. 138) as in Table 3.2 as follows.

Table 1. Nonequivalent Control Group Design

Class	*Pre-test*	Treatment	*Post-test*
Experiment	O_1	X	O_2
Control	O3		O4

This research focuses on the development of a Digital Rotation Based Blended Learning (DRBBL) model. This study involved 83 S1 students of the Mulawarman University Guidance and Counseling Study Program who were divided into two heterogeneous classes (A and B). The sampling technique includes three stages of formative evaluation: Individual testing process with experts as validators, small group evaluation with 10 students with various abilities (3 low, 3 medium, 4 high), and Field trial with 73 students divided into experimental and control groups. The validation sheet is filled out by 1 learning model design expert, 1 material expert and 1 media expert.

To obtain data that supports this research and development, the researcher uses several methods/techniques for data collection, namely through 1) Validation sheets of Digital Project Rotation Based Blended Learning Devices and Models, 2) interviews, 3) document analysis, 4) questionnaires, 5) observations, and 6) documentation (Sugiyono, 2018). This study uses quantitative descriptive techniques to analyze data, focusing on the effectiveness of Digital Project-based Rotation Learning (DPBRL) in improving critical thinking skills. This analysis is supported by the results of field trials in the experimental class. The data includes student project work assessments. Quantitative and qualitative descriptive methods were used to assess the practicality of the DPBBL model. The effectiveness test, which involves comparing the posttest and t-test between the control group and the experiment, determines whether the DPBRL model improves critical thinking skills. The Independent Sample t-test is used to compare the results of the posttest. (Ahmady & Shahbazi, 2020).

Results and Discussion

Based on the data obtained from the respondents, a statement can be given regarding the data.

Table 2. The indicator grid of RPS devices is as follows.

Dimensions	Descriptor	Score
RPS Components	1. Course learning outcomes contain aspects of attitud e, knowledge, and skills.	4
	2. The final abilities planned at each learning stage to fulfill the learning outcomes of graduates.	4
	3. Formulation of objectives/indicators supports learni ng outcomes.	4
	4. Study materials are related to the skills to be achiev ed.	4
	5. Appropriateness of learning strategy selection with indicators.	4
	6. Suitability of learning resources/media with indicat ors	4
	7. Appropriateness of time planning with learning ma terials.	4
	8. Suitability of learning experience with indicators	4
	9. Assessment items are in accordance with the indica tors	4
	10. Reference currency	4
Conformity with language	1. Communicative sentence formulation and no double meaning	4
rules (PUEBI)	2. The correct language used is in accordance with the good and	4

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Dimensions	Descriptor	Score
	rules of Indonesian grammar	
	Average	4

Based on table 2. All indicators, including course learning outcomes, learning materials, learning strategies, resources, time planning, assessment items, and language rules, scored 4. This indicates that these components are considered feasible for use without any revisions.

Table 3. Student worksheet assessment sheet grid

Criteria	Dimensions	Average Score
Content component	Learning objectives	4
	The workbook refers to the stages of the design process	4
	Bring out aspects of *critical thinking*	4
	Linkage to other materials	4
Presentation component	Presentation method	4
	Book display design	4
	Conformity with language rules (PUEBI)	4
	Average	4

Based on table 3. Learning objectives, project steps, design process procedures, critical thinking aspects, integration with other materials, presentation methods, and book display design all scored 4. This shows a high level of eligibility without the need for revision.

Table 4. DPBBL learning model assessment sheet grid

Criteria	Dimensions	Average Score
Content validity	*Need*	4
Aspects of feasibility of supporting theory	Appropriateness of the model's theoretical rationale with the construction of the supporting theoretical foundation	4
	Learning Objectives	4
	State of the art	4
Construct Validity		
Constructability Aspects	Learning Model Steps or Syntax	4
	Social System	4
	Reaction principle	4
	Support system	4
	Instructional impact and accompanying impact	4
	Learning tool components.	4
	Learning Implementation	4
	Evaluation	
	Conformity with Language Rules (PUEBI)	4
	Average	4

Based on table 4. The assessment also scored 4 on all criteria, indicating a strong alignment with needs, supporting theories, construct validity, social systems, reaction principles, supporting systems, and language rules.

Table 5. Assessment of Learning Modules

Criteria	Score
Learning objectives	4
Content Relevance	4
Instructional design	4

Assessment Variations	3
Feedback Mechanism	4
Accessibility	4
Technical Quality	4
Average	4

Based on table 1.5. Similar to other assessments, most of the criteria score 4 except for the "Assessment Variation" which scores 3. This suggests that while this learning module is generally feasible, it may be better if it is revised in its assessment variations to better suit diverse learning outcomes. The syntax of the development of the rotation learning model into the Digital learning model of the Base Rotation Learning project is integrated with a digital project-based approach. The Digital Project-Based Rotational Learning Model (DPBRL) is as follows:

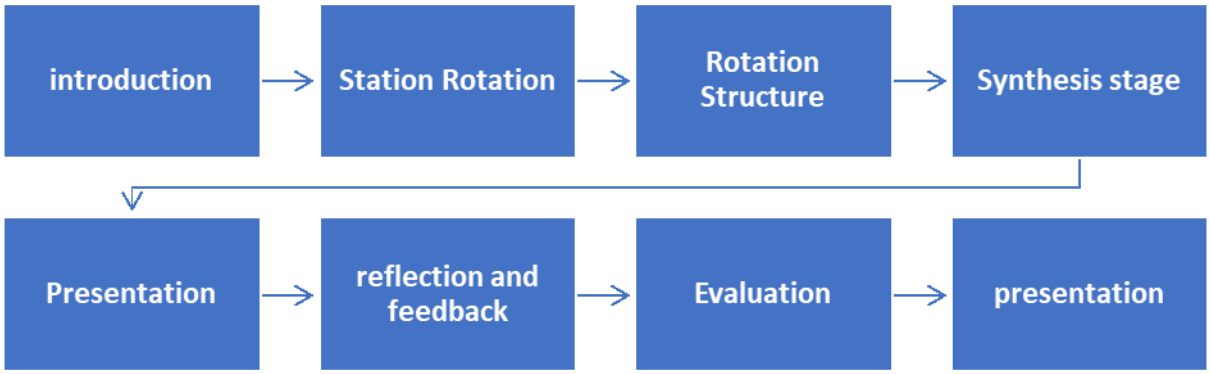

Table 6. Descriptive statistics

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Control Class	37	70,00	82,00	2756,00	74,49	3,33
Experiment Class	37	70,00	85,00	2877,00	77,76	3,54
Valid N (listwise)	37					

Based on Table 6. showed descriptive statistics for two groups: control and experiment. The table shows the minimum, maximum, amount, average, and standard deviation of a variable. Both groups had the same number of participants (N=37). The control group had an average score of 74.49 and the experimental group had an average score of 77.76.

Tabel 7. Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Learning Model	Equal variances assumed	0,027	0,870	4,094	72	0,00	3,27	0,79	1,68	4,86

Equal variances not assumed	4,094	71,736	0,00	3,27	0,79	1,68	4,86

Based on table 7. With a p-value significantly less than 0.05, we rejected the null hypothesis and concluded that there was a statistically significant difference between the control group and the experimental group. This shows that experimental interventions are effective in increasing students' critical thinking.

Discussion

The findings of this study support the idea that the DPBRL model can be an effective tool for improving student learning outcomes. The model's ability to incorporate online research, collaboration, and design-making stations allows students to engage in creative and analytical tasks, which can lead to better learning outcomes. The results also highlight the importance of incorporating feedback mechanisms into the learning process. The reflection and feedback stations in the DPBRL model provide students with the opportunity to review their work, receive feedback from peers, and reflect on their learning process. This is in line with existing research that emphasizes the role of feedback in improving student learning outcomes.

Limitations and Future Directions. Active learning is a pedagogical approach that engages students in creative and analytical tasks, creating a more interactive and participatory classroom environment. Instead of passively absorbing information, students are encouraged to think critically, and work on projects that require a deeper understanding of the subject matter. This hands-on engagement not only enhances understanding but also makes learning more enjoyable and memorable.

Based on the research results, the devices of the Digital project-based Rotation Learning (DPBRL) model include: The RPS device has received the maximum score in all assessment indicators, which indicates that the device is very feasible to use without the need for revision. Similarly, all aspects of the student worksheet assessment have achieved the highest score, indicating its suitability without modification. Although the learning module is generally considered feasible with high scores in almost all criteria, the variety of assessments needs to be increased to improve its overall effectiveness. This evaluation provides clear guidance on the strengths and areas that require improvement in the learning process.

The main difference between the two syntaxes is the addition of Presentation in the DPBRL model, which emphasizes the importance of presenting the completed project. In addition, the DPBRL model has a more structured approach to rotations, with the Rotation Structure playing an important role in guiding students through the project. The development of essential skills is another important benefit. Incorporating technology and digital devices into the learning process improves digital literacy, ensuring that students are comfortable and proficient with modern technology. In addition, it enhances design skills, enabling students to create visually appealing and functional projects. Collaboration is also a key component, as students often work in groups, developing teamwork and communication skills that are crucial for their future careers.

A blended approach to education combines the best of online and offline learning experiences. Online resources provide access to a wealth of information and interactive tools that can complement traditional teaching methods. Meanwhile, offline interactions, such as face-to-face discussions and practical activities, ensure that students still benefit from direct engagement with teachers and peers. This comprehensive learning experience meets a variety of learning styles and needs, making education more flexible and effective.

While this study provides valuable insights into the effectiveness of the DPBRL model, there are some limitations to consider. For example, this study did not control for other factors that may affect students' learning outcomes, such as prior knowledge or motivation. Future research could address this limitation by incorporating stronger control measures. Additionally, this research could be extended to investigate the long-term impact of the DPBRL model on student learning outcomes. This will provide a more comprehensive understanding of the effectiveness of the model and its potential for wider application.

The development of the DPBRL (Design, Project-Based, and Rotational Learning) model is an innovative integration of project-based learning and rotational learning methods to create a comprehensive and engaging educational experience. By combining these two approaches, the DPRRL model aims to provide a more dynamic and interactive learning environment for students, where they can engage deeply with the material and develop various skills. This approach is similar to the Project-based Laboratory Rotation Blended Learning (PjBLRBL) model, which also focuses on improving critical thinking and collaboration through a blend of virtual practicum activities and project work. Both models emphasize the importance of hands-on, practical learning experiences and the value of working on projects that require students to apply their knowledge in a real-world context.(Dewi et al., 2023). By blending virtual and physical learning activities, these models foster an environment where students can develop essential skills while engaging in meaningful and relevant educational tasks.

Digital module development involves creating interactive learning materials using a web-based application called Flipbook Maker. These digital modules include a variety of educational resources, including instructional materials, practice questions, virtual lab activities, and project assignments. By integrating these elements, the modules offer a holistic learning experience that combines theoretical knowledge with practical applications.

Figure.2. Average score of control and experimental classes

The density plots visually supported the statistical analysis showing that students in the experimental group, who were exposed to the DPBRL model, performed better on average than those in the control group. This is evidenced by the higher peaks and greater density of scores in the higher ranges for the experimental group. The statistically significant difference (p value <0.05) between the control group and the experimental group has several important implications. The effectiveness of the intervention was evident. The experimental group performed significantly better than the control group, which suggests that the teaching method

or intervention used for the experimental group was more effective in improving students' critically thinking. This suggests that the specific strategies or techniques used had a meaningful impact on students' academic performance. The results showed improved learning among students in the experimental group. These students tended to gain a better understanding of the subject matter or develop stronger skills compared to their peers in the control group. This improvement highlights the potential benefits of the intervention in facilitating deeper understanding and skill acquisition. The positive results indicate the potential for wider applicability. If the experimental approach is shown to be consistently effective, it could benefit from being applied more widely in educational settings. This could result in better learning outcomes for more students, making this intervention a valuable addition to educational practice.Finally, further investigation is needed. Although significant differences have been established, it is important to understand the practical significance of these differences. Calculating the effect size will provide a better understanding of the magnitude of the difference between the two groups. This additional analysis will help determine how substantial and impactful the observed differences are, which will guide future implementation and research. This finding is in line with the results of a study entitled“ Project-based Laboratory Rotation Blended Learning Model to Train Students’ Critical Thinking and Collaboration in Physics Course” Results of the study the effectiveness of the PjBLRBL model in enhancing students' critical thinking and collaboration skills needs to be examined. Based on the findings of this study, the PjBLRBL model can be recommended as a suitable learning approach for tertiary (Dewi et al., 2023)

The DPBRL (Design, Project-Based, and Rotational Learning) model has shown significant effectiveness in improving students' critical thinking skills. This improvement has been measured using various assessment instruments that evaluate students' ability to analyze, evaluate, and synthesize information. By engaging students in projects and rotational learning activities, the DPRRL model encourages deeper understanding and critical examination of the subject matter, leading to better critical thinking outcomes. These findings are in line with previous research on problem-based learning (PBL), which has also been shown to improve critical thinking skills, particularly in biology education courses. Like PBL, the DPBRL model involves students actively working on complex problems and real-world scenarios, which encourage critical analysis and decision-making (Astuti et al., 2019). Both models highlight the importance of active learning strategies in developing higher- order thinking skills, demonstrating their effectiveness in a variety of educational contexts.

Student digital literacy. By integrating digital content creation training into the curriculum, this model ensures that students not only consume digital resources but also actively participate in their creation. This hands-on experience with digital devices and platforms builds their proficiency and confidence in using technology effectively. This aspect of the DPBRL model reflects the application of project-based learning in improving digital literacy through similar digital content creation training. Both approaches emphasize the importance of students becoming proficient in navigating and producing digital content. By engaging in projects that require the use of various digital devices, students develop essential skills that are increasingly important in today's technology-driven world. Through these practical experiences, students gain the digital fluency needed to succeed in their future academic and professional endeavors.

Conclusion

This study concluded that the DPBRL model is effective in improving students' critical thinking skills. Students using the DPBRL model showed significant improvement in these

areas compared to students using traditional learning methods. The project-based nature of the DPBRL model encourages active learning, collaboration, and the application of knowledge to real-world scenarios, which are essential for developing critical thinking. The rotational aspect of the model ensures that all students engage with a variety of digital projects and tools, encouraging a comprehensive learning experience and fostering the development of diverse skills.

Recommendation

In relation to this, it is suggested that the education office and schools organize training for teachers in implementing the DPBRL model. This training should include the use of digital technology, project-based classroom management and strategies for providing effective feedback. Policymakers need to be informed to guide education policy and investment decisions regarding the integration of digital tools and project-based learning models. Future research should focus on building a foundation for further studies on the integration of digital resources and project-based learning in education.

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