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The Transformative Power of Challenge-Based Learning in Cultivating 21st-Century Skills

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Abstrak

Penelitian ini membahas implementasi model pembelajaran yang efektif untuk mengembangkan keterampilan abad ke-21, khususnya kemampuan berpikir kritis dan kreatif. Selain itu, masih terdapat pemahaman yang kurang memadai mengenai bagaimana model Challenge-Based Learning (CBL) berkontribusi dalam meningkatkan keterampilan berpikir tingkat tinggi di berbagai konteks pendidikan. Penelitian ini bertujuan untuk menganalisis dampak penerapan model CBL terhadap pengembangan keterampilan berpikir kritis, berpikir kreatif, dan kolaborasi siswa. Menggunakan metode studi literatur sistematis dengan desain deskriptif kualitatif, penelitian ini meninjau 33 artikel ilmiah yang bersumber dari basis data Scopus, Google Scholar, dan SINTA, yang diterbitkan antara tahun 2010 hingga 2024. Pengumpulan data dilakukan dengan bantuan aplikasi Publish or Perish dan VOSviewer untuk memvisualisasikan dan menganalisis jaringan data. Teknik analisis tematik digunakan untuk mengidentifikasi tren dan pola dalam penerapan model CBL. Hasil penelitian menunjukkan bahwa model CBL secara efektif meningkatkan keterampilan berpikir tingkat tinggi, keterlibatan siswa, kemampuan kolaborasi, dan kreativitas. Namun, penelitian juga mengungkapkan tantangan utama, termasuk keterbatasan sumber daya dan kurangnya dukungan institusional. Kesimpulannya, meskipun model CBL secara signifikan mendukung pengembangan keterampilan berpikir kritis dan kreatif, diperlukan upaya lebih lanjut dari institusi pendidikan untuk mengatasi kendala tersebut guna memaksimalkan dampaknya di lingkungan pendidikan.

***Kata kunci*:** *Tinjauan Pustaka, Pembelajaran Berbasis Tantangan, Keterampilan Abad 21*

Abstract

This research addresses the implementation of effective learning models for developing 21st-century skills, particularly critical and creative thinking abilities. Furthermore, there remains insufficient understanding of how the Challenge-Based Learning (CBL) model contributes to enhancing higher-order thinking skills across diverse educational contexts. This study aims to analyze the impact of implementing the CBL model on fostering critical thinking, creative thinking, and collaborative skills among students. Using a systematic literature review with a descriptive qualitative design, the research examined 33 scientific articles sourced from the Scopus, Google Scholar, and SINTA databases, published between 2010 and 2024. Data collection was conducted with the assistance of the Publish or Perish application and VOSviewer to visualize and analyze data networks. Thematic analysis techniques were employed to identify trends and patterns in the application of the CBL model. The findings indicate that the CBL model effectively enhances higher-order thinking skills, learner engagement, collaboration, and creativity. However, challenges such as limited resources and insufficient institutional support were also identified. In conclusion, while the CBL model significantly promotes the development of critical and creative thinking skills, addressing institutional and resource constraints is essential for maximizing its impact in educational settings.

Keywords: Literature Review, Challenge-Based Learning, 21st Century Skills

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1. INTRODUCTION

21st-century learning requires students to possess cognitive and non-cognitive skills, such as thinking critically and creatively, collaborating, and communicating effectively. The ideal condition expected in modern education is the existence of a learning approach that encourages students to think deeply, solve real-world problems, and innovate in various situations (Azeta et al., 2018; Wibowo & Veronica, 2022). One of the relevant and considered models capable of realizing this ideal condition is Challenge-Based Learning (CBL). The CBL model integrates challenge-based learning, allowing students to engage in

higher-order thinking processes and solve authentic everyday problems (Johnson & Adams, 2011; Saavedra & Opfer, 2012). However, the reality in the field shows a gap between expectations and implementation. Based on observations in several educational institutions, implementing innovative learning models, such as CBL, still faces various obstacles. Previous study reported that the main challenges in implementing CBL include limited resources, a lack of educator training, and inadequate technological infrastructure (Flores et al., 2016). Other study added that although CBL has great potential to improve 21st-century skills, such as critical thinking, creativity, and collaboration, educational institutions often need more systemic support (Beemt et al., 2023).

This problem creates a significant gap between the ideal condition and the reality in the field. On the one hand, students are expected to master higher-order thinking skills relevant to the demands of the workforce and future life. On the other hand, limited resources and a lack of support from educational institutions make it difficult to optimally implement learning models that can develop these skills, such as CBL. Therefore, there is an urgent need to develop solutions to bridge this gap. This research offers a solution through further development and in-depth analysis of the application of the CBL model. The CBL model facilitates a more engaged, collaborative and real project-based learning process, where learners are encouraged to think critically and creatively in solving challenges relevant to everyday life (Ar et al., 2023; Johnson & Adams, 2011). The development of this approach is crucial in order to enhance the 21st-century skills that are needed in an increasingly complex world.

Previous research studies also strongly support the effectiveness of CBL in various educational contexts (Membrillo-Hernández et al., 2018). It found that challenge-based learning strategies significantly increased learners' engagement outside the classroom, an important indicator of critical thinking and collaboration skills development. Another study showed that implementing CBL in engineering education programmes improved learners' collaboration, innovation and problem-solving competencies (Huesca et al., 2024). There is also study's found that students engaged in CBL showed higher levels of creativity and innovative thinking skills than traditional learning methods (Félix-Herrán et al., 2019). These findings suggest that the CBL learning model has the potential to significantly improve learners' 21st-century skills across different levels of education.

The novelty of this study lies in the comprehensive analysis of the implementation of CBL in various levels of education, including primary and secondary education, which still needs to be explored in previous studies. While many previous studies have focussed more on higher education, this research seeks to fill the gap by examining how the CBL model can be effectively implemented in broader educational contexts, as well as how it can be adapted to meet the specific needs of students at different levels of education.

This research is important given the urgency to prepare learners for the increasingly complex challenges of the 21st century. With the world of work demanding collaborative skills, critical thinking, and creative problem-solving, learning models such as CBL play a crucial role in ensuring learners not only master academic materials but also skills relevant to real life. Therefore, this study aims to analyse the impact of implementing the CBL model on developing learners' critical, creative, and collaborative thinking skills in various educational contexts. In addition, this research will also identify challenges and solutions that can be applied to maximise the potential of the CBL model in developing 21st-century skills.

More specifically, the purpose of this research is to deeply understand how the CBL model can overcome various limitations in traditional learning and propose more effective and efficient implementation strategies in a broader educational context, especially at the primary and secondary education levels. The references used in this research are taken from

SINTA-indexed and international scientific articles within the last five years, providing theoretical and empirical foundations to support each argument.

2. METHODS

The type of research used in this study is a literature review with a systematic review design. This research design follows a model adapted from the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method (Moher et al., 2009), which aims to analyse research trends related to Challenge-Based Learning (CBL) and 21st-century skills. The research design chart can be seen in Figure 1, which explains the flow of selecting, screening and analysing articles based on predetermined inclusion and exclusion criteria.

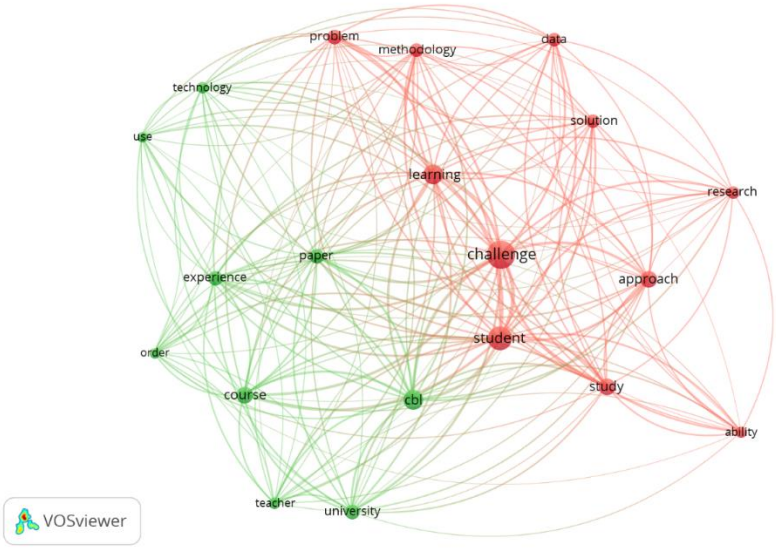

Figure 1. Overlay Visualization Data Mapping on Google Scholar (GS) Database Text Data

Based on Figure 1, there are two different clusters from the visualisation shown in Figure 2. The first cluster (red) keywords are challenge, learning, student, study, methodology, problem, ability, approach, solution, data, and research. The second cluster (green) keywords are cbl, paper, technology, use, experience, course, university, teacher, and order. The subjects of this research trial were 33 relevant scientific articles published between 2010 and 2024. The articles were obtained from various database sources such as Scopus, Google Scholar, and SINTA, which were selected based on the suitability of the keywords 'Challenge-Based Learning' and '21st-century skills'. The data collection method used the Publish or Perish application to extract metadata and VOS viewer to visualise the relationship between articles through keyword mapping. For the instrument, articles were identified and validated using a validity grid based on the relevance of the topic, research methods, and results captured. This grid ensured that each article met the criteria of solid research in terms of methodological quality and contribution to the field of study.

Data analysis was conducted using two approaches: (1) Quantitative analysis, which was calculated based on the percentage frequency of occurrence of the main keywords of the analysed articles. (2) Qualitative analysis was conducted with a narrative exploration of the research findings and emerging trends in the topic of Challenge-Based Learning and its impact on the development of 21st-century skills.

3. RESULTS AND DISCUSSION

Results

The result of preliminary investigation on the contribution of challenge-based learning model is show in Table 1.

Table 1. Results of Preliminary Investigation on the Contribution of Challenge-Based Learning Model

No	Author Name	Title	Methods	Result	Strengths	Weaknesses	Name of Publi-cation
1	(Colombelli et al., 2022)	Entrepreneu rship Education: The Effects of….	Qualita-tive	CBL model enhances entreprene urial	Mindset: Interesting and practical approach	Limited sample size	Journal of Entrepren eurship Education
2	(Beemt et al., 2023)	Taking the Challenge: An Exploratory Study of...	Mixed method	CBL enhances collaborati on and engage-ment	Diverse cultural perspectives	Challenges in standar-dising CBL implement ation	Interna-tional Journal of Higher Education
3	(Binder et al., 2017)	Challenge Based Learning applied to Mobile Software…	Quanti-tative	CBL model effective for teaching mobile application develop-ment	Comprehen-sive technology integration	Difficulties in Implement ation	Educa-tional Techno-logy Research and Develop ment
4	(Blevis, 2010)	Design Challenge Based Learning (DCBL) and…	Case study	DCBL promotes sustainable practices	Focus on sustainabi-lity	Limited to design education	Interac-tions
5	(Chanin et al., 2018)	A Collaborativ e Approach to Teaching Software Startups….	Mixed methods	CBL model encourages collaborati on and engage-ment students in startup develop-ment	Collaborativ e and multidisci-plinary approach	High resource require-ment	CHASE' 18 Procee-dings
6	(Cruger, 2018)	Applying challenge-based learning in the	Case study	The CBL model can improve students' understand	Informative use of SNA	Small sample size	ICLS Procee-dings

No	Author Name	Title	Methods	Result	Strengths	Weaknesses	Name of Publi-cation
		(feminist) communicat ion classroom…		ing of course concepts			
7	(Detoni et al., 2019)	Using Challenge-Based Learning to Create an Engaging Classroom …	Descripti ve study	The CBL model can improve student engage-ment, collaborati on, and learning	Real-world approach, soft skills develop-ment, and deep reflection	Limited time	Journal of Enginee-ring Education
8	(Tissenbau m & Jona, 2018)	Social Network Analysis for Signaling Pedagogical Shifts in…	Qualita-tive and quantitati ve analyses	The CBL model supports conceptual outcomes	Innovative approach and strong references	Focus on online discussion, lack of focus on learning outcomes	ICLS Proceedin gs
9	(Eraña-Rojas et al., 2019)	A challenge-based learning experience in forensic medicine	Quanti-tative Study	The CBL model in forensic education has a positive impact	Comprehen-sive evaluation and practical competence development	Limited sample size and time constraints	Journal of STEM Education
10	(Fairazatunn isa et al., 2021)	Challenge Based Learning *dalam Meningkat-kan Kemampuan Berpikir Kreatif…*	Quasi-experi-ment	Students' mathema-tical creative thinking ability using the CBL model is higher.	Clear Research Methods and Relevant Indicators	Limitations of Research Subjects & Stages that Need Adjustment	Higher Education Research
11	(Félix-Herrán et al., 2019)	Challenge-based learning: an I-semester …	Case study	The CBL model effectively improves practical skills in Mecha-tronics Enginee-ring	Develops industry-relevant practical and problem-solving skills	Requires significant resources for implement ation and evaluation	Interna-tional Journal of Enginee-ring Education
12	(Blanco et al., 2016)	Integration of the	Mixed Methods	Integration of CBL	Improves collabora-	Requires good	Computer s in

No	Author Name	Title	Methods	Result	Strengths	Weaknesses	Name of Publi-cation
		methods CBL and CBI for…		and CBI improves resource manageme nt in the academic environ-ment.	tion and efficiency in the use of academic resources	coordina-tion between various disciplines	Human Behavior
13	(Flores et al., 2016)	Challenge-based gamification as a teaching' Open Educational …	Mixed Methods	Gamificati on in CBL increases engage-ment and innovation in energy sustainabil ity education.	Increase student motivation and participation through gamification	Requires the develop-ment of better evaluation tools and methods	TEEM'16, Salaman-ca, Spain
14	(Gabriel, 2014)	A Modified Challenge-Based Learning Approach in…	Case study	CBL model improves student engage-ment and satisfac-tion in biochemist -try	Increases student engagement and satisfaction	May be less effective for highly theoretical material	Journal of Microbiol ogy & Biology Education
15	(Gama et al., 2018)	Combining Challenge-Based Learning and Design…	Mixed Methods	CBL combined with Design Thinking improves learning outcomes	Improves learning outcomes with an interdisci-plinary approach	It requires more time and effort from students and teachers	IEEE Global Enginee-ring Education Confe-rence (EDU-CON)
16	(Gaskins et al., 2015)	Changing the Learning Environmen t in the…	Quasi-experime nt	The CBL model has the potential to enhance student learning experience s in enginee-ring.	The article emphasises the importance of learning experiences that are practical and relevant to real-world problems.	The teaching experience of the teachers who participate d in this study is limited.	Interna-tional Journal of Enginee-ring Pedagogy
17	(Huesca et al., 2024)	Effectivenes s of Challenge-	Survey	The CBL model is effective	perspective Pay attention to	Requires more in-depth	Internatio nal Journal of

No	Author Name	Title	Methods	Result	Strengths	Weaknesses	Name of Publi-cation
		Based Learning in…		in developing engineering student competencies from a gender perspective	gender aspects in competency development	analysis to understand long-term impacts	Engineering Education
18	(Ifenthaler et al., 2018)	Attributes of Engagement in Challenge-Based Digital Learning Environments	Quantitative research	The CBL model has a significant impact on student performance and learning outcomes	Authors adopted a multidimensional approach to learning engagement	Limitations of performance measurement lack of external validation	Online teaching and learning in higher education
19	(Ibwe et al., 2018)	Active Learning through Smart Grid Model Site in Challenge-Based Learning Course	Mixed Methods	The CBL model is highly effective in promoting student learning	The research involved collaboration between academics, students, and industry stakeholders	There is a risk of bias in the assessment conducted by industry stakeholders	Systemics, cybernetics and informatics
20	(Helker et al., 2024)	A framework for capturing student learning in challenge-based learning	Exploratory study	The CBL model offers an innovative and effective approach to higher education.	The article includes in-depth analyses of different levels of context.	The study involved only eight teachers from one institution	Active Learning in Higher Education
21	(Kohn Rådberg et al., 2020)	From CDIO to challenge-based learning experiences – expanding student learning as well	Case study	The CBL model can add potential to develop skills, cross-disciplinary collaborati	This article provides added value and transformation for society for sustainable development	Collaboration with stakeholders takes a lot of time and effort	European Journal of Engineering Education

No	Author Name	Title	Methods	Result	Strengths	Weaknesses	Name of Publi-cation
		as societal impact?		on			
22	(Kuswadi & NUH, 2016)	Effective Intelligent Control Teaching Environ-ment Using Challenge Based Learning	Quasi-experime nt	The CBL model is effective in improving students' engageme nt and satisfactio n in learning intelligent control	The use of web technology and social media in the learning process helps to increase student engagement.	The success of CBL implement-tation is highly dependent on the availability and quality of internet connection	Interna-tional Sympo-sium on Electro-nics and Smart Devices (ISESD)
23	(Leijon et al., 2022)	Challenge-based learning in higher education: A systematic literature review	Systema-tic literature review	This article summarise s the latest trends and develop-ments in the application of CBL in higher education.	This article provides an overview of CBL in higher education	Findings from the literature review may not always be generali-sable to all higher education contexts	Innovatio ns in Education and Teaching Internatio nal
24	(Lin & Chen, 2017)	A study on the course types of challenge-based learning	Mixed-method	The CBL model has a positive and significant impact on promoting students' innovative ability	This article reviews the application of CBL in various disciplines, providing a comprehend -sive picture of flexibility and adaptability	A more in-depth analysis of teachers' perspective s and experience s in implement-ting CBL will add more value	World Engineeri ng Education Forum (WEEF)
25	(Membrillo -Hernández et al., 2019)	Student Engagement Outside the Classroom: Analysis of a Challenge-Based Learning Strategy in Biotechnolo gy Engineering	Quasi-experime nt	The CBL model success-fully increased student engage-ment in biotechnolo gy engineering	This study emphasised the development of transversal competencies such as ethics, cooperation, resilience, and critical thinking	This study focused on Biotechnol ogy Engineerin g students	IEEE Global Enginee-ring Education Confe-rence (EDU-CON)

No	Author Name	Title	Methods	Result	Strengths	Weaknesses	Name of Publi-cation
26	(Mukarromah & Hari Utomo, 2020)	*Pengaruh Model* Challenge Based Learning *terhadap Kemampuan Berpikir Kritis Siswa SMA pada Materi Perubahan Iklim*	Quasi-experiment	CBL model has a significant effect on students' critical thinking skills	This article explores the use of the CBL model, which has not been widely implemented in Indonesian schools	The use of essay tests as the only measurement instrument is not sufficient to capture all aspects of students' critical thinking skills	*Jurnal Pendi-dikan: Teori, Peneli-tian, dan Pengemb angan*
27	(Nurlaili et al., 2017)	*Pengaruh Model Pembelajar an* Challenge Based Learning *terhadap Kemampuan Berpikir Kritis Siswa pada Materi Lingkungan*	Quasi-expe-riment	The CBL model has a significant effect on improving students' critical thinking skills	The research can be a practical guide for educators about CBL learning model to improve students' critical thinking skills	This research focuses more on quantitative data, less on exploring students'and teachers' experiences and perceptions of CBL	*Jurnal Pena Sains*
28	(Romero Caballero et al., 2024)	Challenge-Based Learning and Design Thinking in Higher Education: Institutional Strategies for Linking Experiential …	Mixed methods	CBL and design thinking (DT) models can increase student engagement in challen-ging real-world projects	CBL and DT allow students to work in teams consisting of various disciplines	This article does not detail the challenges or barriers faced in the implement-tation of CBL and DT,	Innovatio ns in Education and Teaching Interna-tional
29	(Serrano et al., 2018)	Challenge-based learning in Computatio nal Biology and Data Science	Case study	The CBL model can improve students' problem-solving skills	This article shows that students become more skilled in co-operation and communi-cation.	Requires more preparation and resources than traditional teaching methods.	ICTERI Work-shops
30	(Sodikin & Sarwanto, 2014)	*Penerapan Model* Challenge Based	Quasi-experi-ment	CBL model with experiment	This study did not only focus on cognitive	Measure-ment of students' scientific	*Jurnal Inkuri*

No	Author Name	Title	Methods	Result	Strengths	Weaknesses	Name of Publi-cation
		Learning *dengan Metode Eksperimen dan Proyek Ditinjau dari Keingintahu an dan Sikap Ilmiah Terhadap Prestasi Belajar Siswa*		and project method is effective in improving students' learning achieveme nt and scientific attitude	achieve-ment, but also looked at affective and psycho-motor aspects	attitudes only uses question-naires, which can produce subjective and less accurate data	
31	(Nawawi, 2017)	Developing of Module Challenge Based Learning in Environmen tal Material to Empower the Critical Thinking Ability	R&D	CBL module is proven effective in improving students' critical thinking skills in environ-mental materials	This article integrates theory with practice through learning modules that can be applied directly in the classroom	This article focuses on the developme nt of modules for environme ntal material in biology lessons	*Jurnal Inovasi Pendidi-kan IPA*
32	(Suwono et al., 2019)	Challenge Based Learning to Improve Scientific Literacy of Undergradu ate Biology Students	Quasi-experime nt	This research shows that CBL and PBL models are effective methods in improving students' science literacy	This study compared three different learning strategies (CBL, PBL, and Discussion-Presentatio)	The implement-tation of CBL in this study was limited to the use of theoretical reviews from journals without many empirical activities	Procee-dings of the 6th Internatio nal Confe-rence for Science Educators and Teachers (ISET)
33	(Yang et al., 2018)	Challenge Based Learning nurtures creative thinking: An Evaluative Study	Quasi-experi-ment	Using the CBL model in this study provides a good reference for educators.	The use of the internationally validated CIEP provides reliability and validity in the measure-ment of creativity and innovation	The absence of a control group may limit the ability to isolate the specific effects of CBL	Nurse Education Today

Base on Table 1 there is 33 relevant scientific articles published between 2010 and 2024. The articles were obtained from various database sources such as Scopus, Google Scholar, and SINTA, which were selected based on the suitability of the keywords 'Challenge-Based Learning' and '21st-century skills'.

Discussion

The application of the CBL model in learning in higher education institutions and schools has been proven to produce positive impacts. Based on the research results presented, CBL emphasises real-world challenges as the main approach to learning, aiming to develop learners' technical, social and cognitive skills. By presenting real problems that require creative solutions, this model creates an interactive and relevant learning environment, which supports the development of better competencies.

Previous research found that the CBL model has a significant effect on increasing students' entrepreneurial mindset (Colombelli et al., 2022). Through the challenges provided in learning, students can develop skills that are more relevant to real-world needs. This is supported by other studies, which showed that implementing CBL in universities in various countries (Mexico, Netherlands, Ireland, and China) can increase student collaboration and engagement in the learning process (Beemt et al., 2023). This improvement is crucial in facing global challenges that require cross-cultural and collaborative skills.

Other research showed that CBL is effective for teaching mobile application development in engineering education (Binder et al., 2017). Students who participate in this challenge-based learning learn from the technical side and engage in a realistic problem-solving process. This is supported by research, which shows that Design Challenge Based Learning (DCBL) increases student motivation and strengthens academic rigour (Blevis, 2010). The challenge-based approach forces students to think beyond the limits of theory and apply concepts in real situations.

Another study showed that the CBL model can encourage student collaboration and engagement in software startup development (Chanin et al., 2018). This methodology incorporates multidisciplinary learning that prepares students to engage directly in the professional world. However, the study noted that implementing CBL requires high resources, such as tools and sufficient time, to facilitate the given challenges.

In the more traditional field of education, research stated that applying the CBL model in mathematics can improve students' creative thinking ability (Fairazatunnisa et al., 2021). This is in line with another study which showed that the CBL model effectively improved students' critical thinking skills in climate change material (Mukarromah & Hari Utomo, 2020). These results confirm that the CBL model can be applied in various subjects, both exact and non-exact, to encourage student engagement and the development of critical thinking skills.

On the other hand, other researches also support these results by showing that CBL significantly affects students' critical thinking skills in environmental subjects (Nawawi, 2017; Nurlaili et al., 2017). Both studies emphasise that a challenge-based learning approach can improve students' understanding of real issues, such as environmental change, which is important for developing 21st-century skills. One of the main advantages of the CBL model is its flexibility and adaptability in various disciplines, as seen in the study, which showed that CBL combined with Design Thinking was able to improve student learning outcomes in an interdisciplinary context (Gama et al., 2018). This interdisciplinary approach provides students with the skills to solve complex problems involving multiple disciplines, which is increasingly important in modern education.

However, this research also shows some limitations that need to be considered. For example, the study showed that although CBL offers an innovative and effective approach, it

only involved eight teachers from one institution, which limits the generalisability of the results (Helker et al., 2024). Likewise, other found that while CBL can support significant conceptual outcomes, an excessive focus on online discussions can distract from deeper learning outcomes (Tissenbaum & Jona, 2018).

The results of this study have several important implications for the development of challenge-based learning. Firstly, educators and policymakers need to consider CBL as an effective learning model to be applied at various levels of education. This model helps develop technical skills and critical and creative thinking abilities, which are indispensable in the era of information and globalisation. Secondly, the implication for curriculum development is the need for challenge-based learning to integrate relevant cross-disciplinary skills, such as entrepreneurship, digital literacy and international collaboration. Thus, CBL can be a powerful tool to bridge the gap between academia and the world of work.

While the results of this study make a significant contribution, some limitations need to be noted. One of the main limitations is the need for long-term data to evaluate the impact of CBL more comprehensively. Many studies, as mentioned have yet to measure the long-term impact of CBL implementation, especially regarding behavioural changes and skill development of learners after they enter the workforce (Beemt et al., 2023). In addition, limitations in generalising the results are also a challenge. Local context can greatly affect the outcome of CBL implementation, so further research is needed to understand how CBL can be adapted to the specific needs of each educational setting.

A recommendation for future research is to conduct a more in-depth longitudinal study to explore the long-term impact of CBL. In addition, research with more diverse and larger samples is needed to ensure a stronger generalisation of the results. Research also needs to develop better evaluation tools to measure critical, creative and collaborative thinking skills in the context of challenge-based learning. Overall, this study provides a strong foundation for further development in the application of CBL in various educational contexts. However, efforts are still needed to overcome the existing limitations so that this model can be implemented more effectively in the future.

4. CONCLUSION

Based on the analysed literature review, the challenge-based learning model can be used in higher education institutions and schools. Overall, CBL shows effectiveness in various educational contexts, ranging from entrepreneurship development and mobile applications to forensic and biological sciences. This model enhances technical and interdisciplinary skills and critical and creative thinking abilities. Nonetheless, some challenges need to be addressed, such as limited long-term data, generalisability of results, and variations in implementation contexts. Further research is needed to explore the long-term impact and address the existing limitations in CBL implementation.

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