

Project-Based Learning (Pbl) In Enhancing Students' Higher-Order Thinking Skills (Hots): Systematic Literature Review

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ABSTRAK

Kajian literatur sistematik ini bertujuan untuk menyelidik penggunaan pembelajaran berasaskan projek (PBP) dalam meningkatkan kemahiran berfikir aras tinggi (KBAT) pelajar. PBP telah menjadi pendekatan yang semakin popular dalam pendidikan kerana keupayaannya untuk melibatkan pelajar secara aktif, menggalakkan pemikiran kritis, dan membangunkan kemahiran berfikir kreatif. Kajian ini melibatkan analisis kajian-kajian yang telah dilakukan sebelum ini dalam bidang ini. Maklumat dan data dikumpulkan melalui pencarian sistematik dalam pangkalan data akademik yang relevan. Fokus utama kajian ini adalah untuk mengkaji kesan PBP terhadap KBAT pelajar, termasuk kemahiran seperti analisis, penilaian, sintesis, dan penyelesaian masalah. Dapatan kajian ini memberikan pemahaman yang komprehensif tentang kesan PBP dalam meningkatkan KBAT pelajar. Hasil kajian ini diharapkan dapat memberikan panduan praktikal kepada pendidik dalam melaksanakan pendekatan pembelajaran ini untuk memperkukuhkan kemahiran berfikir aras tinggi pelajar.

Katakunci: Pembelajaran Berasaskan Projek, Kemahiran Berfikir Aras Tinggi, Kbat.

Abstract

This systematic literature review aims to investigate the use of project-based learning (PBL) in enhancing students' higher-order thinking skills (HOTS). PBL has become an increasingly popular approach in education due to its ability to engage students actively, promote critical thinking, and develop creative thinking skills. This study involves the analysis of previous studies conducted in this field. Information and data were collected through a systematic search in relevant academic databases. The main focus of this study is to examine the impact of PBL on students' HOTS, including skills such as analysis, evaluation, synthesis, and problem-solving. The findings of this study provide a comprehensive understanding of the effects of PBL in enhancing students' HOTS. The results of this study are expected to provide practical guidance to educators in implementing this learning approach to strengthen students' higher-order thinking skills.

keywords: Project-based Learning, Higher-Order Thinking Skills, HOTS.

Introduction

Project-Based Learning (PBL)

Project-Based Learning (PBL) is a learning approach that involves students in projects that require research, analysis, and active problem solving. In PBL, students work in groups or individuals to create products or results that reflect their understanding of the topic being studied. This approach provides students with the opportunity to apply their knowledge and skills in a realistic and meaningful context.

One of the recent references is a study by Shernoff, Ruzek, Sinha, et al. (2018) that examined the effects of PBL in increasing student motivation and involvement in learning. This study shows that PBL provides students the opportunity to take charge of their own learning, increase intrinsic motivation, and enrich their learning experience. These results provide evidence on the effectiveness of PBL in increasing student motivation and active involvement in the learning process.

Previous research shows that PBL can provide significant benefits to students in strengthening their higher-order thinking skills (HOTS). For example, a study by Smith et al. (2018) examined the effects of PBL in improving the analytical and synthesis skills of students in Science subjects. The findings showed a significant improvement in the thinking skills of students involved in project-based learning compared to traditional learning approaches.

Additionally, a study by Johnson et al. (2019) examined the effect of PBL in improving students' problem-solving skills in the subject of mathematics. The findings of the study found that PBL enables students to apply mathematical concepts in real-world situations and improve their problem-solving skills.

Another relevant reference is a study by Thomas, Hayward, and Grover (2019) that examined the effects of PBL in STEM learning (Science, Technology, Engineering, and Mathematics). This study found that PBL allows students to apply Science and Mathematics concepts in practical contexts, improve their understanding of STEM concepts, and develop critical and creative thinking skills. The results of this study provide evidence about the effectiveness of PBL in enriching STEM learning and fostering students' interest in this field.

In addition, a study by Wang, Yu, and Chiu (2020) examined the use of PBL in foreign language learning. This study shows that PBL provides opportunities for students to apply foreign languages in real communication contexts, improve their speaking and writing skills, as well as enriching their cultural understanding and understanding of the foreign languages. The results of this study provide additional evidence about the effectiveness of PBL in foreign language learning.

Overall, the previous studies showed the importance and effectiveness of PBL in student learning. PBL provides students with the opportunity to develop critical, creative, and analytical thinking skills, enrich conceptual understanding, increase motivation and engagement, as well as apply the knowledge in realistic contexts. Therefore, PBL is a relevant and effective learning approach in preparing students for the challenges and demands of a complex world.

Higher-Order Thinking Skills (HOTS)

Higher-Order Thinking Skills (HOTS) is an important concept in education that involves deeper and more complex thinking skills. HOTS involves critical, analytical, creative, and integrated thinking that enables students to understand, analyze, interpret, evaluate, and apply knowledge in new and complex situations. It involves the ability to solve complex problems, relate concepts, and make evidence-based decisions.

One of the latest references is a study by Azman, Abdul Rahman, and Rahim (2019) that examined the effects of using the HOTS approach in teaching and learning Mathematics. This study shows that the continuous use of the HOTS approach can improve students' understanding and achievement in Mathematics. The results of this study provide evidence on the effectiveness of HOTS in improving students' thinking skills in the field of Mathematics. Yusof, Mohd Salleh, and Idris (2021) who studied the influence of the application of HOTS in the teaching and learning of Science found that students involved in learning that emphasized HOTS gained a deeper understanding, higher critical thinking skills, and the ability to relate Science concepts in different contexts. The results of this study support the importance of HOTS in enriching students' learning and improving their thinking skills in the field of Science.

In addition, a study by Cheong, Lim, and Tan (2018) examined the use of the HOTS approach in teaching and learning English. This study shows that students involved in learning that emphasizes HOTS acquire better critical thinking skills, the ability to analyze and evaluate information, as well as the ability to relate complex ideas in writing and problem solving. The results of this study provide additional evidence on the importance of HOTS in enriching students' thinking skills in the field of English. Therefore, the use of the HOTS approach in teaching and learning is an important step in preparing students with relevant and quality thinking skills to face challenges in the modern world.

In this context, this systematic literature review will research and review the latest evidence on the effects of PBL in improving students' HOTS. The literature review will involve empirical studies, academic reviews and related articles in this field. By understanding more about the effectiveness of PBL in strengthening students' HOTS, this study can contribute more to the educational development and provide practical guidance to educators in implementing project-based learning effectively.

Research Questions

This systematic literature review aims to help synthesize previous studies in order to identify the effectiveness of project-based learning (PBL) in improving students' higher-order thinking skills (HOTS). There are several research questions that are studied through this systematic literature review. Among them are:

- a) What are the Educational Trends or Patterns of Previous Studies on Project-Based Learning (PBL) on students' higher-order thinking skills (HOTS) from 2018 to 2023 in terms of: (a) Research title, (b) Research Purpose, (c) Research methodology, (d) Research fields and (e) Research findings?
- b) What are the factors involved in the use of Project-Based Learning (PBL) in assessing students' high-order thinking skills (HOTS)?
- c) Is Project-Based Learning (PBL) effective in improving students' higher-order thinking skills (HOTS)?

Methodology

The systematic literature review is a systematic analysis and combination of several previous studies with the same research scope to determine the overall pattern or findings. The Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) 2020 guide was used as a guide during this systematic literature review. In addition, steps in synthesizing previous studies (Tawfik et al., 2019; Cavero-Redondo et al., 2019) have been identified and used in this systematic literature review. Figure 1 illustrates the process of selecting articles.

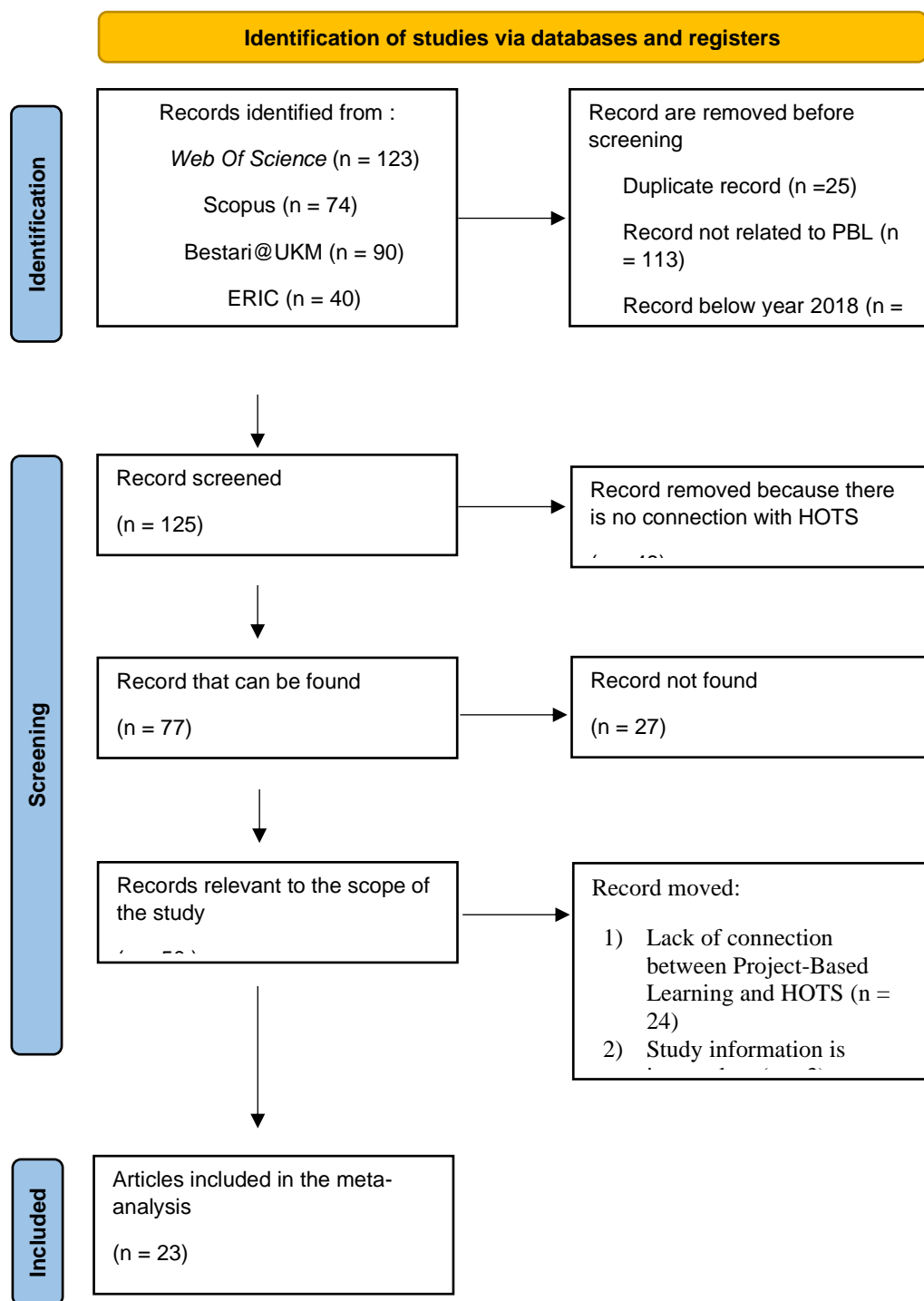


Figure 1. PRISMA Flow Chart

In addition, this study also consists of the article's findings that have been analysed using Scopus, Web of Science (WOS), ERIC (Education Resources Information Centre) and Bestari@UKM/Discovery Service@UKM databases. The articles were obtained through the selection of search strings considering that the articles obtained from the four databases are of high quality and through systematic evaluation of researchers in the same field. Thus, the selection of studies has been made for the identification phase and screening phase, then the article will be screened for analysis. PRISMA consists of three phases of search and selection of articles or books for analysis.

Identification Phase

Based on the PRISMA guidelines, the first step is the identification phase. Three databases namely Scopus, WOS, ERIC and Bestari@UKM were selected to perform this phase; that is subject to a search string through the selection of keywords that include the goals of this study. Keywords related to project-based learning, PBL, higher-order thinking skills, HOTS and keywords synonymous with them have been formulated and subjected to Boolean search strategies. Next, the database obtained will be presented in **Table 1** as follows:

Table 1

Search strings used for this study

Database		Search Strings
Scopus	1	TITLE-ABS-KEY: "PROJECT-BASED LEARNING*" OR "STUDENTS' HIGHER-ORDER THINKING SKILLS*" OR "HOTS*" OR "KBAT*" AND "A SYSTEMATIC LITERATURE REVIEW"
Web of Science (WoS)	1	TS: "PROJECT-BASED LEARNING*" OR "STUDENTS' HIGHER-ORDER THINKING SKILLS*" OR "HOTS*" OR "KBAT"
ERIC (Education Resources Information Centre)	1	TITLE: "PROJECT-BASED LEARNING*" OR "STUDENTS' HIGHER-ORDER THINKING SKILLS"
Bestari@UKM / Discovery Service@UKM	1	TITLE: "PEMBELAJARAN BERASASKAN PROJEK*" OR "KEMAHIRAN BERFIKIR ARAS TINGGI"

Screening Phase

After obtaining a total of 327 article writings from four databases through search strings, the next step was to remove the duplicate articles. I have removed 202 articles that are repeated and unrelated to the information to be studied so that only 125 articles remain. Next, the article is researched through the titles, abstracts and keywords; only articles related to project-based learning and higher-order thinking skills in various subjects were selected, making a selection of 77 articles. Next, the selection of articles that can be obtained from various websites is done and only 50 articles can be obtained. The search string was performed for a more in-depth selection of articles and only 23 articles met the study criteria based on the inclusion and exclusion criteria, as in the PRISMA guidelines (**Table 2**).

Table 2

Inclusion and exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Previous studies from 2018 to 2023	Studies conducted outside the range
Studies from researchers in the same field	Books, reports and records of conference proceedings.
Articles written in English or Malay related to project-based learning and higher-order thinking skills in various subjects	Articles written in foreign languages and not related to project-based learning and higher-order thinking skills in various subjects

Included Phase

23 articles selected from Scopus, WOS, ERIC and Bestari@UKM databases are based on

several criteria such as project-based learning and higher-order thinking skills in various subjects. The articles were carefully read and analysed to examine the author's opinion, effects, results and research findings related to the topic studied.

Research Findings

Meta-analysis was used in this study, where previous studies on project-based learning in improving HOTS were systematically analyzed and intertwined. The research findings for the following research questions can help in achieving the research objectives for this meta-analysis study.

3.1 PK1: What are the Education Trends or Patterns of Previous Studies on Project-Based Learning (PBL) on Students' Higher Order Thinking Skills (HOTS) from 2018 to 2023 in terms of: (a) Research title, (b) Research Purpose, (c) Research methodology, (d) Research field and (f) Research findings?

A total of 23 selected articles have been comprehensively analysed by reading and understanding the author's perspective, the results of the experiments conducted, and the analysis of the reviews conducted. In the data collection process, aspects such as the research title, research objectives, research methodology, field of research and research findings are collected in the form of a table as in **Table 3**

Table 3

Summary of Articles Selected For Analysis

Author	Title	Research objectives	Methodology	Research field	Findings
Zelhendri Zen et al. (2022) (1)	Academic Achievement : The Impact of Project-Based Online Learning Methods and Student Engagement.	This study aims to analyse the impact of Project-Based Online Learning (PBOL) and student engagement on academic achievement.	Qualitative & Quantitative Data	Entrepreneurs hip	The results showed that students' perception of the implementation of PBOL methods and student engagement improved their academic performance to become new entrepreneurs through the experience they gained during project-based

learning

L. Mutakinati (2018) (2)	Analysis of high school students' critical thinking skills through STEM education project-based learning.	This research is to investigate students' critical thinking skills by using STEM education through Project-Based Learning.	Descriptive research design	STEM	The results showed that the average score of students' critical thinking skills was 2.82. Students' critical thinking skills are categorized as advanced thinker: 41.6%, practicing thinker: 30.6%, beginning thinker: 25%, and challenged thinker: 2.8%. And the category for students' critical thinking skills is practicing thinkers.
Viranda et al. (2022) (3)	Vlog Media Assisted Project-Based Learning Model Application on higher order thinking skills (HOTS) during the	Determining whether or not there is an impact of project-based learning models assisted by vlog media on the higher-order thinking skills	Quasi experiment	Science	The results showed that there was a difference in HOTS between the experimental class and the control class with a significance value of 0.023 < 0.05. With

Covid-19
Pandemic.

(HOTS) of
high school
students
during the
Covid-19
pandemic.

the mean
value of the
experimental
class (80.03)
=> mean of
the control
class (60.71).
It was
concluded
that Vlog's
media-
assisted
project-based
learning
model
impacted high
school
students'
higher-order
thinking skills
during the
Covid-19
pandemic.

Mathew Keleman et al. (2021) (4)	Higher-order thinking skills assessment through STEM Integration and elementary level Project- Based Learning	To assess the level of HOTS among students through the integration of STEM in Project- Based Learning (PBL) by using the conceptual framework and HOTS development module	Action research	STEM	The findings showed that the need for students to use modules to improve HOTS was high. A t-test performed to compare students' achievement from pre-test and post-tests showed significant differences in pre-test scores. Post- test scores have proven that STEM integration learning
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					methods through Project-Based Learning can improve students' HOTS.
Sri Rahayu Ningsih et al. (2020) (5)	The effectiveness of using Project-Based Learning Models in Improving Creative Thinking Ability.	The purpose of this study was to investigate the effectiveness of the use of project-based learning models in enhancing the creative thinking ability in economic subjects among secondary school students in the West Bandung District, West Java, Indonesia.	Quasi experiment	Economy	The findings state that there is an increase in creative thinking in the experimental class which is higher compared to the control class in line with the findings of Uziak (2016) which states that project-based learning has been widely viewed as an effective and innovative educational method, including technical education.
Muhammad Umar and Ihsan Ko (2022) (6)	E-learning: The Direct Impact of Student Learning Effectiveness and Engagement through Project-Based Learning,	The cross-effects of project-based learning, team cohesion and flipped learning were investigated by examining their direct	Quantitative data	Multidisciplinary	The analysis found that project-based learning (PBL) and team cohesiveness increased the positive direct impact of student learning effectiveness

	Team Cohesion, and Flipped Learning during the COVID-19 Pandemic	impact on the student learning effectiveness , engagement and the impact of engagement on learning effectiveness .			and engagement. However, flipped learning showed increase positive effects on student learning effectiveness and negative effects on engagement.
W. Sumarni and S. Kadarwati (2020) (7)	ETHNO-STEM Project-Based Learning: Its Impact on Critical and Creative Thinking Skills.	ETHNO-STEM project-based learning for secondary school students has been implemented and its impact on students' critical and creative thinking skills has been investigated.	Pre-experimental method	STEM	The STEM results show that ETHNO-STEM project-based learning is able to improve students' average critical and creative thinking skills in all different indicators from low to medium categories.
M Lukitasari et al. (2018) (8)	Higher-Order Thinking Skills: Using E-Portfolio in Project-Based Learning.	The aim of this research is to explain students' higher-order thinking skills through project-based learning using e-portfolio.	Descriptive qualitative methods	STEM	The results showed that through project-based learning using e-portfolio, students' ability to: analyze (medium category, N-Gain 0.67), evaluate (medium

						category, N-Gain 0.51), and create (medium category, N-Gain 0.44) was improved. E-portfolio using the project base learning (PBL) model can improve the ability of higher-order thinking.
Manihar Situmoran g et al. (2021) (9)	Implementati on of project-based learning Innovations to Develop Students' Critical Thinking Skills as a Strategy to Achieve Analytical Chemistry Competency	This study aims to implement project-based learning to facilitate active and independent learning through the implementati on of projects to build students' critical thinking skills.	Project package developme nt	Science		Project-based learning innovations are very effective in improving critical thinking skills as well as enhancing students' competencies in the field of analytical chemistry.
Rosmiati et al. (2022) (10)	Application of PHET Simulation Assisted Project-Based Learning Model to Improve Higher-Order Thinking Skills in Physics.	This study aims to improve Higher-Order Thinking Skills by using the PhET Simulation Assisted Project-Based	Quasi Experiment .	STEM		The application of the Project Based Learning models assisted by PhET simulations can increase students' HOTS.

Learning
Model.

Ali Mufti (2022) (11)	Project-Based Learning to Improve Higher-Order Thinking Ability in Arabic Subjects	This study describes the PBL model in Arabic language learning at Madrasah Aliyah with steps; asking basic questions, planning and scheduling, monitoring, product evaluation, and research evaluation.	Descriptive Qualitative	Arabic language	Arabic Project-based learning is a suitable learning model for achieving 21-st century learning criteria and HOTS level learning.
Ilham Mubassyr et al. (2021) (12)	The Impact of PBL on Student's HOTS in the Human Excretory System	The aim of this study was to: (1) determine the effect of PBL on students' HOTS in the human excretory system. (2) To know the difference between PBL and cooperative learning with HOTS.	Experiment al research	Science	PBL is very influential on HOTS students. Project-based learning has a very high influence on students' HOTS with an effect size of 1.29 and is included in the very high category. PBL has a very high impact on students' HOTS in science, especially in the human excretory system.

Ulfatul Ma'rifah (2022) (13)	Implementati on of Project-Based Learning in EFL Classes: Fostering Higher-Order Thinking and Learner Autonomy	The aim of this study is to analyze students' HOTS and learn autonomy for English students in EFL classes to design lesson plans through the implementati on of Project-Based Learning.	Quantitativ e and Qualitative Methods	English	The findings revealed that the indicators and characteristic s of HOTS and learning autonomy were presented consistently during classroom interactions and were able to implement projects outside the classroom. Students frequently demonstrate critical and creative thinking in various ways when participating in the classroom. Implementing project-based learning is highly effective and contributes significantly to fostering HOTS and student autonomy.
Perdana D et al. (2021) (14)	The impact of Inquiry Project-Based Learning towards the	The aim of the research is to analyze how the Guided Inquiry	Quasi-experiment al research	Biology	Based on the data analysis, it is known data that the Guided Inquiry

Improvement of Students' Scientific Literacy Skills and Creative Thinking Skills application combined with Project-Based Learning improves scientific literacy and creative thinking skills in the Learning Biology of 81 secondary school students from Malang, Indonesia

application combined with Project-Based Learning improved scientific literacy skills by 48% and creative thinking skills by 48%. 37% of this study also found that the improvement of students' scientific literacy skills and creative thinking skills was not only influenced by internal factors such as learning materials but also influenced by their knowledge of real problems in their immediate environment and their experiences.

Syukri M et al. (2022) (15)	Implementati on of PBL based on Blended Learning To Improve Students' Creative Thinking in	This study aims to find out the improvement of students' creative thinking skills after applying PBL based on blended	Quasi-experiment al research	Physics	Based on the t-test analysis data, it was found that H0 was rejected, meaning that there was an increase in the creative thinking
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Physics learning in ability of
Learning physics students who
learning. applied PBL
based on
blended
learning.

Uhame Harun (2020) (16)	Project- Based Learning Integrated with STEM (STEM-PBL) to Improve HOTS-Based Arabic Language Learning.	This learning model encourages students to be active, creative, and innovative in learning, which is in line with the educational goals in Learning Arabic as a foreign language.	Literature review	Arabic language	This study shows that the STEM-PBL learning model is a learning model that can improve students' higher-order thinking skills (HOTS). In addition, learning Arabic can use the STEM-PBL learning model.
Sejati et al. (2021) (17)	An Analysis of Higher Order Thinking Skills, Character, and Science Process Skills of Secondary School Students in Project- Based Learning	The study aimed to analyze the higher-order thinking skills, character, and science process skills of secondary school students in plant tissue topics through the Project- Based Learning (PBL) model.	Science Pre- Experiment al Design	Science	The results showed that the Project- Based Learning Model (PBL) was effective in improving students' higher-order thinking skills (HOTS) with an average N- Gain of 0.52 in the "moderate" category. It is also effective in developing the character of students

					with an average score percentage of 70.36% that fall into the "good" category. Developing student character includes responsibility and disciplinary cooperation. In addition, this model is also effective in improving students' science process skills with an average score of 74.73% in the "good" category. Developing science process skills include observing, planning experiments, conducting experiments, and communicating.
Ofianto et al. (2021) (18)	Historical Development of students' thinking skills through project-based	This study aims to look at the impact of Project-Based Learning Models on the historical	Quasi Experiment	Science	The results showed that there was a positive and significant impact of the Project-Based Learning

	learning models	development of students' thinking skills.				Model (PBL) on the history of students' thinking skills which is confirmed with a significance value of 0.000. Based on the value of N-Gain, the PBL model gives the effect of improvement and historical development of thinking skills by 41%. Thus, it can be concluded that the Project-Based Learning Model (PBL) has a positive influence on the historical development of students' thinking skills.
Santoso, A. M. et al. (2021) (19)	Student worksheet development using project-based learning (PBL) in improving higher-order thinking skills (HOTS) and students' time management skills	This study aims to develop a project-based learning worksheet		Plomp design research consisting of an initial phase, prototype and evaluation	STEM	The results of this study show that both critical thinking and creative thinking skills have increased (moderate category) and it has an impact on improving students' time

						management with an effect size of 14,18 (very high).
Jalinus & Nabawi (2018) (20)	The Effectiveness of The Cooperative-Project Based Learning (PBL) in Improving HOTS for Vocational Education Students.	The study aims to reveal the effectiveness of cooperative project-based learning models in enhancing cognitive competency up to higher-order thinking skills.	Experimental method	Vocational Education Students		Through a combination of cooperative and project-based learning, students learn in groups and shared responsibility for the success of their project tasks. Enhancing students learning activities that occur during project assignments, students actively improve and develop their competence through cognitivist and constructivist principles.
Wayan & Wayan (2022) (21)	Integrated Quiz of Online Project-Based Learning as a Formative Assessment to Trigger Higher-Order	This study aims to analyze HOTS differences between students who take the Online Project-Based Learning	Quasi-experimental research	Multidisciplinary		The data analysis results showed a higher difference in the level of HOTS for students who took the Online

	Thinking Skills.	integrated quiz as a formative assessment and HOTS students who take regular online learning.				Project-Based Learning integrated quiz as a formative assessment than the level HOTS of students taking regular online learning. For this reason, teachers are expected to apply Quizizz Online Project-Based Learning as a formative assessment in learning to obtain maximum higher-order thinking skills.
Sambite et al. (2019) (22)	Application of Project-Based Learning on Simple Teaching Aids to Improve Student HOTS.	This study aims to improve students' High Order Thinking Skills (HOTS) through the implementation of project-based Project-Based Learning (PBL).	Action Research refers to the Kemmis and Taggart model	STEM		The results showed that 1) the implementation of the lesson plan increased, in the first cycle by 50 at the first meeting and 60 at the second meeting, in the second cycle by 61 at the first meeting and 66 at the second meeting, and 2) the average

value of the HOTS of the student increased, in cycle I was 61.96 to 71.49 in cycle II. Thus, the application of PBL can increase the student's HOTS.

Rusydiana et al. (2022) (23)	The influence of project-based learning models on higher-order thinking skills in Grade V Primary School Students.	This study aimed to determine whether or not there is an effect of project-based learning models on higher-order thinking skills among primary school students.	Quasi experiment	Multidisciplinary	Based on the results it can be seen that the number is greater than the table (4.480 > 0.2632)., it can be concluded that the implementation of the project-based learning model has an impact on higher-order thinking skills in grade V primary schools.
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From the 23 empirical studies selected for this systematic analysis, 15 (65.22%) are from STEM fields and 8 (34.78%) are from other fields namely English, Arabic, Economics, Entrepreneurship and multi-disciplines. **Table 4** clearly shows the summary of study level, sample of research, research approach and research instrument.

Table 4

Summary of study level, sample of research, research approach and research instrument.

Characteristics	Study level					Sample	Research				Approach				
	PS	SS	HC	T	St	I	QN	QL	MM	Q	I	O	PP	QE	DA
Zelhendri Zen et al. (2022)			/		/				/		/	/	/		/
L. Mutakinati (2018)		/			/				/			/			/
Viranda et al. (2022)		/			/		/						/	/	
Mathew Keleman et al. (2021)	/			/	/				/	/	/		/		
Sri Rahayu Ningsih et al. (2020)		/			/		/						/	/	
Muhd. Umar and Ilsang Ko (2022)			/		/		/			/					
W. Sumarni and S. Kadarwati (2020)		/			/		/						/	/	
M Lukitasari et al. (2018)			/		/			/			/	/			/
Manihar Situmorang et al. (2021)			/		/		/			/					
Rosmiati et al. (2022)		/			/		/						/	/	
Ali Mufti (2022)			/		/			/							/
Ilham Mubassyr et al. (2021)	/				/		/						/	/	
Ulfatul Ma'rifah (2022)	/				/				/	/		/			
Perdana D et al. (2021)	/				/		/						/	/	
Syukri M et al. (2022)	/				/		/						/	/	
Uhame Harun (2020)	/				/			/							/
Sejati et al. (2021)	/				/		/						/	/	
Ofianto et al. (2021)	/				/		/						/	/	
Santoso, A. M. et al. (2021)			/		/			/							/
Jalinus & Nabawi (2018)			/		/		/						/	/	
Wayan & Wayan (2022)	/				/		/						/	/	
Sambite et al. (2019)		/			/			/							/
Rusydiana et al. (2022)	/				/		/						/	/	
Total	2	14	7	1	23	0	14	5	4	4	3	4	14	12	7

Keywords:

PS	Primary School	I	Instructor/ Lecturer	I	Interviews
SS	Secondary School	QL	Qualitative Methods	O	Observation
HC	Higher Education	QN	Quantitative Methods	PP	Pre-Pos Test
T	Teacher	MM	Mixed Methods	QE	Quasi Experiment
St	Student	Q	Questionnaire	DA	Document Analysis

PBD is widely used in secondary schools (14, 60.87%) compared to higher education (7, 33.43%) and primary schools (2, 8.70%). While the study sample consisted of students (23, 100%) and teachers (1, 4.35%). Researchers are more interested in using quantitative methods with a percentage of 60.90% (14 out of 23 articles). This means that quantitative methods are very suitable to be used in studies to obtain more relevant and accurate data. In addition, the research approach used in previous studies is a qualitative method as much as 21.74% which is 5 out of 23 articles and while the mixed method is less used which is 4 out of 23 articles with a percentage of 17.40%. Therefore, the research instrument that researcher's most interested in is the pre-post-test which is 14 out of 23 articles with 60.87% followed by the quasi-experiment which is 12 out of 23 articles with 52.17%. Other research instruments used in past studies are document analysis (7, 30.43%), observation (4, 17.40%), questionnaires (4, 17.40%) and interviews (3, 13.04%).

The implementation of the Project-Based Learning + Online (PBOL) methods and students' involvement in PBL improves students' academic performance and helps them become new entrepreneurs through the learning experience gained [1]. PBL using e-portfolio enhances students' higher thinking skills in analysing, evaluating, and creating. The Project Based Learning (PBL) model with e-portfolio can improve students' higher-order thinking ability [8]. The application of the PBL model assisted with PhET simulation can improve students' higher-order thinking skills [10]. The STEM-PBL learning model enhances students' higher-order thinking skills (HOTS). Arabic language learning can also use the STEM-PBL learning model [16]. The results [3, 4] showed that there was a significant difference in higher-order thinking skills (HOTS) between the experimental class that uses the Vlog media-assisted PBL learning model as well as the use of STEM integration modules and learning methods through PBL with control class. The experimental class achieved a higher HOTS mean score compared to the control class.

The findings [5] show that PBL improves students' creative thinking. This result is consistent with previous findings stating that PBL is an effective and innovative educational method, including in technical education. A study [7] using the STEM approach shows that ETHNO-STEM project-based learning can improve students' critical and creative thinking skills in all indicators for low to medium categories.

The findings [2] show that students' critical thinking skills were at the practicing thinker level and showed improvement. This study categorized students' critical thinking into four categories: advanced thinker, practicing thinker, beginning thinker and challenged thinker. Project-based learning innovation is effective in improving critical thinking skills in the field of Analytical Chemistry [9]. PBL in Arabic is suitable to achieve 21st century learning criteria and improve HOTS learning [11]. This study showed a modest improvement in students' critical thinking, creative thinking, and time management skills through PBL [19].

PBL is very influential in students' higher-order thinking skills (HOTS). PBL has a very high impact on students' HOTS in Science [12]. Research findings [13] show that project-based learning consistently fosters higher-order thinking skills (HOTS) and student autonomy.

The Guided Inquiry and Project-Based Learning application enhances students' scientific literacy skills and creative thinking skills. This improvement is influenced by internal factors such as learning materials and students' knowledge of the real problems in the immediate environment [14]. The analysis [6] shows that PBL and team cohesion had a positive effect on student effectiveness and engagement.

The application of Online Project-Based Learning enhances students' creative thinking abilities [15]. The use of Quizizz online PBL as a formative assessment improves students' higher-order thinking skills (HOTS) compared to regular online learning [21].

The PBL model is effective in improving students' higher-order thinking skills (HOTS), as well as developing students' character and science process skills [17]. The PBL model enhances and has a positive impact on the historical development of students' thinking skills [18]. The combination of cooperative learning and PBL develops students' competence through cognitivist and constructivist principles [20].

The implementation of PBL improves the lesson plan and HOTS students in primary school [22]. The implementation of the PBL model has a significant impact on students' higher-order thinking skills in primary school [23].

Overall, the analysis of selected articles shows that Project-Based Learning (PBL) has a positive impact and enhances the level of Higher Order Thinking Skills (HOTS) of students at all levels

of Education. In addition, PBL also creates a fun learning environment that influences student engagement behaviour. Through the implementation of PBL at the school level, it shows that students' critical thinking skills are at the practicing thinker level. Practicing thinker is the developmental stage of critical thinking. Students have sufficient skills in thinking to criticize their own plans in systematic practice and to build a realistic criticism of the strength of their thinking to solve contextual problems. It can be concluded that, post-test scores have proven that integration learning methods using source materials such as models or modules through PBL can improve students' HOTS. PBL allows students to practice professional techniques openly. All of the analysis of the 23 articles highlighted Project-Based Learning (PBL) as the best effort to meet the needs of the industry. PBL can also enhance students' abstract thinking and explore students' understanding. Finally, the implementation of student worksheet based on PBL can also improve students' higher-order thinking skills and time management skills. Through the application of their knowledge on project assignments, they get the opportunity to learn at the stage of applying, analysing, evaluating and creating.

3.2 PK2: What are the factors involved in the use of Project-Based Learning (PBL) in assessing students' higher-order thinking skills (HOTS)?

The use of Project-Based Learning (PBL) involves a number of factors that influence the assessment of students' higher-order thinking skills (HOTS). **Table 5** shows the factors involved in the use of PBL to assess students' HOTS.

Table 5

Factors involved in the assessment of students' level (HOTS) in implementing PBL

Article	Factors in HOTS Assessment				
	PD	SAA	CC	SS	RSA
(1)	/	/	/		
(2)	/	/	/		/
(3)	/	/		/	/
(4)	/		/	/	
(5)	/	/	/		
(6)	/	/	/		
(7)	/	/	/	/	
(8)	/	/	/	/	/
(9)	/	/	/		
(10)	/	/	/	/	
(11)	/		/	/	
(12)	/		/	/	
(13)	/		/	/	/
(14)	/	/	/		
(15)	/	/	/		
(16)	/	/	/		
(17)	/	/	/	/	
(18)	/		/	/	
(19)	/	/	/	/	/
(20)	/		/	/	/
(21)	/	/	/		
(22)	/		/	/	
(23)	/	/	/		

Indicator:

Project design: **PD**

Supervision and support: **SS**

Selection of assessment activities: **SAA**

Reflection and self-assessment: **RSA**

Collaboration and communication: **CC**

Project design: Projects in PBL should be carefully designed to ensure that they provide opportunities for students to apply higher-order thinking skills. Projects should involve research, analysis, problem solving, and critical thinking. A well-designed project will encourage students to engage higher-order thinking skills such as analysis, synthesis, evaluation, and creativity [1-23].

Supervision and support: Effective supervision and support from teachers or project supervisors are important factors in evaluating a student's HOTS. Teachers need to provide clear instructions, provide guidance, and provide the necessary support to students when implementing projects. Effective supervision will ensure that students can effectively develop higher-order thinking skills [3, 4, 7, 8, 10-13, 17-20 and 22].

Selection of assessment activities: Assessment activities in PBL should be well planned to evaluate students' HOTS. Assessment activities need to test higher-order thinking skills such as analysis, synthesis, evaluation, and creativity. For example, students may be asked to prepare a project report that containing in-depth analysis, problem-solving proposals, or creative design. Evaluation can also involve project presentations, group discussions, or evaluations based on products or project results produced [1-3, 5-10, 14-17, 19, 21 and 23].

Reflection and self-assessment: The process of reflection and self-assessment is important in evaluating a student's HOTS in PBL. Students should be given the opportunity to reflect on their experience in implementing projects, assessing their strengths and weaknesses, as well as making improvements for future projects. This process allows students to develop critical and metacognitive thinking skills [2, 3, 8, 13, 19 and 20].

Collaboration and communication: Collaboration and communication between students also play an important role in evaluating HOTS in PBL. Project-based work groups allow students to interact, share ideas, and develop critical thinking skills through discussion and problem solving together. Assessment can involve peer assessment or assessment based on individual contributions in group work [1-2, 4-23].

3.3 PK3: Is Project-Based Learning (PBL) effective in improving students' Higher Order Thinking Skills (HOTS)?

Project-Based Learning (PBL) has been found to have a positive effect in improving students' Higher Order Thinking Skills (HOTS). Through the study of Kilic, H. (2018) and Mergendoller, J. R., Maxwell, N. L., & Bellisimo, Y. (2018). **Table 6** shows the effects of PBL in improving student HOTS.

Table 6

Effect of PBL in improving students' HOTS

The effect of the integration of PBL and STEM in improving students' HOTS					
Article	CrS	AS	SS	CS	ES
(1)	/	/			
(2)	/				/
(3)	/		/		/
(4)	/		/		
(5)				/	
(6)	/	/			
(7)	/			/	
(8)		/	/		/
(9)	/	/			
(10)	/	/			
(11)	/				
(12)	/		/		
(13)	/	/			/
(14)	/			/	
(15)				/	
(16)				/	
(17)	/	/	/		
(18)	/				
(19)	/			/	/
(20)	/	/	/		/
(21)	/				
(22)	/				
(23)	/				

Indicator:

Improved critical thinking skills : **CrS**Improved analytical thinking skills: **AS**Improved synthesis thinking skills: **SS**Improved creative thinking skills: **CS**Improved evaluative thinking skills: **ES**

Improved critical thinking skills: Through PBL, students are given the opportunity to develop their critical thinking skills. They are taught to analyze, evaluate, and synthesize information derived from the projects they carry out. This process stimulates students' critical thinking and nurtures their skills in criticizing, decision-making, and problem solving [1-4, 6-7, 9-14, 17-23].

Improved creative thinking skills: PBL provides students with the opportunity to use their creativity in planning and implementing projects. They are taught to think outside the box, create new ideas, and produce unique results. Through PBL, students learn to broaden their perspectives and develop creative thinking skills [5, 7, 14-16 and 19].

Improved analytical thinking skills: In PBL, students need to collect and analyze data, conduct research, and make conclusions based on the information obtained. This process strengthens students' analytical thinking skills, where they learn to observe, analyze, and interpret data critically [1, 6, 8–10, 13, 17 and 20].

Improved synthesis thinking skills: PBL involves students in integrating information from various sources, connecting different ideas, and reorganizing information to produce a more comprehensive understanding. Through this process, students improve their synthesis thinking skills, which helps them make connections and see the connection between different elements [3-4, 8, 12, 17 and 20].

Improvement of evaluative thinking skills: In PBL, students are taught to evaluate the results and outcomes of their projects. They learn to evaluate the effectiveness of the measures taken, identify weaknesses and strengths, and provide a critical assessment of the results of their projects. This process stimulates evaluative thinking and fosters students' critical thinking skills [2-3, 8, 13 and 19-20].

Overall, PBL provides students with an active, fun, and contextual learning experience. It promotes deeper learning, develops higher-order thinking skills, and helps students apply their knowledge in a practical context.

Discussion

Challenges in implementing Project-Based Learning (PBL) in Learning and Facilitation (PdPc) is an important issue in today's educational context. PBL is a learning approach that emphasizes the active involvement of students in conducting integrated projects with the aim of improving their understanding, skills, and abilities in a particular field of learning. Although PBL has many benefits, there are also challenges that educators and facilitators have to face in implementing it.

According to the researchers Dhindsa, H. S., Thatai, D., & Kaur, M. (2018), one of the main challenges is the need to implement a comprehensive and detailed planning for each project. PBL requires careful and detailed planning so that the project can be carried out smoothly and achieve the learning goals set. Planning involves the selection of relevant project topics, the determination of learning objectives, the compilation of implementation measures, the necessary resources of materials and tools, as well as the scheduling of the appropriate time. This approach requires sufficient time, effort, and knowledge for educators and facilitators to plan and organize projects well.

In addition, another challenge according to Hmelo-Silver, C. E. (2018), in implementing PBL is the need to ensure that students obtain adequate support and effective supervision. PBL involves students in research, exploration, and independent learning. Therefore, it is important for educators and facilitators to provide the necessary support and guidance to students throughout the learning process. This support can include the provision of quality learning resources, guidance in project planning, as well as the provision of feedback and guidance as students implement projects. In addition, facilitators should play the role of effective supervisors in monitoring the progress of projects and providing appropriate instructions to students.

Next, in the study of Oosterheert, I., Vermunt, J. D., & Denessen, E. (2021), another challenge that needs to be faced is the involvement of students in group work and collaboration. PBL

often involves group work where students work together to complete projects together. While group work has the potential to improve students' social skills and collaboration, it can also be a challenge if there is an imbalance in the contribution and involvement of group members. Facilitators should ensure that each member of the group is given the opportunity to contribute fairly, encourage open and effective communication, as well as address conflicts that may arise among group members.

In addition, according to the study of Zhang, L., & Fong, C. (2023), another important challenge is the project assessment and evaluation. PBL often emphasizes assessment based on projects carried out by students. For educators and facilitators, this may be challenging because they need to develop assessment methods that are objective, authentic, and relevant to learning goals. The assessment should focus on the skills, understanding, and abilities that the students want to acquire through the project. In addition, it is also important to provide effective feedback and assist students in improving their performance.

Overall, implementing PBL in PdPc is a challenge that teachers must face. Although there are some challenges that need to be faced, with good preparation, adequate support, and relevant assessments, PBL can provide valuable opportunities for students to improve critical thinking, creativity, and collaboration skills.

Conclusion

The conclusion from the systematic literature review about Project Based Learning (PBL) in improving students' Higher Order Thinking Skills (HOTS) is that PBL is a high-potential learning approach to strengthen students' high-order thinking skills. Based on 23 studies analyzed from 2018 to 2023, there is consistent evidence supporting the benefits of PBL in developing critical thinking, analytical, creative, and problem-solving skills.

PBP provides an opportunity for students to engage in complex and meaningful projects, where they need to apply the knowledge and skills that have been learned in real-world contexts. Through this experience, students can develop high-order thinking skills such as analysis, synthesis, evaluation, and problem solving that involve critical and creative thinking. They can also improve communication skills, collaboration, and systemic thinking in facing challenges and completing projects effectively.

The systematic literature studies that have been done show that PBL can also increase students' motivation and interest in learning. Students tend to be more involved and motivated in carrying out projects that give them the freedom to express opinions, make decisions, and take responsibility for their learning. They see learning as something meaningful and relevant to their lives, making them more eager to find new knowledge and expand their understanding.

However, although PBL offers many benefits, there are challenges that need to be overcome in implementing this approach. The challenges that are often face include the need for careful and detailed project planning, adequate support and supervision, effective management of group work, as well as objective and relevant project evaluation and assessment. It is important for educators and facilitators to overcome these challenges with good preparation, adequate knowledge and skills, as well as appropriate support for students.

In conclusion, a systematic literature review shows that Project-Based Learning (PBL) can play an important role in improving students' High Order Thinking Skills (HOTS). PBL provides students with the opportunity to develop critical thinking, analytics, creative, and problem-solving skills through project-centered experience. Students can also increase their motivation, interest, and understanding through meaningful and relevant learning. However,

it is important to overcome the challenges associated with project planning, support, management, and evaluation to ensure the effectiveness of the implementation of the PBL.

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