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Students' Perceptions of Project-Based Learning in K-12 Education: A Synthesis of Qualitative Evidence

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As an engaging instructional approach, project-based learning has gained prominence as a means of adapting K-12 education to a changing world. However, research assessing the effectiveness of project-based learning has primarily focused on teachers, whereas studies on students' perceptions of project-based learning have been limited to isolated cases. This review aimed to provide a comprehensive synthesis of qualitative and mixed-approach studies that investigated K-12 students' perceptions of project-based learning. A meta-ethnography approach was employed to identify, evaluate, and combine the findings of the 14 peer-reviewed studies. These studies were selected based on an extensive search of databases such as Web of Science, ERIC, and ScienceDirect. Six themes were identified to reflect K-12 students' perceptions of project-based learning: enhancing 21st-century skills, enhancing enthusiastic engagement, fostering interdisciplinary integration, time consumption, evoking initial jitter, and content insufficiency. Additionally, two research gaps were identified, with the majority of studies conducted among senior high school students in Europe and Asia. In conclusion, this synthesis highlights the effectiveness of project-based learning in promoting essential contemporary skills. However, caution is advised regarding challenges, such as content insufficiency. Stakeholders should consider targeted support and resource adequacy to optimize project-based learning benefits for diverse students.

Keywords: K-12 education, meta-ethnography, project-based learning, students' perceptions, synthesis of qualitative evidence

INTRODUCTION

As education continues to evolve, there is an increasing need to explore alternative approaches to teaching and learning that equip students with the skills necessary for the

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rapidly changing modern world. The traditional model of education, which is mainly teacher-centered, has been predominant for decades. Although the traditional approach has some advantages (e.g., it facilitates the transmission of a large amount of information to a considerably large number of students), it often falls short with regard to engaging students and helping them develop the necessary knowledge and skills (Deslauriers et al., 2019; Serin, 2018; Suyantiningsih et al., 2023). Consequently, educators are exploring alternative teaching approaches to adapt to a changing world (Lucas & Spencer, 2017), and project-based learning (PBL) has gained prominence because it meets the need for education to adapt to a changing world (Boss & Jane, 2022). This approach has been identified as an effective and engaging teaching approach in the context of K-12 education (Markula & Aksela, 2022). PBL is an instructional approach that emphasizes hands-on collaborative learning, in which students mainly focus on completing specific projects within a given period (Boss & Jane, 2022; Thuan, 2018). At the heart of PBL is the belief that students must be actively engaged in learning and have opportunities to apply their knowledge and skills to real-world problems (England et al., 2020).

Moreover, research (e.g., Marsiti et al., 2023a; Othman et al., 2022) has suggested that PBL can improve students' creativity, critical thinking, collaboration, and problem-solving skills while enhancing their motivation and engagement in learning. Despite its potential benefits, no consensus has yet been reached regarding the effective implementation of PBL in K-12 education (Condliffe et al., 2017), and some teachers may hesitate to adopt this approach because of concerns about its practicality and effectiveness (Mou, 2020). Although teacher factors (e.g., classroom management, facilitation skills, assessment, and feedback) are important for the successful implementation of PBL, it is ultimately students who are at the center of the educational experience (Farrow et al., 2022), and their perceptions play a crucial role in determining whether PBL effectively caters to their unique learning needs (Wongdaeng & Hajihama, 2018). Therefore, it is crucial to consider the perceptions of K-12 students when evaluating PBL effectiveness. Students' attitudes toward PBL can greatly impact their motivation and engagement in the learning process, which in turn can lead to improved learning outcomes (Almulla, 2020). By examining students' perspectives and feedback, educators and researchers can gain valuable insight into the alignment between the PBL approach and students' individual requirements. Students' perceptions of PBL refer to their individual understanding, interpretation, and evaluation of the instructional approach (Parker, 2020). Such perceptions encompass their thoughts, beliefs, attitudes, and opinions regarding the various aspects of PBL, including its effectiveness, relevance, engagement, and overall impact on their learning experiences (Amerstorfer & Münster-Kistner, 2021). By understanding and addressing students' perceptions of PBL, educators can create more effective and engaging learning experiences that better meet students' needs (Strahan & Poteat, 2020).

Despite the abundance of research on teachers' and students' experiences in the context of PBL, there is a paucity of studies focusing exclusively on students' perceptions of PBL (Virtue & Hinnant-Crawford, 2019). Moreover, it is noteworthy that there is a conspicuous absence in the realm of research pertaining to the qualitative synthesis of studies examining students' perceptions of PBL. This notable gap in the literature

highlights the significance and novelty of this study. Therefore, by synthesizing the available qualitative evidence, this research endeavors to shed light on the invaluable insights obtained from students' perceptions on PBL, thus offering a pioneering contribution to the field. Two research questions were proposed to guide this review: (1) How do K-12 students perceive their PBL experience? and (2) What gaps arise from the available results?

Theoretical Background

PBL has seen a growing trend in its use as a teaching methodology within K-12 education. Numerous studies have explored students' perceptions on PBL, but they have mainly focused on a specific aspect (e.g., translations with the help of PBL or the use of a flipped classroom approach with PBL), providing various perspectives on how this approach to learning can impact students' academic experiences (Shih & Tsai, 2017). As an innovative instructional method, PBL promotes collaboration and cooperation among students (Othman et al., 2022; Turcotte et al., 2022), making it a valuable pedagogical tool for K-12 education. Although its origins can be traced back to Dewey's constructivist approach, PBL has been used in various disciplines throughout history (Larmer et al., 2015). From the Italian School of Architecture's "*progetti*" in the 16th century to engineering studies in North America and Europe in the 18th century, PBL has been an integral part of education (Ferreira et al., 2017; Knoll, 1997; Larmer et al., 2015). PBL is still recognized for its inquiry-based learning experiences, problem-solving approach, and collaborative projects, all of which align with its constructivist and participative nature (Chu et al., 2021; Lenz et al., 2015). Students' perceptions of PBL have also been overwhelmingly positive, highlighting its ability to enhance critical thinking, foster creativity, and enable students to develop essential skills that are crucial for success in their future academic and professional pursuits (Ayish & Deveci, 2019; Marsiti et al., 2023; Meyer, 2015).

Based on the assumption that PBL should be incorporated more completely into K-12 education, Marqués (2001) found that PBL is part of a broader group of active methodologies that have evolved to reflect the changing needs and expectations of teachers and students. In this context, PBL incorporates a diverse range of frameworks and models that offer useful support and guidance to K-12 students. These frameworks enable students to navigate the complexities of the learning process and gain a deeper understanding of key concepts and skills (Weiss & Belland, 2018). In particular, PBL frameworks consider the fundamental shifts taking place in education and provide a roadmap for transforming traditional didactic models into dynamic, interactive, and collaborative learning experiences. By leveraging these frameworks, students can develop the critical thinking, problem-solving, and communication skills they need to succeed in today's rapidly changing world (Boss & Jane, 2022; Mulcahy & Wertz, 2021).

As the educational landscape evolves, as mentioned above, it has become increasingly clear that PBL can play a crucial role in helping K-12 students develop critical skills and competencies. However, for PBL to truly reach its potential, it must be fully integrated into the curriculum in a flexible manner that meets unique needs and is in

line with the unique interests of each student (Boss & Larmer, 2018; Simonton et al., 2021). Recent research has highlighted the importance of aligning students' perceptions of PBL with its practical implementation in the classroom and has emphasized the need for educators to explore innovative approaches to curriculum design and delivery that can empower students to take ownership of their learning journeys (Boss & Jane, 2022; Kaput, 2018).

METHOD

This study employed a meta-synthesis to identify, assess, and synthesize qualitative studies that investigated K-12 students' perceptions of PBL. The study utilized a "meta-ethnography" approach, an interpretive methodology initially developed by Noblit and Hare (1988), which is used to combine qualitative data in the field of education (Britten et al., 2002; Park et al., 2020). Unlike a quantitative meta-analysis, the meta-ethnography approach involves interpretation rather than data aggregation (Atkins et al., 2008; Lee et al., 2015). Using meta-ethnography, the reviewers have analyzed and compared studies while developing novel interpretations across multiple studies (Cahill et al., 2018). The key stages of this study are presented in Table 1.

Table 1
The process of completing meta-ethnography (Cahill et al., 2018; Noblit & Hare, 1988)

Phases	Steps involved in this study
(1) Aim	Our main area of interest pertains to perceptions of PBL among K-12 students.
(2) Deciding what is relevant	Conducted search in relevant databases; applied exclusion criteria; appraised selected studies using an adapted version of CASP
(3) Reading the studies	Upon careful examination of the studies, key concepts were identified as articulated by the students and the authors
(4) Determining how the studies are put together	Key concepts from each study were compiled into a single file and the file was imported into Nvivo 14 software
(5) Translating the studies into one another	Key concepts within and across papers were analyzed, comparing each concept with others to categorize them into broader conceptual categories
(6) Synthesizing the translations	Evaluated whether the studies offered differing or similar accounts. A line of argument was established since the studies' accounts were similar (i.e., reciprocal)
(7) Expressing the synthesis	This involved writing the synthesis while considering the intended audience

Phases 1 and 2 focused on determining the research focus of the study and locating the sample, respectively. The sample of studies included in this meta-synthesis was identified through an extensive search of the Web of Science, Elsevier ScienceDirect, and EBSCO-ERIC databases. The search was based on combinations of the keywords outlined in Table 2. Other search filters, such as (a) peer-reviewed, (b) journal articles, and (c) publication dates between January 2018 and April 2023 were used in the search engines.

Table 2
Keywords and search blocks used in databases

Search	Keywords
Block 1	PBL OR project-based learning
AND	
Block 2	K-12 education OR primary education OR secondary education OR primary OR secondary OR school

The reviewers opted to conduct a review of studies published from January 2018 to April 2023 due to the previous literature review conducted by Condliffe et al. (2017), which encompassed the literature on the use of PBL in K-12 settings published from 2000 to 2017. The search for articles was completed on April 24, 2023, by the review team, which comprised four meta-ethnographers of this article, all of whom were experienced in PBL research. The search yielded 180 journal articles. After excluding duplicate and review articles, the remaining articles were examined for their compliance with three criteria for inclusion in the meta-synthesis after a careful reading of the abstract and methodology: (1) the research should focus on PBL in K-12 education, (2) the research design should be either qualitative or feature a mixed-methods design, and (3) the research should seek the perceptions of K-12 students (as shown in Figure 1).

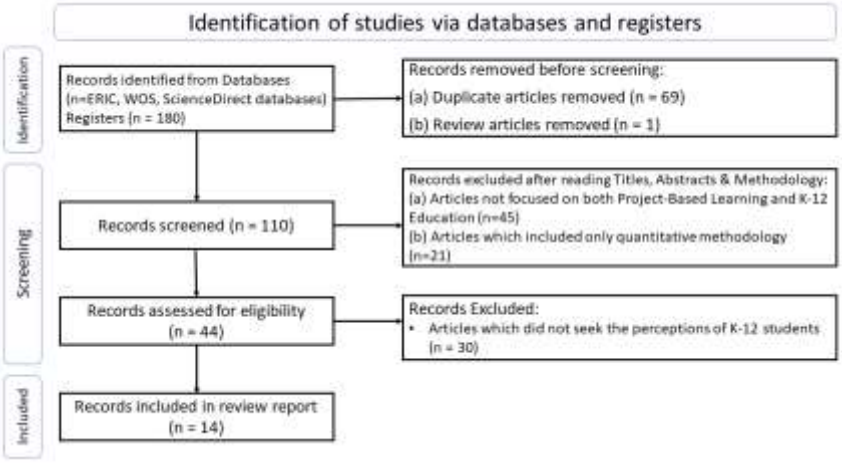

Figure 1
Flowchart for determining relevance

Fourteen articles were included in this review, and their quality as well as potential gaps were assessed using a modified version of the Critical Appraisal Skills Program (CASP)[1] from 1988 (Long et al., 2020). Table 3 displays the evaluation criteria applied

[1] The Critical Appraisal Skills Program was created to provide individuals with tools and resources that can facilitate the critical evaluation of research studies. Its purpose is to help assess the trustworthiness, accuracy, and significance of the evidence presented in these studies.

by the three reviewers for all 14 studies. Any discrepancies between reviewers were resolved through discussion. Moreover, throughout the critical appraisal process, reviewers discovered that certain methodological aspects were either absent or inadequately described in some studies. Specifically, the sampling method was either missing or insufficiently explained in 11 of 14 studies. Despite these omissions or ambiguities pertaining to methodological details, all 14 studies made valuable contributions to the synthesis, and as a result, were included in the review report.

Table 3
Quality criteria and results (Atkins et al., 2008, based on the CAS Program)

Questions	Yes	No	Unclear
(1) Does the study involve qualitative research?	14	0	0
(2) Are the research questions clearly stated?	12	0	2
(3) Is the qualitative approach justified?	13	0	1
(4) Is the approach appropriate for the research question?	12	0	2
(5) Is the study context clearly described?	12	0	2
(6) Is the role of the author clearly described?	12	0	2
(7) Is the sampling method clearly described?	03	3	8
(8) Is the sampling strategy appropriate for the research question?	06	2	6
(9) Is the method of data collection clearly described?	14	0	0
(10) Is the method of data collection appropriate to the question?	14	0	0
(11) Is the method of analysis clearly described?	11	0	3
(12) Is the analysis appropriate for the research question?	11	1	2
(13) Are the claims made supported by sufficient evidence?	14	0	0

During the subsequent phase, which focused on "reading the studies" (Phase 3), the reviewers aimed to acquaint themselves with the content and specific details of the 14 selected articles and to identify key concepts and gaps. In the consolidation phase (Phase 4), key concepts from both students and authors were extracted from all articles and compiled into a unified file, which was then imported into the NVivo 14 software. The reviewers collaborated to code the key concepts provided by the students. In cases where students' statements were unclear, the authors' insights[2] were used to provide contextual understanding. The translation and synthesis processes (Phases 5 and 6) involved analyzing and comparing each coded key concept (totaling 47) with others to categorize them into broader conceptual categories, resulting in six distinct themes to explain K-12 students' perceptions of PBL. Two additional themes were identified, reflecting gaps in these studies. The reviewers considered the accounts of the studies as reciprocal (i.e., similar) instead of refutational (i.e., different) and developed a line of argument to write the synthesis (Phase 7). Table 4 presents an example of the coding and categorization processes.

[2]That is, the authors for the 14 included articles

Table 4
An excerpt of the coding and categorization process

Key concepts	Conceptual categories	Theme
Communication with peers	Communication and collaboration	21st-century skill
Communication with a mentor		
Peer feedback		
Easy to understand science	Knowledge acquisition	
Gaining new knowledge		

Throughout this process, careful consideration of and repeated references to the original data were ensured to verify, challenge, or enrich the interpretations. Any discrepancies in coding, grouping, or categorization among the reviewers were resolved through comprehensive discussion. Each theme is thoroughly described and relevant examples are provided in the Results section. The general profiles of all the reviewed studies are presented in Table 5.

Table 5
Overview of the included articles

First Author	Year	Regional Context	Topic	Method	Respondents
Chang	2022	Taiwan	Educational values and challenges of i-STEM project-based learning: A mixed-methods study with data-transformation design	Mixed method: Open-ended questionnaire and interviews	48 freshmen from senior high school
Drljača	2020	Bosnia and Herzegovina	Constructivist learning theory and logopedagogy in arts education	Systematic observations, introspection, a survey, interviews, and selected case studies	29 primary school students in year nine; 29 general secondary students in year two
Gómez-Pablos	2020	Spain	Project-based learning in the classroom: A case study at High school level	Semantic differential and semi-structured interviews	114 year one high school students; 23/28 groups were interviewed
Imaduddin	2021	Indonesia	Students' Attitude toward STEM Project-Based Learning in the Fun Cooking Activity to Learn about the Colloid System	Documentations and narrative responses	101 high school students
Kilic	2022	Turkey	Teachers' and students' views about the applicability of the project-based learning approach in science courses in Turkey	Semi-structured interviews	38 students (6^{th}-7^{th} graders); 11 science and technology teachers
Lin	2021	Taiwan	The Effect of a Pedagogical STEAM Model on Students' Project Competence and Learning Motivation	Quasi experimental, semi-structured interviews	114 senior high students (14-16 years); 8 students were interviewed
Othman	2022	Malaysia	Creative Teaching STEM Module: High School Students' Perception.	Case study: Worksheets, classroom observation forms, and an open-ended questionnaire	31 grade 8 students & 26 grade 11 students

Prachagool	2021	Thailand	Literature and Project-Based Learning and Learning Outcomes of Young Children	Observations, debriefing, a focus group, and interviews	25 young children (5-6 years)
Tran	2021	Vietnam	Vietnamese EFL High School Students' Use of Self-Regulated Language Learning Strategies for Project-Based Learning	Questionnaire and semi-structured interviews	147 high school students (grade 10-12), 40 participated in the interviews
Tsybulsky	2022	Israel	IoT in Project-Based Biology Learning: Students' Experiences and Skill Development	In-depth interviews, observations, and one-on-one discussions with students	11 students in eleventh grade
Turcotte	2022	USA	This School is Made for Students: Students' Perspectives on PBL	Semi-structured interviews, group interviews, and observations	Five biology students (grade 10)
Ubuz	2019	Turkey	Project-based geometry learning: Knowledge and attitude of field-dependent/independent cognitive style students	Classroom observations and interviews	97 students in the seventh grade
Virtue	2019	USA	"We're doing things that are meaningful": Student Perspectives of "We're doing things that are meaningful": Student Perspectives of Project-based Learning Across the Disciplines	A focus group and semi-structured interviews	28 high school juniors
Zhou	2022	China	Developing Core Competence with Project-Based Learning: Voices from Chinese High School Students Serving Visually Impaired Students.	Semi-structured interviews	16 students (public high school students and 9th graders)

FINDINGS

According to the synthesis, the findings revealed eight prominent themes, with six themes pertaining to students' subjective interpretations of their PBL experiences in the K-12 educational context, thus answering the first research question. The other two themes that highlighted the research gaps identified based on the results answered the second research question. The synthesized findings were grouped into three sections: (1) four themes related to students' classroom experiences with PBL; (2) two themes examining PBL design and implementation; and (3) two themes addressing the identified gaps. Table 6 provides a detailed representation of the key themes pertaining to each study (excluding those related to gaps).

Table 6
Key themes pertaining to each article

Study	Key themes					
	Enhances 21st-Century Skills	Enhances Enthusiastic Engagement	Time-Consuming	Evokes Initial Jitter	Content Insuffi-ciency	Inter-disciplinary Integration
Chang (2022)	x		x	x	x	
Drljača (2020)	x	x				
Gómez-Pablos (2020)	x	x	x	x	x	
Imaduddin (2021)		x	x			
Kilic (2022)	x					x
Lin (2021)	x					x
Othman (2022)	x	x	x			
Prachagool (2021)	x	x				
Tran (2021)	x	x				
Tsybulsky (2022)	x	x		x		
Turcotte (2022)	x	x				
Ubuz (2019)	x	x		x		
Virtue (2019)	x	x	x		x	
Zhou (2022)	x			x		

Key Themes Associated with Students' Classroom Experiences

Theme 1: Enhancing 21st-Century Skills. An overall theme observed in 13 out of 14 studies relates to how PBL enables K-12 students to develop 21st-century skills. Eleven studies (e.g., Prachagool, 2021) reported communication and collaboration skills, eight studies (e.g., Virtue & Hinnant-Crawford, 2019) observed knowledge acquisition, eight studies (e.g., Kilic & Ozel, 2022) highlighted creativity and innovation, seven studies (e.g., Tsybulsky & Sinai, 2022) found practical abilities such as writing skills, digital competence, and leadership skills, six studies (e.g., Lin & Tsai, 2021) documented metacognitive skills, four studies (e.g., Turcotte et al., 2022) focused on students' autonomy, and four studies (e.g., Ubuz & Aydınyer, 2019) described students' ability to apply concepts.

To illustrate the development of communication and collaboration skills, a seventh-grader acknowledged the importance of working together as a group: "I have understood the importance of working together, respecting others' decisions, helping each other, group work, and sharing ideas. Our work finished more easily and faster. I became better friends with my group mates. (…). It increased communication" (Ubuz & Aydınyer, 2019, p. 297). Moreover, the students remarked that PBL makes it very easy to understand concepts and apply them to real life. An eleventh-grade student in the study conducted by Othman et al. (2022) illustrated the ease with which knowledge is acquired during PBL: "These methods make it easier for students to understand science concepts and the ability to apply them" (p. 2131). Senior high school freshmen in the study conducted by Chang and Chen (2022) expressed their ability to apply the knowledge they had acquired in real life: "I generally understood the concept of robot

and principles of robot motion taught by the teacher and later learned how to put them into practice" (p. 8). Likewise, "I seldom operated the multimeter in school before, so I was unfamiliar with it. After the teacher's demonstration, I'm able to measure the voltage" (p. 9).

Furthermore, PBL gives students autonomy in the classroom and provides them with the opportunity to hone their creative and innovative skills. Drljača (2020) and Zhou and Li (2022) provided comments demonstrating students' autonomy in the PBL classroom: "The students said they can have fun in the art class, choose the audience they wish to present their completed projects to, (…) all of which are factors that have a positive effect on student motivation" (Drljača, 2020, p. 194) and "All materials and sources were collected by ourselves; that made the information more reliable and made me understand them better" (Zhou & Li, 2022, p. 386). Classroom autonomy in PBL settings establishes a conducive environment for student creativity and innovation. Two students –eleventh and eighth graders– in the study conducted by Othman et al. (2022) explained that PBL offers space for students' creativity and innovation: "This activity encouraged the students' high-level thinking skills, creating various creative and innovative ideas" (p. 2132) and "I had to think more creatively from every perspective to give ideas to my group" (p. 2132).

Additionally, PBL enhances students' metacognitive skills. Students had the opportunity to plan, monitor, and evaluate their thinking and learning strategies. The following narratives provided by high school students in the study conducted by Tran and Tran (2020) attest to the enhancement of students' metacognitive skills: "From my perspective, planning is the most essential SRLL strategy because it helps me scaffold my projects step by step" (p. 466), "I believe that attention control helps me choose the order of assignment in priority, so I consider it as the most important strategy" (p. 468), "In my opinion, the most important strategy when implementing PBL is self-monitoring" (p. 469) and "I can use a self-evaluation strategy to evaluate my own projects, so it is an important strategy" (p. 470). Regarding practical abilities, a tenth-grader in the study conducted by Turcotte et al. (2022) explained how PBL afforded him/her the chance to demonstrate leadership abilities: "And it's like, I've learned so much about who I am -- I mean, my leadership skills have actually come to shine. I'm good with public speaking; I'm good with taking on a role if somebody's not here. I've found kinda who I am in a sense, and I'm a leader!" (p. 58). Another high school student –in first year– reported working with technology: "We did a lot of computer activities, apps, blogs, we also did a video" (Gómez-Pablos et al., 2020, p. 435).

Theme 2: Enhances enthusiastic engagement. This theme was mentioned in 10 out of 14 studies (e.g., Imaduddin et al., 2021), thereby providing insights into the motivational aspects of PBL. Two subthemes emerged from these studies: engaging classroom experiences, and enthusiasm for PBL. Regarding engaging classroom experiences, students expressed their appreciation for PBL as it provided them with interactive and engaging learning environments (Drljača, 2020). They reported feeling more invested in their education because they actively participated in the learning process through hands-on activity. A seventh-grader in the study conducted by Ubuz and Aydınyer (2019) expressed his or her enjoyment and noted that PBL helped him/her understand geometry

better, stating, "It is more enjoyable and meaningful to learn in this way. This experience helped me understand geometry more" (p. 294). Additionally, students demonstrated enthusiasm for PBL, viewing it as a refreshing and exciting learning approach. They exhibit genuine excitement, eagerness, and interest in the learning process, indicating a strong desire to learn and actively participate in PBL projects (Tsybulsky & Sinai, 2022). Their enthusiasm was reflected in their curiosity, motivation, and creativity when working in groups. For example, an eleventh grader in the study conducted by Othman et al. (2022) expressed the motivation to be more active in learning, stating, "I am motivated to be active while learning. I also must think creatively because we do every activity in groups. If I'm passive, I won't be able to give a creative opinion, and I might burden my team members" (p. 2132). Students emphasized the importance of being active and seeking additional knowledge and skills while working as a team on their assigned projects.

Theme 3: Time-consuming. This theme was identified in five studies. While students generally had positive perceptions of PBL, they perceived it as time-consuming because of the increased workload and the demands of their efforts. In the study conducted by Gómez-Pablos et al. (2020), first-year high school students mentioned increased workload as a significant obstacle that required considerable time and effort. As they claimed, "You have to use up more time because you have to reach agreement with your classmates, and that takes more time," "It took us time, and we had to do the project and study for exams," and "It took a lot of work and effort" (Gómez-Pablos et al., 2020, p. 435). Similarly, in the study conducted by Imaduddin et al. (2021), high school students voiced concerns regarding the time-consuming nature of PBL, with the most frequent negative experience being the perception that the process requires excessive time. Furthermore, the students discussed the frustration caused by the lack of adequate time to complete their projects. For instance, an eighth-grader stated, "At first, I was excited, but now I'm a little disappointed because I didn't get the chance to complete the task because the time given was too short" (Othman et al., 2022, p. 2132). Another student –a senior high school freshman– made the following statement: "I had never studied programming before, and I think it is a little bit difficult, and the *time* and content are insufficient" (Chang & Chen, 2022, p. 9).

Theme 4: Evokes initial jitter. One notable finding that emerged in 5 of the 14 studies pertained to students' nervousness regarding PBL. This sentiment was evident when students expressed apprehension and unease when they were first introduced to the PBL concept. In the study conducted by Zhou and Li (2022), one quotation from a high school student encapsulated students' apprehension concerning PBL: "All my previous experience in class was to learn what the teachers told me, so this self-initiated research process was unfamiliar to me and made me nervous" (p. 387). Additionally, the results of the study conducted by Tsybulsky and Sinai (2022) indicate that students encounter challenges during PBL. Reflecting on their experiences, the eleventh graders noted the following: "This was the first time we had such a challenging experience" in the context of their biology studies. They highlighted their unfamiliarity with certain concepts, as exemplified by the following comment: "Even the language was new to us, for example, 'constructing the experiments algorithm' – what is that anyway? How do you do it? We had never experienced that before" (p. 547). Similarly, a study conducted by

Gómez-Pablos et al. (2020) revealed that many students felt lost and overwhelmed, particularly when confronted with new and unfamiliar projects. They expressed a need for guidance, highlighting the importance of providing scaffolding and mentorship in the PBL context. A first-year high school student expressed confusion, noting that "We were a bit lost because they didn't tell us what we had to do next; we finished one thing and had to go and ask what we had to do next because we didn't know; they hadn't told us what we had to do next" (Gómez-Pablos et al., 2020, p. 436). Therefore, offering clear instructions, clarifying expectations, and providing ongoing support are crucial for empowering students to overcome their initial confusion and confidently navigate the complexities of PBL.

Key Themes Associated with PBL Design and Implementation

Theme 5: Content insufficiency. This issue was identified as a theme in three studies (e.g., Chang & Chen, 2022) in which students expressed concerns regarding their learning experiences and cited insufficient content in the provided materials and the fact that the content was somewhat difficult for beginners. One senior high school freshman noted, "I had never studied programming before, and I think it is a little bit difficult, and the time and content are insufficient" (Chang & Chen, 2022, p. 9). Another student in junior high school expressed concern with the fact that students in the PBL class lagged behind students in the regular chemistry class, which was a source of worry to him/her: "The only thing that bugs me is how in doing projects, we'll focus on a certain chapter that we're learning, and we have, you know, a few weeks to do it and you talk to the regular chemistry classes and they are so far ahead. I feel like in New Tech, we don't get to learn everything we could be learning in a whole school year" (Virtue & Hinnant-Crawford, 2019, p. 9).

Theme 6: Interdisciplinary integration. This theme was identified in two of the 14 studies. Students acknowledged the value of an interdisciplinary curriculum in enhancing their understanding of core concepts and their ability to apply knowledge across multiple subject areas. In the study conducted by Lin and Tsai (2021), senior high students provided comments referring to the diverse subject applicability associated with PBL classrooms: "(After taking part in the curriculum) I was able to apply this approach while reading the social studies textbook… I used to read it slowly and in detail, but now I am able to know where the main points are immediately" (p. 120) and "For me, the High Scope curriculum allowed us to discuss different topics and articles…and we were able to care about various situations or problems from different perspectives" (p. 121). Furthermore, in the study conducted by Kilic and Ozel (2022), sixth-seventh graders expressed a preference for the implementation of PBL in the context of science and technology: "It is science because there are more projects to choose. Also, I like science courses very much. The science course teacher is also our classroom teacher, and she helps a lot with the projects" and "With the science course, there are various topics to choose from, and it contains important information about life, such as magnets and atoms" (p. 6).

Key Themes Addressing Gaps in the Research Results

Theme 7: Geographical area. The articles included in this review were conducted in 11 different contexts across Europe, North America, and Asia. Within Europe, both the Western and Southern regions were the focus of two studies that examined K-12 students' perceptions of their PBL experiences. Two studies focused on North America, specifically the United States. Asia, on the other hand, accounted for a total of ten studies, with three studies conducted in East Asia, four in Southeast Asia, and three in West Asia. However, no studies have been conducted in Northern Europe, Eastern Europe, Central Asia, South Asia, Africa, South America, or Oceania to investigate K-12 students' perceptions of their PBL experiences.

Theme 8: Educational level. All studies included in this synthesis were conducted within K-12 educational settings. Specifically, seven studies focused exclusively on senior high school students, two exclusively involved junior high school students, and one included only primary school students. Furthermore, three studies included both junior and senior high school students, whereas one study involved both junior and primary school students. It is worth noting that research on primary school students is relatively scarce in the reviewed literature.

DISCUSSION

This meta-ethnography focused on K-12 students' perceptions of their PBL experiences and the gaps arising from the available results. Eight themes: 21st-century skill enhancement, enhanced enthusiastic engagement, time consumption, evoking initial jitter, content insufficiency, interdisciplinary integration, geographical area, and educational level emerged from the synthesis. This section discusses the results in terms of four aspects: (1) the implications of PBL in K-12 education, (2) PBL design and implementation, (3) research gaps in PBL research in K-12 educational settings focusing on student perceptions, and (4) the limitations of the study. The first and second aspects pertain to answering the primary research question, and the third addresses the second research question. The limitations of the study are thereafter dealt with in the fourth aspect.

PBL Implications in K-12 Classrooms

The findings of this meta-ethnography have significant implications for PBL implementation in K-12 classrooms. One key theme pertains to the enhancement of 21st-century skills. Studies (e.g., Zhou & Li, 2022) have consistently shown that PBL can effectively enable students to develop critical thinking, problem-solving, collaboration, and communication skills. These skills are crucial for students' success in the modern world and are in line with the needs of the workforce (González-pérez & Ramírez-montoya, 2022). Another important theme pertains to the enhancement of enthusiastic engagement. Students expressed appreciation for PBL, as it provided them with interactive and engaging learning environments (Othman et al., 2022; Ubuz & Aydınyer, 2019). They reported feeling more invested in their education and exhibiting genuine excitement, eagerness, and interest in the learning process (Drljača, 2020; Ubuz & Aydınyer, 2019). PBL can foster a positive learning experience that motivates

students to actively participate, be creative, and develop a strong desire to learn (Lin & Tsai, 2021; Marsiti et al., 2023; Turcotte et al., 2022).

However, students perceive PBL to be time-consuming because of the increased workload and demands entailed by their efforts (Gómez-Pablos et al., 2020; Imaduddin et al., 2021). They mentioned the additional time they required to collaborate with classmates and complete projects, as well as the need to balance PBL tasks with exam preparation (Gómez-Pablos et al., 2020; Othman et al., 2022). Although PBL offers valuable learning experiences, it is essential to address student concerns regarding time management (Imaduddin et al., 2021). Educators can support students by providing clear guidelines, structuring project timelines, and facilitating efficient group work to ensure that PBL activities are manageable within a given timeframe (Schwalm & Tylek, 2012). Additionally, students expressed nervousness and uncertainty, as PBL requires a shift from traditional teacher-led instruction to a self-initiated research process. They felt unfamiliar with this new approach and encountered challenges in their attempts to understand certain concepts and project requirements (Chang & Chen, 2022). To address this initial jitter, it is crucial to provide clear instructions, clarify expectations, and offer ongoing support. Educators can provide scaffolding, mentorship, and guidance to help students overcome their initial confusion and develop confidence in their ability to navigate PBL complexities (Boss & Larmer, 2018; Grossman et al., 2022).

PBL Design and Implementation

The findings of this meta-ethnography have significant implications for the design of PBL curricula. While PBL offers valuable learning opportunities, some students experience difficulties with insufficient content in the provided materials, particularly regarding new or challenging topics (Chang & Chen, 2022). Educators must carefully select and develop resources in line with students' levels of understanding and provide adequate content to support their learning needs (Drljača, 2020; Lin & Tsai, 2021). By ensuring the availability of relevant and comprehensive resources, educators can help students overcome content-related challenges and promote a deeper understanding of their subject matter (Virtue & Hinnant-Crawford, 2019). Moreover, students appreciate the opportunity to connect and integrate knowledge from multiple disciplines into PBL projects (Othman et al., 2022; Tsybulsky & Sinai, 2022). This interdisciplinary approach allowed them to see the relevance and interconnectedness of different subjects, promoting a holistic understanding of the real-world problems that they were addressing (Chang & Chen, 2022; Ubuz & Aydınyer, 2019). Educators should strive to incorporate interdisciplinary elements into PBL projects, thus fostering a multidisciplinary perspective and encouraging students to connect with various areas of knowledge (Tsybulsky & Sinai, 2022; Ubuz & Aydınyer, 2019).

Research Gaps Regarding PBL Research in K-12 Educational Settings

In response to the second research question, the literature review also revealed several research gaps in the PBL field in the K-12 educational setting, focusing on students' perceptions. One notable gap pertains to the geographical areas in which these studies were conducted. Most of the included studies were conducted in Europe, North America,

and Asia, whereas other regions, such as Africa, South America, and Oceania, received only a limited representation. Future research should include a more diverse range of geographical areas to provide a comprehensive understanding of students' perceptions of PBL in different cultural contexts. Another gap pertains to the limited research on primary school students. Most studies have focused on senior high school students, with a smaller number of studies including junior high school students. The inclusion of primary school students in PBL research is relatively rare. Further research should explore the effectiveness of PBL in younger students and investigate how it can be adapted to suit their developmental needs and abilities.

The Limitations of the Study

It is important to acknowledge the limitations of this meta-ethnography. The studies varied in terms of methodology, sample size, and geographical location, which could affect the generalizability of the findings. In addition, when reading the 14 papers and exploring the students' statements (first-order concepts) and the authors' interpretation of the first-order concepts (second-order concepts), it was impossible to determine which student statements were excluded from the authors' original findings and discussion, and whether this would have altered our findings.

CONCLUSION

The primary aim of this meta-ethnography was to investigate K-12 students' perceptions of PBL experiences and identify research gaps. The synthesis revealed eight key themes encompassing the enhancement of 21st-century skills, enthusiastic engagement, time consumption, initial jitter, content insufficiency, interdisciplinary integration, geographical variation, and educational level disparities. The results underscore PBL's potential to foster critical skills and engagement while acknowledging challenges related to time management and initial apprehension. Implications suggest the need for targeted support in PBL design and implementation, emphasizing resource adequacy and interdisciplinary integration. The study's limitations include variations in methodologies and sample sizes, potentially impacting generalizability. Future research should explore PBL's effectiveness in primary school settings, incorporate more diverse geographical representations, and adopt a longitudinal design to study the long-term impact of PBL. Despite these limitations, this meta-ethnography contributes to the literature by synthesizing diverse studies and offering insights into students' varied experiences with PBL, paving the way for informed educational practices.

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