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REVIEWS

Project-based Learning and Student Outcomes in Health Professions Education: A Literature Review

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Abstract

Purpose: Project-based learning (PjBL) is an instructional method designed to help students cultivate skills transferable beyond traditional education systems focused on didactic learning. This literature review aims to critically summarise existing literature on PjBL and its value in tertiary health professions curricula, especially with regards to cognitive, affective and behavioral student outcomes. In doing so, this study seeks to inform teaching and learning approaches that nurture skills desirable in professional settings.

Method: An electronic search for relevant English journal articles was conducted using four databases; EBSCOhost, Medline, Web of Science and Scopus. Studies which pre-date 2012, fail to or incorrectly define PjBL and/or did not explore its effect on student outcomes through original research were excluded.

Results: By applying theory to practice in a real-world setting, PjBL has been shown to not only enhance course-based knowledge but also successfully facilitate cognitive strategies in critical analysis and problem solving. The construction of tangible artifacts as part of PjBL projects also stimulates engagement and interest in the subject area amongst students and nurtures a greater sense of fulfillment from the learning process. Consequently, students experience increased confidence in operating autonomously in professional settings and are empowered to engage in healthcare advocacy. At its core, the creation of project-based learning was intended for students to express creativity and personal development, providing an opportunity for a more hands-on and experiential learning experience. The benefit of integrating PjBL into post-secondary healthcare curricula is historically underexplored with most existing literature focusing on K-12 education or non-health disciplines.

Discussion: Evidence presented in this review strongly supports the favourable effect of PjBL on student outcomes, with the potential to outperform traditional pedagogies. Future research should consider the implementation of PjBL across diverse disciplines with a focus on exploring its long-term effects.

Keywords: Project-based learning, Health professions, Cognitive outcomes, Affective outcomes, Behavioural outcomes

1. Introduction

Built upon the foundation of philosopher and educator John Dewey's proposition that active inquiry and learning can emulate real life, project-based learning (PjBL) has progressively become a more prominent pedagogy taught in educational institutions [1]. PjBL intends to challenge the traditional schooling models and instead, finds value in allowing students to work autonomously and supports them in culminating their critical thinking skills into realistic, tangible outcomes.

The impact of social change on healthcare in recent years has prompted a shift in educational paradigms to favour pedagogies such as project-based learning which help develop skills transferable beyond tertiary education [1]. This is critical in healthcare disciplines including medicine, dentistry, veterinary science, physiotherapy, nursing, pharmacy and occupation therapy, where the cultivation of skill-sets such as critical thinking and autonomous learning requires more than just passive transfer of knowledge through traditional instruction [2].

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The nature of healthcare work necessitates a wide range of competencies which encompass the employment of not only didactic knowledge but also transferable skills in problem solving, teamwork, communication as well as empathy [3]. Student outcomes should incorporate research skills, including autonomous critical thinking, knowledge acquisition, data interpretation and self-reflection, which will produce physicians that can keep up with advancements in their fields and adopt evidence-based practices [4]. Learning within a social context will also be instrumental in developing long-term persistence and intrinsic motivation within clinicians as they coordinate their efforts to navigate real-life situations [3,5]. This will concurrently cultivate desirable qualities of emotional intelligence [6], interdisciplinary collaboration and professionalism as students gain confidence in becoming productive members of society [5,7]. As such, healthcare education and training would ideally be built upon learning based around practical experience.

In this literature review, PjBL is defined as ‘an inquiry-based instructional method that engages learners in knowledge construction by having them accomplish meaningful projects and develop real-world products’ [8]. Six key hallmarks highlighted by Krajcik & Shin [8] form the foundation of this pedagogy: (1) driving question; (2) focus on learning goals; (3) participation in educational activities; (4) collaboration among students; (5) use of scaffolding technologies; and (6) creation of tangible artifact(s). Within healthcare education, these objectives are achievable not only through practice-based experiential learning [9] but also within wider contexts presented by community health services [10].

Existing literature celebrates the application of PjBL within healthcare curricula as a potential approach to enhance various student outcomes and professional skills. Through participation in PjBL research projects, students acquire research skills necessary for healthcare professionals to maintain pace with advancements in their field [3]. By designing, organising and conducting research within groups, students nurture skills in critical literature evaluation and in formulating original investigative questions [3,11]. Subsequently, students exercise skills in active learning, critical thinking and collaboration as they coordinate their own learning process alongside their peers [3,4]. As teachers operate only as facilitators in PjBL, students benefit from a greater sense of autonomy over their own learning process, leading to a higher level of motivation and engagement [11]. PjBL research

methods contribute to a deeper understanding of the clinical applicability of research content by shifting focus from content memorisation to active participation [12], thus setting the foundation for evidence-based practice in clinical context. PjBL programs involving real-world projects are able to develop diverse leadership qualities including professionalism, effective collaboration, team management and problem solving within an extracurricular setting [7]. The broad nature of driving questions in PjBL draws upon student creativity as they are encouraged to seek solutions actively and engage in problem solving, experimental design and in the development of a final artifact [13].

The effect of PjBL on student outcomes within tertiary healthcare education is under-explored in current literature. Concurrently, existing studies incorporating PjBL in K-12 learning or non-health disciplines have demonstrated potential for improvement in existing educational practices. Furthermore, multiple controversies exist within current literature in differentiating PjBL from problem-based learning (PBL). Despite being recognised as two distinct pedagogies, with PjBL more focused on the active construction of a tangible artifact [8] while PBL places a greater emphasis on the learning process and the creation of an academic solution [8,14,15], there is no universal consensus on the definitive characteristics of each model [16]. This greatly restricts the consistency of existing research which variably employs characteristics of both PBL and PjBL [17].

Grounded in this research history, the aim of this review is to critically summarise available literature on PjBL, as defined by the 6 hallmarks outlined in Krajcik & Shin [8], and its value in higher education healthcare disciplines. The objectives of the research were to explore (1) the effect of PjBL on student outcomes, specifically cognitive, affective and behavioral outcomes and (2) the limitations of PjBL in health professional education. In doing so, this study seeks to inform the development of teaching and learning approaches that provide tertiary health professions students with critical skills deemed desirable in professional settings.

2. Methodology

The research question for this literature review is: ‘What is the effect of project-based learning on student outcomes when implemented in higher education health disciplines?’ The ideal study design to answer this prognosis type question is a prospective cohort study. This provides strong

evidence for a causal link between a single, potentially under-explored exposure, such as PjBL, and multiple student outcomes. However, due to the limited availability of literature relevant to our research question, other study designs such as case studies and qualitative research were also included.

An electronic search was conducted using four databases; EBSCOhost, Medline, Web of Science and Scopus. The Medical Subject Headings (MeSH) terms including the Boolean parameters for the search included the following: project-based learning, curricul*, cours*, learn*, student, medic*, dent*, health*, pharmac*, nurs*, occupational therap*, physiotherap*, vet*. To ensure reliability, only English journal articles were included and overlapping studies between the four databases were manually excluded.

The inclusion criteria for this review included peer-reviewed literature published from 2012 to 2022 exploring PjBL in post-secondary health professions education including undergraduate, post-graduate and any other forms of tertiary or further education. Studies that were not peer-reviewed, were published prior to 2012, fail to or incorrectly define PjBL, particularly if they lacked the report of artifacts and/or did not explore its effect on student outcomes through original research were excluded (see Fig. 1). Following this, selected articles were compiled and assessed both manually and independently by each researcher for quality and compatibility with aforementioned inclusion and exclusion criteria. Conflicting perspectives which emerged on study eligibility were mediated through group discussion and consensus.

Articles selected for the review had contents assessed and organised into a matrix (Appendix A) with titles, research design, data type, time of data collection and outcomes assessed. As clustering learning outcomes is commonly adopted, results were subsequently categorised into cognitive (knowledge-based), affective (student perceptions) and behavioral (skills and engagement) related outcomes [16].

3. Results

There were 21 papers identified as meeting the inclusion criteria for this review. The results of this review have been structured to present findings on the effect of PjBL on cognitive, affective and behavioral student outcomes. Additionally, common limitations of these studies as well as the constraints of implementing PjBL itself in post-secondary health-care education were expounded upon.

3.1. Cognitive student outcomes

PjBL has been shown to successfully foster cognitive outcomes within students by enhancing not only course-based knowledge [18,19] but also the development of cognitive strategies to critically analyse, organise and communicate the knowledge learnt [3,11].

Various studies which examined PjBL via rubric-based assessment have demonstrated its value in deepening students' concept comprehension with little previous course-content knowledge, [20,21] promoting autonomous learning and also improving academic grades [22]. Specifically, research indicates that PjBL achieves this through the application of theoretical knowledge to practical, real-world settings [4,6,23–27]. This is evidenced in Koo and colleagues [23] study where the introduction of PjBL to nursing students, requiring them to make an educational video clip on managing high-risk newborns, increased both knowledge and clinical competency in the field. Furthermore, dental students in Costa-Silva et al. [4] who undertook a PjBL cell biology course displayed a greater understanding of scientific methodology and its relationship with clinical dentistry. Data collected through focus group discussions and student questionnaires reveal that PjBL programs facilitate not only the synthesis of knowledge, but also the contextualisation of clinical practice within the socioeconomic and cultural climate of the healthcare dimension [18,28].

As an adjunct to traditional learning, PjBL promotes the employment of cognitive strategies which enable students to devise plans, gather information and evaluate findings as well as their own approach [28]. Mateo & Sevillano [11] and Si [3] both explore this in relation to undergraduate medical research based on the assessment of a final scientific report produced by PjBL students. Results reveal that participants were able to acquire key skills in undertaking laboratory work, critical appraisal of literature, formulating research questions and methodology, data presentation and interpretation. Furthermore, Mateo & Sevillano [11] required students to present their project to a University Congress, thereby nurturing abilities in both oral and written communication of scientific research. PjBL has also been demonstrated to be important in training healthcare students to employ cognitive strategies in clinical settings [10,29]. This is highlighted in a study on medical students who undertook a PjBL pharmacology course during COVID-19 lockdown [10]. Despite the lack of in-person training, feedback obtained through questionnaires indicated that PjBL was still effective in equipping students with skills in

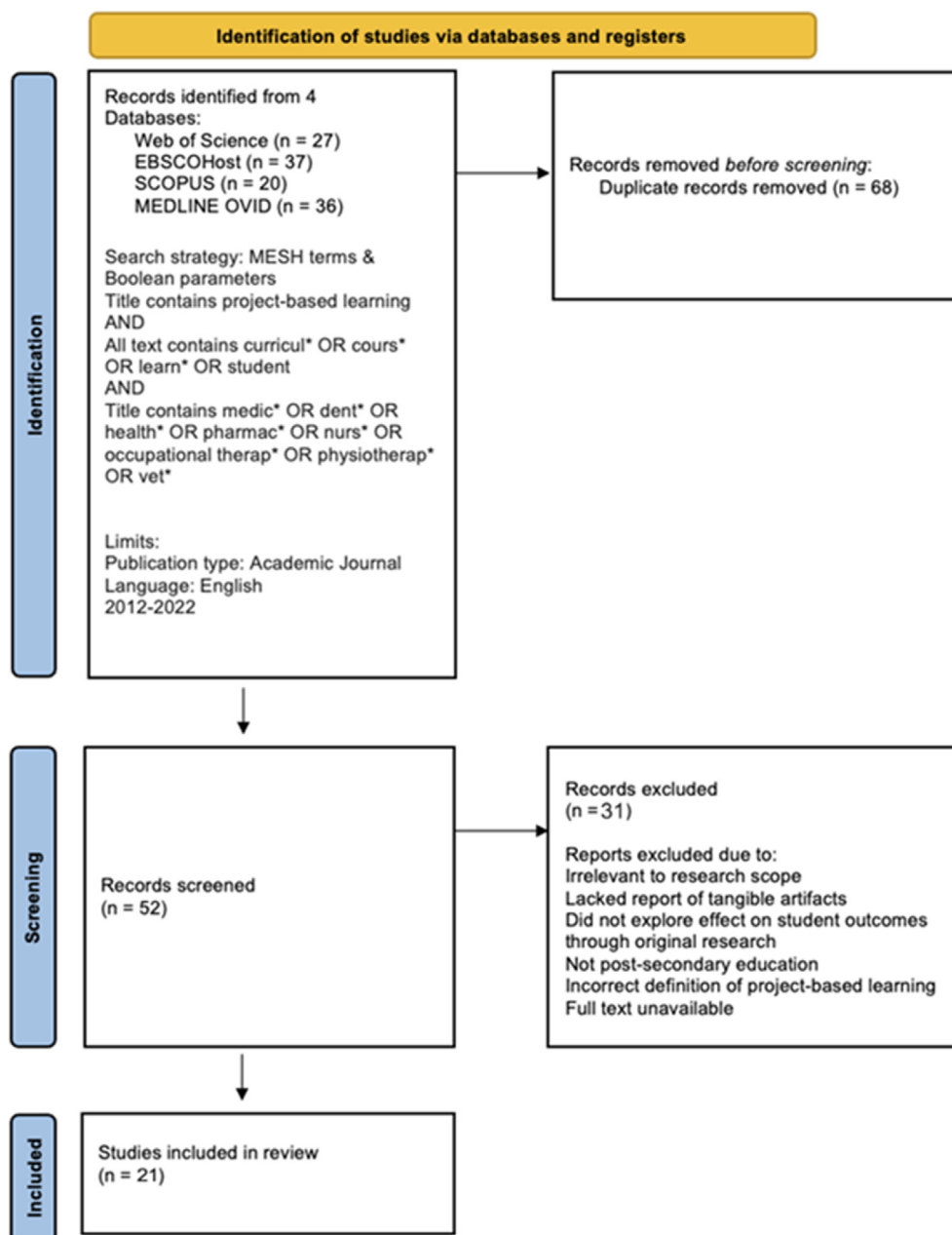


Fig. 1. Flowchart of literature review methodology.

analysing professional practice situations and in decision-making. Similarly, the findings of Yoo [29] illustrate how these skills can be translated to dental practice where oral-health professionals are trained to identify dental hygiene problems from a community perspective and plan, construct and implement logical models to address these issues.

3.2. Affective student outcomes

By having the autonomy to play key roles in their own knowledge construction, students perceive the

PjBL experience to be motivating and successful in stimulating interest in the subject area [10,11,20,24,28,30,31]. Both dental [4] and medical students [11] reported greater engagement with research following participation in PjBL. Similarly, in Shahi-wala [19], findings suggest that the vast majority of pharmacy students expressed greater interest in independent pharmacy ownership following a business proposal building PjBL activity.

The social aspect of collaborating with peers not only builds upon essential team-work and conflict resolution skills required in real-world working

environments, but also contributes to student engagement in the learning process [18,19,21,23,25,32]. This sentiment was shared by undergraduate medical students who undertook an experience-based research course in groups of four to five, and described the experience as being ‘interesting and helpful to discuss and collaborate with other students’ [3]. Furthermore, PjBL places teachers, sponsors and students in active roles within the learning environment [20,23,27,33], allowing the opportunity for self-directed learning and a different model of supervision whereby teachers act as facilitators of learning. While a more collegial relationship with supervisors initially appeared foreign to students, participants nevertheless highlighted the transformative role of project supervisors in challenging and broadening their skills and perspectives [27,33]. This was evident in Fortune and McKinstry [33] whereby occupational therapy students undertaking a project placement recognised the crucial role of supervisors in guiding students through the notion of health practice at a macro level.

In the construction of real-world products, students establish credibility for their own skills, and gain a greater sense of independence and confidence in project management and their ability to improve on skills relating to professional practice [33]. This was especially evident in Fortune and McKinstry [33] where the involvement of agency project sponsors demonstrated real-world applications of student project artifacts. Similarly, in Lau [26], occupational students volunteering in a health promotion service-learning project for children at risk of obesity were able to witness the direct impact of project goals through health improvements in the children, thereby contributing to a sense of fulfillment and validation towards their efforts.

Through PjBL, students reported a greater ability to synthesize earlier understandings, fundamental knowledge and skill with clinical application [4,6,10,24,26]. Students expressed overall satisfaction with the PjBL experience in terms of course structure, methodology and group work [3,22,24,31]. This is substantiated through the majority of students expressing a desire to continue future courses with PjBL structures [24].

3.3. Behavioral student outcomes

The assessment of behavioral outcomes is vital in reflecting the fulfillment of learning objectives by students as well as their level of engagement in PjBL. Fortune and McKinstry [33] highlights the importance of PjBL in promoting self-directed learning

where students are empowered to achieve a higher level of skill and knowledge application by working autonomously. Peireira [18] further asserts that to develop autonomy and organize one's own learning experience, students are required to develop a sense of belonging and engagement in PjBL activities.

Three studies explored the development of health advocacy skills in PjBL. From the perspective of healthcare, the integration of practice and theory cannot be attributed to a single discipline and is rather underpinned by various healthcare determinants related to social, political, economic and cultural contexts [6,18]. Lau [26] also highlighted the importance of context-driven PjBL programs in empowering students to develop transferable skills and knowledge which can be applied to community-based health promotion. This point is further substantiated by the engagement of one participant in ongoing activism to introduce a new healthcare bill into law even following completion of the study.

Various studies on PjBL also reported improvements in hard skills such as community dental hygiene competency [29], data collecting skills, project presentation and report-writing skills [28]. However, the improvement in soft skills across literature was found to be more substantial. Almost all articles utilised similar study instruments: a questionnaire/survey or the 5 point Likert scale which evaluated the participants' ability to apply theory to practice and the quality of their interaction with team members before, during and after completion of the PjBL studies [19]. Teamwork competency [3,30,32], problem-solving ability [27,29], decision making and strategic thinking [4,10,19], leadership, communication [20,22], time management [26], conflict resolution [18] and interprofessional skill development [24,25] were reported across these articles. Several studies also observed the development of student persistence and engagement as they progressed through the PjBL course as well as after completion. Both Tiwari et al. [28] and Mateo & Sevillano [11] suggest that motivation to complete the project was predominantly attributed to the collaborative and autonomous nature of PjBL.

3.4. Limitations of PjBL

The emerging themes of concern with PjBL by students were time management, lack of direction and issues with teamwork. Students reported difficulty in balancing extracurricular PjBL activities when conducted in conjunction with regular coursework as they felt personal leisure time [26] and clinical placement exposure were compromised [33]. Additionally, a lack of direction and clarity was

identified as a concern. One study highlighted that despite participants' overall positive outcomes with PjBL, the experience was initially overwhelming [33]. Students, having been accustomed to passive learning, expressed discomfort at the novelty of being an active learner [3]. The student-driven nature of PjBL may also raise contention regarding the extent of instructor responsibility, with studies finding that instructors must be able to balance the importance of student autonomy and their need for order as they guide participants [20,28,33]. Consequently, appropriate supervisor training poses a potential challenge when implementing PjBL. Furthermore, concerns regarding the collaborative nature of team projects were highlighted, with one study finding 23% of participants reporting uneven distributions of work and 16% mentioning difficulties in agreeing on project topics [20]. While some team members 'free-riding' was an issue identified in one study [3], another study attributed the source of conflict between team members to a team leader who was perceived by others to be "blocking the flow of information" and preventing others from being heard [30].

3.5. Limitations of studies selected

The definition of PjBL and its differentiation from instructional methods such as PBL and inquiry-based learning is a recurring matter of contention. Qutishat et al. [32] based their study on practice-based learning, however their instructional method satisfies the six key hallmarks of PjBL as outlined by Krajcik and Shin [8]. Another study used PjBL and PBL interchangeably [30] despite their being different pedagogies. As such, the exclusion of studies that satisfy characteristics of PjBL but incorporate inconsistent differentiation and definitions of instructional methods may limit this study's ability to accurately reflect the present climate of research into PjBL in health education.

Small cohort sizes and limitations on valid controls, nature of participant recruitment, study duration and wider study relevance emerged as key concerns when assessing evidence quality. Often, studies were unable to adopt control groups, thereby potentially overestimating the benefits of PjBL due to a failure in distinguishing its effect on student outcomes from that of other courses taken by participants as part of their curricula [4,10,25,27]. This is evidenced in Koo et al. [23] which found that whilst self-leadership skills increased for the PjBL group, the control group also showed an improvement, rendering the causative effect of PjBL potentially negligible.

Additionally, small cohorts, single institutions and low student responses reduce study generalisability [4,10,22,25,32]. Multiple studies adopted convenience sampling which, while affordable and time efficient, does not provide a representative cohort, thereby reducing external validity and creating issues in replicability. Furthermore, some studies did not adopt pre- and post-op comparisons, thereby potentially skewing the effects of PjBL on student outcomes. Short study durations fail to explore the longer term effects of PjBL [22,23] such as its impact on future academic achievement. Therefore, the far reaching impact of PjBL compared to traditional didactic methods remains unclear.

4. Discussion

The existing scope of research on PjBL has been traditionally based around K-12 education [34] with few studies exploring its potential in healthcare education. Furthermore, many studies are restricted to implementation strategies of PjBL [35] rather than exploring its effect on student outcomes. In contrast to traditional pedagogies which passively transfer knowledge through theoretical content, the efficacy of PjBL is endorsed by existing literature, highlighting the importance of integrating knowledge through problem-solving, decision making and fostering student innovation [8]. This approach is pertinent to healthcare education including dental curricula, with the limited existing research indicating potential for improved cognitive, affective and behavioral outcomes.

A PjBL approach provides meaningful first-hand experiences through which students can integrate their knowledge of theoretical concepts with real-world problems [6]. In this review, we identify that PjBL can be effectively implemented into health sciences curricula whether it be in cell biology [4], anatomy [22], developing research skills [3], theoretical and practical skills of dental hygienists [29] or in fostering student innovation both autonomously and as a team member [32]. Further, the included studies demonstrate that PjBL fosters the development of transferable behavioural skills, including critical analysis, organisation and communication [3,10,11,28,29]. However, the common separation of basic science education and clinical training in dental curricula can lead to disconnected learning without a patient centered focus [4]. As such, PjBL is a viable solution by offering active, integrated learning and encouraging autonomy and critical thinking [4]. For our senior students, PjBL approaches [3,11] could be adapted and used to foster the authentic application of knowledge in areas such

as treatment planning, evidence-based practice and health promotion, across a multitude of health professions programs in higher education.

Students engage positively with the collaborative nature of PjBL. Working with other students on authentic projects was reported to be motivating [4,18–20] and engaged with learning [3,19,20,26,33]. The responsibility required from students in PjBL, particularly when the projects are developed for ‘real-world’ application, stimulates the intrinsic motivation of contemporary students, and encourages active participation in learning [36]. This is critical for health professions, where it is essential to develop the motivation and skills for lifelong learning, so they may continue to provide quality patient care for the duration of their careers [37].

Through PjBL, there is a great opportunity to benefit the communities in which health professions students service. Several studies reported the impact of projects among high-risk patient groups [26,33], which could be easily adapted to other health professions and other communities and populations. PjBL approaches could be used alongside clinical or service-learning placements, and have the potential to develop students’ advocacy skills for vulnerable populations, influencing public health policy and interprofessional collaborations.

It should be considered that like other teaching and learning initiatives, PjBL approaches might be implemented in health professions education, but are not being evaluated or are under-reported in the educational research literature. Health professions educators should be encouraged to engage in the scholarship of teaching and learning and educational research to report on adaptations and evaluations of PjBL. This can be challenging in the health professions, where there is often a strong focus and more funding opportunities in laboratory or clinical research.

The strengths behind this review process involve the use of multiple databases and inclusion of numerous healthcare disciplines along with both qualitative and quantitative evidence. In doing so, our search results represent a wider scope of literature and address the various approaches used to implement PjBL within different health professions curricula. Articles published before 2012 were excluded to limit results to those that remain relevant to modern healthcare settings and pedagogies. Furthermore, the definition of PjBL was

standardized in the selection of articles to reduce inconsistencies.

However, several limitations remain within our research process. In order to achieve a replicable search method, we developed a more targeted database search question which can inadvertently lead to the exclusion of articles relevant to the research question. Due to the limited pool of existing literature focused on PjBL in health professions curricula all articles congruent with the exclusion and inclusion criteria were included, regardless of the quality of evidence provided. Furthermore, as an unavoidable consequence of the resources available, the data gathered is biased to the databases accessible to the authors of this review.

In conclusion, this review of existing literature suggests PjBL can be successfully implemented into various healthcare curricula to foster a number of cognitive, affective and behavioral outcomes. These are driven by active student participation and collaboration in the construction of tangible artifacts as part of real-life projects. As such, students are able to cultivate a holistic skillset in their understanding, appreciation and practical application of course-based knowledge which prove valuable within professional workforce settings. Additional considerations such as the nature of supervisor training and student workload distribution may pose a focus for further study into PjBL to refine its implementation into healthcare teaching curricula. Despite evidence of its potential, current investigations into PjBL and its relevance to healthcare teaching are hindered by several limitations including inconsistencies in definitions, overlap with other teaching methods and difficulties in adopting control groups. Further research, ideally consisting of valid control groups with appropriate assessment of artifacts and outcomes over a longer follow up period, is necessary to assess and establish the true value of PjBL within specific healthcare disciplines.

Ethics approval

Ethical approval was not required as this is a review of the literature.

Conflict of interest

None.

Appendix

Appendix A.

Study	Control group present	Study Duration	Participant number	Data Collection time point			Cognitive Outcome	Affective Outcome	Behavioral Outcome
				Pre	During	Post			
Dehdashti et al. (2013)		6hrs/week x 17 weeks	51 students 4 educators	x		x	x	x	x
Van Hoover (2015)		1 semester	Unknown	x	x	x		x	
Ogilvie (2016)		6 x 75 min	Unknown		x	x	x	x	
Lau (2016)		10 weeks	9	x	x	x	x	x	x
Tiwari & Ranjana (2017)		1 semester (unclear)	99			x	x	x	x
Shahiwala & Aliasgar (2017)		1 year	72	x		x	x	x	x
Pereira (2017)		2 years	11		x	x	x	x	x
Costa-Silva et al. (2018)	x	4 years	108 (control = 27)	x		x	x	x	x
Mateo & Sevillano (2018)		3 years	173		x	x	x	x	x
Kim (2020)		1 semester	46			x	x	x	x
Ikami et al. (2020)		14 weeks	120			x	x	x	x
Yoo et al. (2020)		15 weeks	78	x		x	x		x
Si (2020)		15 weeks	42		x	x	x	x	x
Borroni et al. (2021)	x	13 weeks x 3 years	1st year: 109 2nd year: 134 3rd year: 138	x		x	x	x	x
Hanklang et al. (2021)		5 weeks	95	x		x	x		x
Jose et al. (2021)		4 months	100			x		x	x
Qutishat (2021)		4 months	55			x		x	x
Elkhamisy et al. (2022)		5 months	694			x	x	x	x
Koo et al. (2022)	x	7 weeks	45	x		x	x	x	x
Kim D (2022)		15 weeks	25	x	x	x		x	x

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