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ABSTRACT

Problem-based learning (PBL) can take many different shapes but has as a common denominator that it builds on the principles of collaborative, constructive, contextual, and self-directed learning. Systematic review approaches that aim to provide insight in what features make PBL work generally fall short, as they tend to disregard the influential role of implementation contexts. The realist review approach seems to be promising in this respect, as this type of review aims to address the comprehensive question: What works for whom, in what circumstances, in what respects, and how? This article elaborates on the theoretical foundation of the realist review approach, provides examples and a step-by-step description of how to conduct a realist review, and sketches a promising perspective on the way in which realist reviews can contribute to furthering insight in PBL and its future development.

Keywords: problem-based learning, research methodology, realist review

Introduction

Since its development in the 1970s, problem-based learning (PBL) has been adopted by a growing number of higher education institutions from all over the world in an effort to stimulate students' deep approach to studying (Hung & Loyens, 2012). PBL was established based on the premise that collaborative, constructive, contextual, and self-directed educational approaches (the so-called CCCS principles that underpin PBL) have a positive effect on students' learning and development (Dolmans, 2019). That is, learning and development are expected to be reinforced when education is developed as an interactive process which builds on the activation of prior knowledge, elaboration, and an exposure to cases that reflect the professional field or a complex real world problem (Dolmans et al., 2021). Moreover, PBL stimulates students to play an active role in planning, monitoring, and evaluation of their own learning process (Dolmans et al., 2021).

Along with its more widespread use, the number of variations in the way that PBL is implemented has increased over time. Both this variation, and the fact that the core CCCS principles of PBL form complex social processes, make the conduct of systematic reviews on PBL a challenging endeavour (Dolmans et al., 2005; Frambach et al., 2019).

Based on an exploration of available systematic reviews and meta-analyses, Hung et al. (2019) identified three main waves of PBL research carried out in the last few decades. The first research wave (1990–2000) focused on the justification of using PBL (aiming to answer the question, does PBL work?), by exploring differences in learning outcomes of PBL versus other, more conventional, educational approaches. In the second wave (2000–2010), PBL constituents, such as modular or curriculum-wide implementations, and the alignment of assessment practices with PBL gained attention (delving into the question, how does PBL work?). In the third

wave of PBL research (from 2010 onwards), PBL reviews and meta-analyses indicate that the question, how does PBL work in specific contexts, had become topical (Hung et al., 2019).

Despite the value of previous systematic reviews and meta-analyses in terms of their contribution to the justification, explanation, and clarification of PBL, these studies are subject to critique. The available reviews tend to concentrate on outcomes and add little to the understanding of how the context in which PBL is implemented matters. For instance, the availability of a sufficient number of staff members, their backgrounds and beliefs about teaching and learning, and how they value teaching in relation to other roles and responsibilities (e.g., in doing research) might influence the way in which PBL is shaped. Moreover, student backgrounds, beliefs, and experiences play a role in the way PBL works out in practice. A second important critique on available reviews and meta-analyses is that they have failed to contribute to theory building (Farrow & Norman, 2003; Norman & Schmidt, 2000).

According to Hung and colleagues (2019), the next wave of PBL research would therefore ideally address the comprehensive question “why does PBL with specific implementation characteristics for specific outcomes work or not work in the context where it is implemented?” (p. 952). Hence, rather than merely focusing on insights whether PBL as an intervention programme works, it would particularly be useful to uncover which contextual aspects might be important to consider, and to provide more attention to why characteristics of PBL make it work (Dalkin et al., 2015).

In this article, we portray the realist literature review method as a promising approach to synthesise PBL research and contribute to theory refinement. Realist reviews are particularly useful to evaluate under which conditions PBL (or features of PBL) are effective, why this is the case, and how PBL characteristics lead to certain effects. Realist reviews involve a systematic, but flexible, review process aimed at establishing configurations between contexts, mechanisms, and outcomes (CMO). As we will describe in this article, realist reviews have an advantage, as compared to conventional systematic review approaches, in that they allow for an interpretation of findings, iterative search strategies, and idea generation (Jagosh et al., 2014). This makes realist reviews particularly useful to research complex social interventions. With this article, we aim to provide PBL researchers with an overview of the realist review methodology and to stimulate readers to apply the approach in future PBL studies.

Overview of the Realist Review Research Approach

History and Development

The realist review approach is rooted in critical realism as a philosophy of social science. According to critical realists, our knowledge and understanding of the world are constructed and expressed through interpretations and perspectives (Bhaskar, 2014). An important assumption of critical realism is that unobservable processes can cause observable events or outcomes. As it focuses on explaining phenomena instead of merely providing empirical descriptions of process or outcomes, critical realism is particularly useful to analyse social interventions (Fletcher, 2017). Critical realists hold that social processes can only be understood through analysing and reconstructing the unobservable processes (or mechanisms) that generate outcomes (Danermark et al., 2002). Realists acknowledge that a perfect understanding of reality is not possible. However, as knowledge constantly furthers over time, researchers contribute gradually to what is understood (Salter & Kothari, 2014). Theory development is key in the analysis and reconstruction of social interventions because theories provide rational explanations for the causes of social events (Archer et al., 1998).

Realist evaluation studies were developed to highlight “what works for whom, in what circumstances, in what respects, and how” (Pawson et al., 2005, p. 21). The term realist evaluation refers to a generic type of inquiry that may include the analyses of a variety of data sources, such as empirical data gathered through field research, interviews, focus groups, and document analysis. In this article, we focus on realist literature reviews (also referred to as realist synthesis) which are an operationalisation of realist evaluations that use published peer-reviewed articles, evaluation reports, and/or grey literature as main sources for analysis (Greenhalgh et al., 2017).

Types of Research Questions that Realist Reviews

Aim to Answer

Typical systematic review questions concerning PBL fail to indicate for which students PBL did work, for whom it did not, and potentially, for which students or other stakeholders the intervention had negative effects (Wong et al., 2013). Realist reviews would start from the assumption that PBL will work well for some students (e.g., students who have previous experience with working in small groups), but not for others, and that PBL can work out differently in various settings. For instance, the implementation of PBL might fail in settings where traditional, lecture-based curricula

have always been the norm (Frambach et al., 2019). The explanatory character of realist reviews and the fact that the reviewed social interventions are multifaceted and complex rather than simple make realist review research questions broad, instead of narrowly defined. We now provide four examples of the way research questions underpinning realist reviews on PBL could be formulated. All research questions incorporate attention to contexts (C), mechanisms (M) and outcomes (O):

- How (M) and under what circumstances (C) may features of PBL help students to improve their study behaviour (O)?
- What are the key mechanisms (M), triggered in particular contexts (C), which lead to the success or failure of PBL in terms of student learning and development (O)?
- What PBL features are effective for developing a student's academic skills (O)? When and why are they effective (M), for whom, and in what circumstances (C)?
- What are hampering and promoting organisational context elements (C) that impact the successful implementation of PBL? How do the mechanisms triggered by PBL work (M), and what outcomes are associated with the introduction of PBL (O)?

Please note that the way in which the research questions above are phrased can indicate a difference in focus. Question 1 is more directed towards identifying key context elements and mechanisms that influence the implementation of PBL, and focuses less on potential outcomes. In question 2, mechanisms are at the centre of study, while question 3 is mainly concerned with features of PBL (the intervention). Question 4 exemplifies a study approach with a broad and explorative purpose.

Instead of providing a summary of the literature like narrative or scoping reviews, realist reviews allow researchers to reach beyond average conclusions that interventions work "to some extent" and "sometimes" (Pawson et al., 2004, p. IV). Questions addressed by realist reviewers inform practitioners and policy makers about whether and when to use certain interventions, and how to adapt them to local circumstances (Pawson et al., 2004). Therewith, realist reviews complement established systematic review approaches, which were developed to review the outcomes of simple interventions with clearly specified outcomes (e.g., the health effect of implementing a new clinical treatments or therapy).

Systematic reviews require the use of a pre-specified and strict protocol in which target populations, interventions, and outcome measures are clearly defined, and the quality of empirical studies is assessed in detail. In contrast, realist

review protocols allow for iterative adaptations based on initial findings and fine-tuning in the search and analysis phases. In addition, the quality of included studies may or may not be assessed in realist reviews. In Table 1, we present a simplified overview of the main characteristics of realist reviews and three other commonly used approaches: narrative, systematic, and scoping reviews (this overview is generated based on the works of Gough et al., 2012; Grant et al., 2009; Moher et al., 2015, and Pawson et al., 2005).

Main Tenets Underpinning the Realist Review Approach

Realist reviews start with the formulation of a programme theory: the hypothesised relationship between contexts, mechanisms, and outcomes. In this section, the concepts of programme theory, context, mechanisms, outcomes, and CMO configurations are described and illustrated in relation to research on PBL.

Programme Theory

A programme theory provides an explanation of how and why an intervention is expected to work, and is often expressed as a preliminary CMO configuration (Coleman et al., 2020). Based on the research findings, the programme theory can be altered or refined. Article selection and inclusion criteria in realist reviews are primarily based on their potential contribution to programme theory development (Pawson, 2006). The realist review approach encompasses that no theories on interventions can explain all outcomes in every context (Pawson, 2003; Rycroft-Malone et al., 2012). The following examples of programme theories relate to the CCCS principles that underpin PBL:

- The posing of critical questions will stimulate students to discuss cognitive disagreements and lead to better knowledge retention because students relate new information to their prior knowledge (constructive learning).
- By analysing complex and authentic tasks from multiple perspectives, students are stimulated to deepen their understanding and insight in potential problem solutions, and will be able to transfer this knowledge to similar problems encountered in different settings (contextual learning).
- By implementing processes in which students' development is dependent on learning with and from each other, students are triggered to evaluate their own and each other's functioning, which will lead to an increase in knowledge exchange (collaborative learning).

	Review Type			
	Narrative	Systematic	Realist	Scoping
What	A general review of literature. Can cover a wide range of subjects at various levels of comprehensiveness	An exhaustive search, appraisal, and synthesis of evidence on outcomes of an intervention	A theory-driven systematic review, usually for complex interventions	A broad literature analysis and synthesis to provide conceptual clarity on a certain topic
Why	To identify and summarise previous publications, identify knowledge gaps, and provide suggestions	To provide a detailed summary of a topic, including effectiveness	To develop theory on how, when, and why interventions lead to outcomes of interest	To map the current literature on approaches to a particular topic and highlight gaps
How	May or may not include specific and comprehensive search strategy Study quality not always assessed Qualitative integration and interpretation (includes no quantitative data)	Specific, pre-determined, exhaustive search strategy Study quality is assessed Quantitative integration and interpretation +/- meta analysis or systematic qualitative integration	Specific, iterative search strategy Study quality not always assessed Qualitative integration and interpretation to refine theory using CMO configurations	Specific, iterative search strategy Study quality not always assessed Qualitative integration and interpretation (includes little quantitative data)

Table 1. Main Characteristics of Narrative, Systematic, Realist, and Scoping Reviews

- The exchange of prior knowledge by means of group discussions triggers the motivation of students to direct the planning and monitoring of their own learning process (self-directed learning).

Context

The realist philosophy suggests that interventions may work in some contexts but not in others. Contexts can refer to observable features (e.g., available resources), but also relational and intangible features which emerge over time (e.g., shared values) (Greenhalgh & Manzano, 2021). Context in the case of PBL research could concern the background of study programmes and institutions in which PBL is implemented. Examples of context features include pre-existing social, economic, political, and organisational structures, organisational (sub) cultures, social norms, and interrelationships between staff members and students. Staff and

student backgrounds, educational leadership, and present resources and infrastructure constitute contextual conditions that should be taken into account when PBL is implemented.

Staff members might consider teaching subordinate to doing research, and this could diminish their intrinsic motivation to enhance constructive, contextual, collaborative, and self-directed learning. Staff might also believe that students prefer to receive direct instruction and guidance, which could explain why they tend to give mini-lectures and tell students what the intended learning outcomes are, instead of stimulating them to activate prior knowledge. Meanwhile, students’ backgrounds and motivation can have an important impact on their performance in PBL as well. For instance, who the students are (what their national, cultural, and personal background is), what their motivation to study is (e.g., being particularly interested in academia or a job in the industry), and their previous study experiences, skills, and expectations, will determine how well they are prepared to study in a PBL environment.

Educational leaders ideally have a clear vision on the way in which to implement PBL in an optimal way, and they should be capable of communicating this vision to various stakeholders. In order to continuously improve PBL, leaders should nurture a supportive feedback and feed-forward culture.

Lastly, resources and infrastructure form basic requirements that relate to the structural context of PBL. For instance, the availability of sufficient resources to train teachers, the availability of a sufficient number of teachers available to facilitate small groups, the number of study places available, and the number of students enrolled in the curriculum will all influence PBL implementation.

Some context features enable the triggering of particular mechanisms, while other aspects of context may prevent mechanisms from being triggered. Typically, promoting and inhibiting context features are mirrored. For instance, the availability of sufficient financial means provides room to implement small-scale teaching such as PBL, while budget constraints might prevent PBL implementation.

Mechanisms

An intervention (in this article, the PBL approach) provides certain resources, opportunities, or constraints that influence the reasoning and behaviour of stakeholders. Mechanisms cause things to happen and can be defined as the “underlying entities, processes, or structures which operate in particular contexts to generate outcomes of interest.” (Astbury & Leeuw, 2010, p. 368). Mechanisms are usually hidden, sensitive to variations in context, and generate outcomes. Hence, it is not the intervention itself that leads to outcomes; it is the participants’ reaction to the opportunities provided by the intervention that triggers the change (Wong et al., 2013). Mechanisms can mediate effects. For example, the principle of collaborative learning might trigger mechanisms of motivation, commitment, and a felt responsibility to invest effort in preparing for the next tutorial group meeting, which in turn leads to increased learning as an outcome. A main task of realist reviewers involves identifying key mechanisms—those that are common and significant enough to contribute to the pattern of outcomes of the intervention.

Outcomes

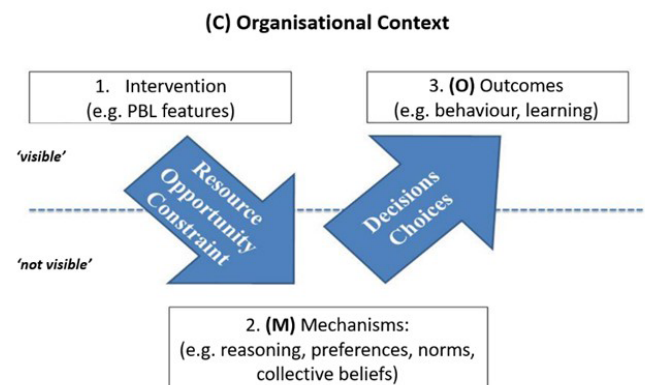
Previous research indicates that PBL leads to various beneficial outcomes. PBL, for instance, stimulates students’ critical thinking capacity (Sharma et al., 2022), collaborative competences (Phelan et al., 2022), and contributes to long term knowledge retention, better conceptual understanding (Moallem, 2019), and a higher degree of student satisfaction with the teaching and learning process (Neville et al., 2019). In addition, PBL curricula can lead to a similar knowledge

acquisition and increased performance levels in certain areas of knowledge application, when compared to traditional programmes (Moallem, 2019). The broad scope of realist reviews leaves room to also report on unintended and unexpected effects of PBL. Outcomes can be reported on different levels, depending on the researcher’s main interest: micro (e.g., individual or course), meso (e.g., study programme), or macro (e.g., study discipline) level.

It can be challenging for realist reviewers to differentiate between mechanisms and outcomes. The specific research question, stance of the researcher, and the interpretative analysis process play a role herein. Consider, for instance, that a student’s engagement in the PBL process might be interpreted as a mechanism, which leads to an outcome of increased study performance, while engagement could also be reported as an outcome of specific interest in itself. Conceptualising and analysing reviews through CMO configurations helps realist researchers and their audience to clarify the analysis process and the interpretation of results.

Context-Mechanisms-Outcome Configurations

Context-mechanism-outcomes (CMO) configurations form the basis of programme theories. In the case of PBL research, CMO configurations can relate to implementation of PBL in its broadest sense or delve deeper into certain aspects of PBL. Figure 1 presents the main concepts as described in this section in line with a CMO configuration.



Note. Adapted from Wong et al. (2013, p.5)

Figure 1. Generic Context-Mechanism-Outcome Configuration of a Realist Review on PBL

A Step-by-Step Illustration of the Realist Review Method

Realist literature reviews follow an interpretative, flexible, and iterative process (De Weger et al., 2020). Several articles describe the generic steps that form the backbone of realist reviews, though these sources describe these steps in slightly varied ways (e.g. Jagosch et al., 2014; Pawson et al., 2004; Pawson et al., 2005). Worthy of special mention are the RAMESES Project Training Materials manual developed by Wong et al. (2013) and other sources available on the RAMESES project website.

In this section, we will present the five main steps of realist reviews. Under each of the steps, we provide examples and practical tips on how to carry out a realist review on PBL. These examples are based on the approach followed in a realist review on quality culture in higher education, conducted by the author team (Bendermacher et al., 2017).

Step 1: Formulate the Research Question and Develop an Initial Programme Theory

The first step in executing a realist literature review is to determine the research question. One might choose to concentrate the review compressively on PBL as an education approach or on certain features of PBL (e.g., the quality of problems used, the quality of assessment in PBL, inter-professional collaboration as a specific outcome measure, etc.). For the sake of this example, suppose we frame our research question with the aim to identify hampering and promoting organisational context elements affecting the successful implementation of PBL, explore the most important working mechanisms of PBL, and provide insights in the outcomes associated with PBL implementation. Guided by this question, initial programme theories can be developed. The development of a programme theory can involve using the results of an initial review of existing literature and input from different stakeholders. The programme theory should include the key features of the intervention. In the case of PBL, the CCCS principles, the reasons why these principles are assumed to work (e.g., because they trigger mechanisms of motivation or learning behaviour), and expected outcomes (e.g., competency and skills development and/or knowledge preservation) should be formulated. The programme theory can either be presented as an integral part of the introduction of your paper or in a separate section.

Step 2: Search for Evidence

The second review phase consists of the search for and selection of relevant literature. The search strategy in realist reviews is systematic. Ideally, multiple databases are

used and the authors should apply a combination of the key search terms and their synonyms in a well-structured and recorded manner. We recommend involving a librarian in the search process.

In order to identify the search terms, it is important that the researcher team conducts several searches iteratively; making use of different combinations of keywords and a broad range of their synonyms used in key literature (do check if the most prominent articles that you are already familiar with are retrieved via the search). The search terms should be aligned to the main research question; the key concept search in this example would relate to (a) PBL, as the main topic of concern; (b) higher education, as an example of a particular context; (c) student, as an example of the main actor you are interested in; and (d) learning (or any other outcome measure of performance you might be interested in).

Based on an initial analysis of retrieved articles (see step 4), researchers might conclude that a certain area of the literature is underrepresented in the search results. Then realist review allow for an iterative search. Such a search can be conducted through snowballing (crosschecking of references of the most relevant articles retrieved). Alternatively, hand-searching of relevant journals and grey literature or asking peer researchers and experts in the field for information on key articles add to the comprehensiveness of the search.

Step 3: Appraisal and Selection of Articles

Setting of inclusion and exclusion criteria for articles forms an important part of the appraisal and selection process. The most important factor is that the articles included in your review can contribute to answering the research question. As noted earlier, in realist reviews, the quality of included studies is not necessarily a criterion (whereas this most often is the case in systematic reviews). Nevertheless, in order to limit the range of included articles, choices might be made in the selection criteria. In-or-exclusion could for instance be based on the year of publication, availability of the full article in English language, the context, and whether the reviewed article reports on empirical research or represents a theoretical or narrative account. Do detail the reasons for exclusion of each individual article (by assigning them to a sub map of articles relating to a specific exclusion criterion) in order to be able to design a clear flowchart which presents the steps in which the initially retrieved articles are reduced to the finally included articles. The first author usually conducts the initial appraisal and preselection process based on a screening of article titles and abstracts. The final selection normally involves multiple team members to discuss articles

in which there is a doubt of inclusion (based on an independent review of multiple review team members and peer discussion).

Step 4: Extracting and Organising the Data

In order to gain a good overview of all article results after the relevant articles have been selected, it is advised to compose a data extraction table in which for each article, the main characteristics and outcomes are summarised. Suggested categories for data extraction are: study objectives, study design, data collection instruments, specific setting/study population, main results, and conclusion. Additionally, the conclusion and discussion section of the performed review will benefit from extracted information in the reviewed articles on gaps in the literature or recommendations by other researchers for the conduct of future studies.

Step 5: Data Analysis & Synthesis

Realist reviewers might apply thematic analysis or other qualitative analysis approaches to identify patterns and themes in the retrieved body of literature. The thematic analysis approach described by Braun and Clarke (2006), for instance, provides a structured way of analysis, which aligns well with realist reviews because it allows for both a deductive

and inductive synthesis of data. The main aim of the research team in this final phase is to identify the main contextual elements and key mechanisms that affect the success or failure of the implementation of PBL and to formulate conclusions about the effectiveness of PBL features. The data reporting and synthesis can be structured by a recap of the presented programme theory and/or by reflecting on patterns identified by the research team in which supports or refutes the initial programme theory. In the synthesis phase, involvement of the full research team is key, as the analysis entails an interpretative process. In order to present the results and synthesis of findings in a comprehensible way, it helps to make use of a visualisation of the main themes identified by the review team in a conceptual model. Additionally, the visual representation of CMO configurations (in figures or tables) will help a reader to grasp the researchers' main results and interpretation. Figure 2, presents a theoretical example of a way in which the results of a realist review on PBL could be presented visually, following the CMO configuration principles. Each of the included themes should be substantiated with evidence derived from the included articles in the realist review.

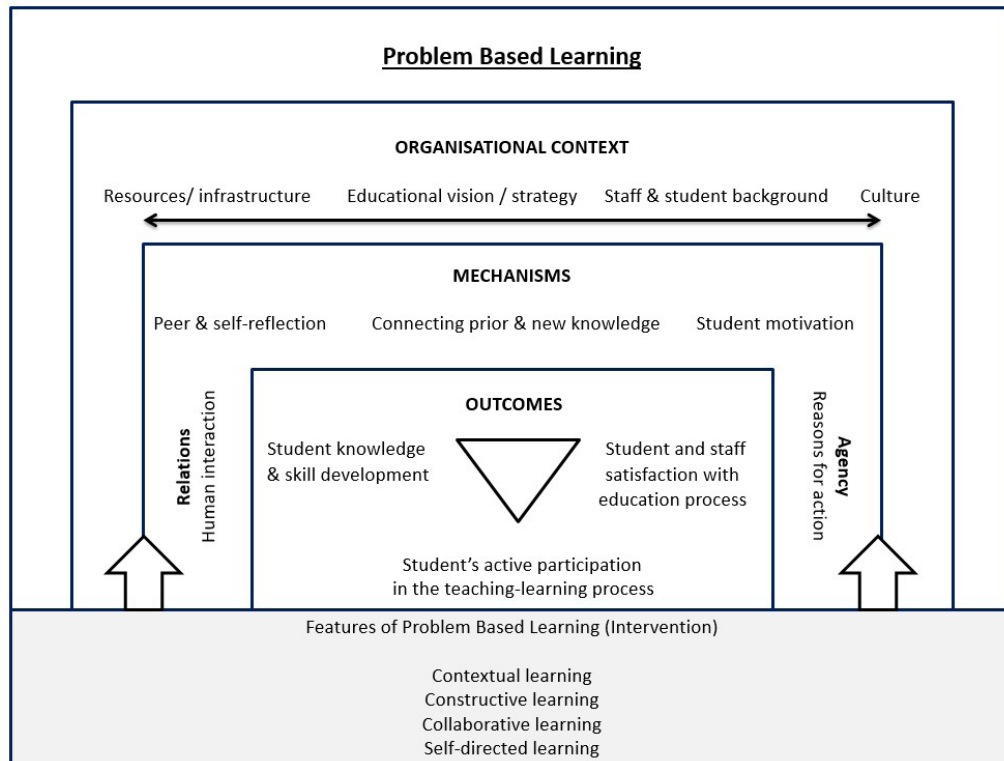


Figure 2. Visualisation of Hypothetical Realist Review Results (Thematic Analysis)

Strengths and Limitations of Realist Reviews

A key strength of realist reviews is the fact that they result in a theory-driven synthesis that takes into account the context of included studies and can explain how and why an intervention works (Ajjawi & Kent, 2022). Consequently, policy makers can determine which features of an intervention are particularly useful in certain contexts and which features might need adaptation before implementation. Realist reviews allow for the incorporation and analysis of qualitative and quantitative data, and build on insights from multiple disciplines. Its holistic approach ensures that realist reviews are comprehensive and relevant to a wide range of stakeholders (Pawson & Tilley, 1997).

While the interpretive character of realist reviews resembles a strength, it can also be seen as a limitation. That is, the review process cannot be replicated in exactly the same manner, as the researchers themselves play a role, e.g., in choosing a certain programme theory to start with (Ajjawi & Kent, 2022). This approach of realist reviews presents unique challenges but with it, the opportunity to develop more pragmatically insightful conclusions than those produced by other approaches to systematic reviewing. Realist reviews are complex, as theory construction is based on the analysis and interpretation of findings which might be hard to synthesise. The interpretation of data gathered in realist reviews requires system-level thinking capabilities from the research team (Ellaway et al., 2020). It should be taken into account that realist reviews are time consuming and human resource intensive and, for those reasons, a potentially expensive endeavour (Rycroft-Malone et al., 2012).

Conclusion

Realist literature reviews constitute a relatively new approach to evidence synthesis, which have rapidly become more popular. To the best of our knowledge, the approach has not yet been applied to research PBL; a search in Google Scholar with the keywords “Realist Review” AND “PBL” or “Realist Synthesis” AND “PBL” in November 2023 did not yield any article results. However, realist reviews are particularly appropriate to investigate PBL because they allow us to address how, why, for whom, and in which contexts PBL works (or does not work). Realist reviews should be seen as a generic logic of inquiry rather than a strictly prescribed methodology. Due to its iterative, interpretative, and flexible character, there is no best way to conduct the approach. Nevertheless, based on the emerging number of realist review studies conducted in various disciplinary settings, insights can be provided on the most important principles that guide realist reviewers and their readership. Above all,

realist reviewers should be transparent in the way they translate the approach to research practice, and it is recommended that the author team pays attention to reflexivity. Continued methodological discussions, hands-on workshops, and publications of illustrative realist review protocols will pay off in terms of a widening use of this promising method.

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