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Teacher professional development and inquiry-based instruction: literature review

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Abstract

Innovative strategies can revolutionise student learning if implemented properly. Nonetheless, teachers need sufficient training to do this. Therefore, teacher professional development programmes should be reviewed to see if they provide sufficient training for teachers to effectively implement inquiry-based instruction, since it is considered one of these innovative methods. This paper synthesises the existing literature on teacher professional development for inquiry-based instruction from the fields of education and social science between 2001 and 2022. The EBSCO host library, Scopus, Science Direct, ProQuest Dissertations & Theses, Linked Papers, and Taylor & Francis data bases were used for this review. The titles, abstracts, keywords, and publication dates of the selected records were converted into Microsoft Excel, where they were then reviewed to identify the publications that were in line with the scope of the study. A total of 135 studies, including articles and dissertations, were reviewed for this study. The findings of this study provide insight into the gaps in the existing literature on inquiry-based instruction and teacher professional development, as well as suggestions for potential areas for further research.

Keywords: education field; innovative methods; inquiry-based instruction; social studies; teacher development

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1.INTRODUCTION

Several studies have examined the efficacy of various innovative methods for enhancing students' learning of a second language. Many teachers have attempted to teach English effectively in tandem with technological and modern development. On the other hand, some teachers insist on instructing in the same traditional way they have been exposed to. They believe their students can also benefit from this traditional approach because they themselves have learned from it. This conventional thinking is based on memorisation and teacher-centred learning, not on developing the knowledge and abilities students require to comprehend the world around them. Consequently, for many years, students have been exposed to passive learning in an environment where teachers transfer knowledge through lectures (Jackson, 2015) and the student's understanding and success were only temporary, and their learning process consisted solely of memorisation.

To fulfil the needs of today's students, teachers are now expected to have higher skill levels (Yang et al., 2022). Therefore, many innovative and constructivist methods have been recommended to enhance students' learning and participation in the classroom and enable them to work creatively and collaboratively. Inquiry-based instruction (IBI) is one of the more recent methods used in education that actively involves students in knowledge-building by creating questions that can be answered through investigations (Harada & Yoshina, 2004). IBI creates a classroom setting where students can independently pursue and assess their learning goals (Perry & Richardson, 2001; Wu & Krajcik, 2005). IBI refers to a teaching and learning process in which students undertake different activities, such as posing questions, identifying issues, investigating, collaborating, analysing, solving problems, finding answers to the questions, and sharing their conclusions (De Jong, 2006; Dorier and Maab, 2012; Pedaste et al., 2015; Pokhrel, 2021; Sandoval, 2005). It is considered a successful method, especially when students are provided extensive scaffolding for their learning (Bennett, Lubben, & Hogharth, 2007; Hmelo-Silver, Duncan, & Chinn, 2007).

Lee (2014) argued that, unlike passive learning, IBI encourages students to engage actively in cognitive and discovery learning. In the IBI classrooms, students are encouraged to work collaboratively to ask critical questions and find solutions. Thus, it improves students' social abilities and problem-solving skills (Dorier & Maab, 2012). It enables them to create new knowledge while assembling their prior knowledge through real-world problems (Pokhrel, 2021). The purpose of IBI is not only to teach students the content of their courses but also to foster their curiosity to learn and enhance their motivation, confidence, interests, and capacity to communicate effectively and learn independently (Barman, 2002; Caswell & LaBrie, 2017; Chichekian, Savard, & Shore, 2011; Lederman et al., 2013; National Research Council, 2000; Shore et al., 2009; Trotter, 2006).

Thus, IBI has caught the attention of many scholars worldwide (see Azizoglu et al., 2022; Karamustafaolu & Havuz, 2016; Marshall & Horton, 2011; Martin, 2007; Ohn & Wade, 2009; Oliver et al., 2019; Ozgelen et al., 2012). Numerous studies have investigated the use of IBI in different fields, including science, history, English, mathematics, social studies, geography, and agriculture. However, most of these studies were about using IBI in science (see Azizoglu et al., 2022; Rop, 2010; Ross, Skinner, & Fillippino, 2005). Several international science teaching reports and European research papers have suggested promoting IBI at all educational levels because of its motivational and cognitive gains in learning (Akcay & Yager, 2010; Havu-Nuutinen et al., 2019). As a result, IBI has recently been incorporated into curriculum reforms in several European countries (Kearney, 2011; Pedaste et al., 2015; Pedaste et al., 2012).

Despite incorporating IBI in different fields as aforementioned, implementing it in a classroom setting can be difficult because it requires teachers to rethink traditional classroom settings, content, and assessment. It requires them to be guides and facilitators, not just transmitters, to encourage their students to actively participate in the classroom within a safe environment via different strategies when using IBI (Bhattacharyya, Volk, & Lumpe, 2009). Many teachers are reported as not being ready to use IBI since they do not have enough knowledge about it, they do not believe that IBI can make any changes in their students' success, or they are resistant to change (Dams-Gouthro, 2020; Castle, 2014; DiBiase & McDonald, 2015; Gillies & Nichols, 2014;

Lakin & Wallace, 2015; Lebak, 2015; Savasci & Berlin, 2012; Zambak et al., 2017). Taylor and Lelliott (2021) recently reported that teachers struggle to implement IBI because they did not participate in any IBI activities when they were students; therefore, they do not attempt to use it in their classrooms. Additionally, many teachers still have many questions regarding IBI in their minds (Anderson, 2002).

The challenge for the education field is finding ways to help teachers gain the skills and knowledge they need to implement IBI in their classrooms (Bell, 2002). Wallace and Kang (2004) believe this can be done with the help of programmes for teacher professional development (TPD). Therefore, this paper aims to contribute to the field of education by examining TPD programmes that train teachers to use IBI in their classrooms. To achieve this aim, the following research question was formulated:

(1) To what extent was IBI incorporated into TPD programmes globally to impact teachers' practices?

1.1 Inquiry-Based Instruction and Teacher Professional Development

Studies have proven that teachers are the most significant aspect of the learning process, and having a high-quality teacher makes a substantial difference in students' learning and development (Jackson, 2015). Receiving an education degree is not enough for teachers to know everything about teaching since teaching is a complex and diverse process (Darling-Hammond, 2006). Teachers must not only understand theories and approaches to teaching but also know how to put them into practice. Practice cannot be effective without experience, and gaining experience in teaching cannot happen overnight. Therefore, teacher professional development (TPD) can help teachers gain experience and critically analyse their methods. TPD is crucial to increasing teachers' expertise, content knowledge, and methods, which can affect students' learning positively (Jackson, 2015).

Effective TPD can also create changes in teachers' beliefs, perceptions, and knowledge that could drive teachers to acquire new ideas, skills, and concepts to improve their teaching practices in their classes (Fishman et al., 2003; McKeown et al., 2015; Hofer & Lembens, 2019; Cohen & Hill, 2000; Garet et al., 2001; Supovitz, Mayer, & Kahle, 2000). Furthermore, it provides teachers with the means to keep their knowledge and skills up to date. Additionally, the teachers can also learn more about IBI through repeated practice and experienced teachers' feedback, which can create realistic environments for real-time active learning and the transfer of knowledge and skills from the virtual to the real (Yang et al., 2022). It has been proven in many studies that a planned TPD altered teachers' ideas, beliefs, and methods when it came to IBI. Duran et al. (2009) ascertained that teachers' beliefs about IBI were positively changed after TPD, and their confidence in using it increased.

Similarly, Tosa and Martin (2010) asserted in their study that TPD helps teachers broaden their understanding of IBI since they lack subject-matter expertise and classroom inquiry experience, making them struggle to implement IBI. More recently, Kiran (2022) noted that participation in the TPD programme greatly altered teachers' perceptions of IBI. He claimed that the teachers first felt uncomfortable about the notion of IBI because they needed to understand it to arrange their classes appropriately. Hence, teachers need to fully comprehend and become aware of the skills required to utilise IBI. In response to this, it is reported that teachers who participate in successful TPD and have the opportunity to reflect on their practice can implement IBI lessons successfully, plan their time appropriately, and increase their confidence since they have had sufficient training (Capps & Crawford, 2013; Leback, 2015; Kazempour & Amirshokoohi, 2014; McNew-Birren & van den Kieboom, 2017; Slim et al., 2017).

Therefore, the TPD focus should not be on changing teachers' beliefs but on helping them learn more about IBI and gain more experience by implementing it (McKeown et al., 2015; Hofer & Lembens, 2019). As noted in Lotter et al.'s (2013) report, there should be an emphasis on fostering an inquiry-based community of practice to aid in teachers' lifelong professional growth. Therefore, this paper is conducted to review the literature and examine to what extent TPD trains teachers on implementing IBI

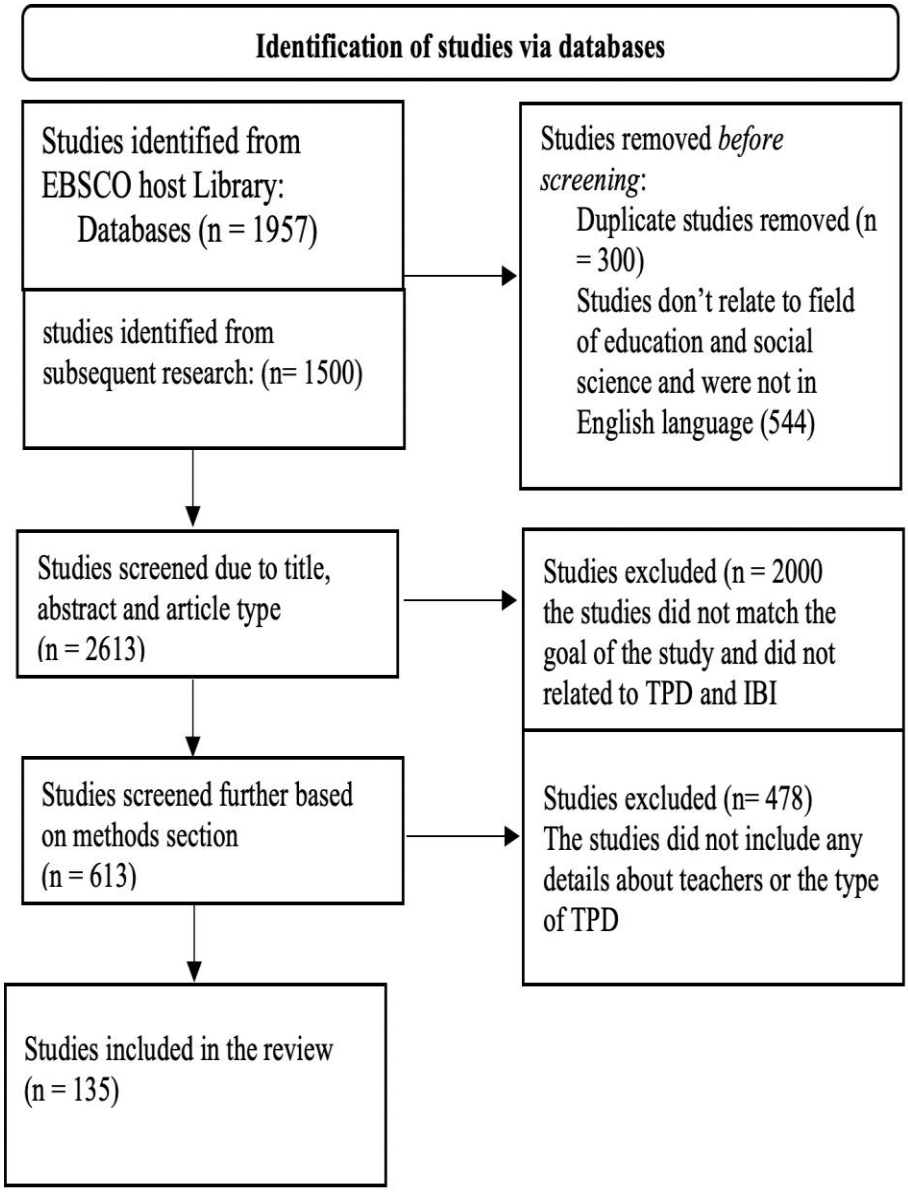
2. METHOD and MATERIALS

The paper aimed to seek out studies in English education about TPD and IBI. But after researching the websites, the studies were so limited in English-language education, thus it was decided to expand the research to cover all the studies in education and social science. Hence, this study is designed to review the existing studies in the education and social studies field regarding TPD that incorporate IBI. The primary search was conducted in the EBSCO library (www.ebscohost.com). This database contains meta-data for more than 65,000 journals, 6 million books, and 400,000 conference papers (Pedaste et al., 2015); therefore, this database was purposefully selected as the primary source of this paper. Subsequent research from Scopus, Science Direct, ProQuest Dissertations & Theses, Connected Papers, and Taylor & Francis was used to create a more comprehensive picture of social science and educational journals.

The keywords used in this research were "teacher professional development and inquiry-based*," "teacher training for inquiry-based*," "teacher development in inquiry-based*," "teachers' perceptions regarding inquiry-based*," "impact of teacher development on inquiry-based*," "inquiry-based for teachers," "inquiry-based for English teachers," and "teacher development and inquiry-based*." The search on websites was limited to journals related to all fields of education, the publication language was restricted to English, and the publication years spanned from 2001 to 2022. The book chapters and the conference proceedings were excluded. Initial research from the websites resulted in more than 3000 articles as illustrated in figure 1. Due to eliminating duplicates and unrelated to the selected fields, the total was drastically reduced to around 2613. The abstract and title were screened to see whether the articles matched the study's focus regarding TPD and IBI. Some articles around 2000 were excluded since they did not include full details about IBI and TPD. This led to review 135 papers (114 articles and 21 dissertations).

Figure 1

Flowchart of the selected papers (the diagram adopted from PRISMA protocol)



2.1 Data analysis

The articles were analysed using Microsoft Excel based on the following criteria:

- Publication year

- Field of studies
- Country of the study
- The study's scope
- Sample groups
- Level taught
- Types of TPD

The study criteria were chosen purposefully, and it was approved by an expert in English language education.

3. Results

To assess the level of IBI integration in TPD programmes worldwide, the 135 published studies at the aforementioned sites were analysed based on specific criteria as follows:

3.1. Year of Publication

The published studies between 2001 and 2022 and the number of published papers is illustrated in Figure 2.

Figure 2
The years' publication and studies numbers

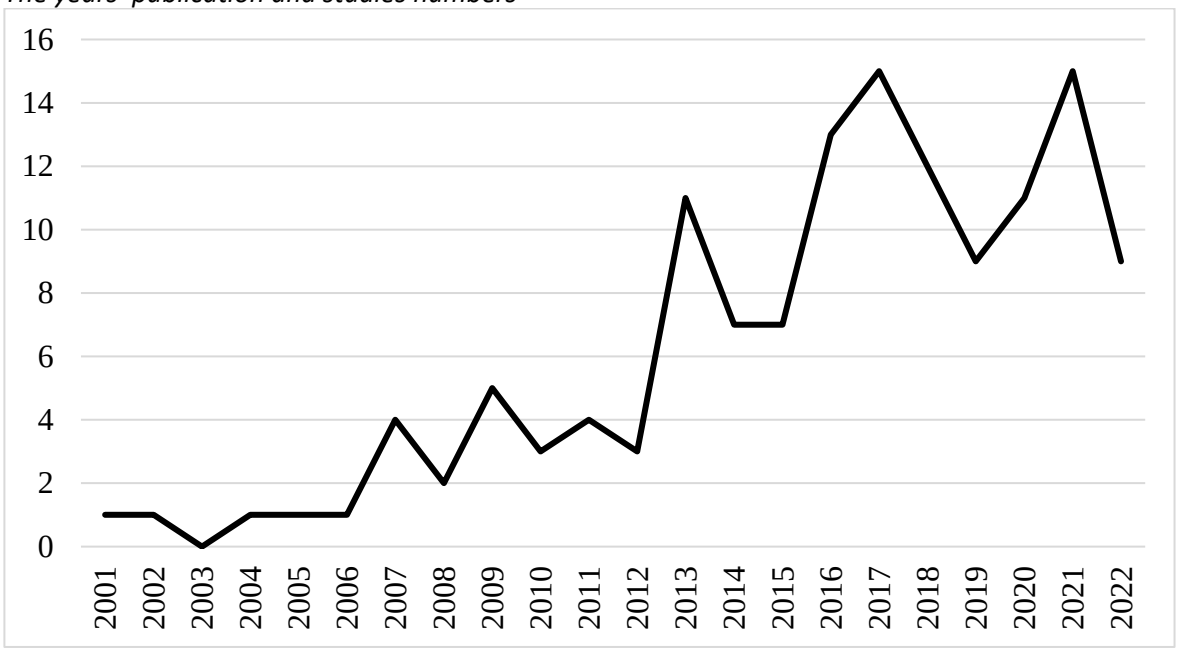


Figure 2 demonstrates a significant rise in TPD programmes that incorporate IBI since 2013, with the maximum number observed in 2017 and 2021 (n = 15 studies). However, there was a decline in the number of TPD programmes in 2022, and there were no studies (n = 0) or TPD programmes conducted in 2003.

Additionally, there were just a few studies, around one or two studies in each year from 2001 to 2012.

3.2. Research field

The 135 published studies were undertaken in several educational fields. Each field's name and number of published papers are presented in Table 1.

Table 1.
Field of the studies and study numbers

Field of study	**Number of studies**
English	2
Mathematics	9
Agriculture	3
Early Childhood Education	4
Teacher Education	10
History	5
Science	86
Studies included Mixed fields:	**Total =16**
• History and Geography	1
• Library and Special Education	1
• Science and History	1
• Science and Mathematics	5
• Science and Engineering	2
• Science and Health	1
• Science and Technology	2
• Language-based subjects, including English, Literature, and Communication	2
• Endocrinology, Political Communication, and Ecology Field	1

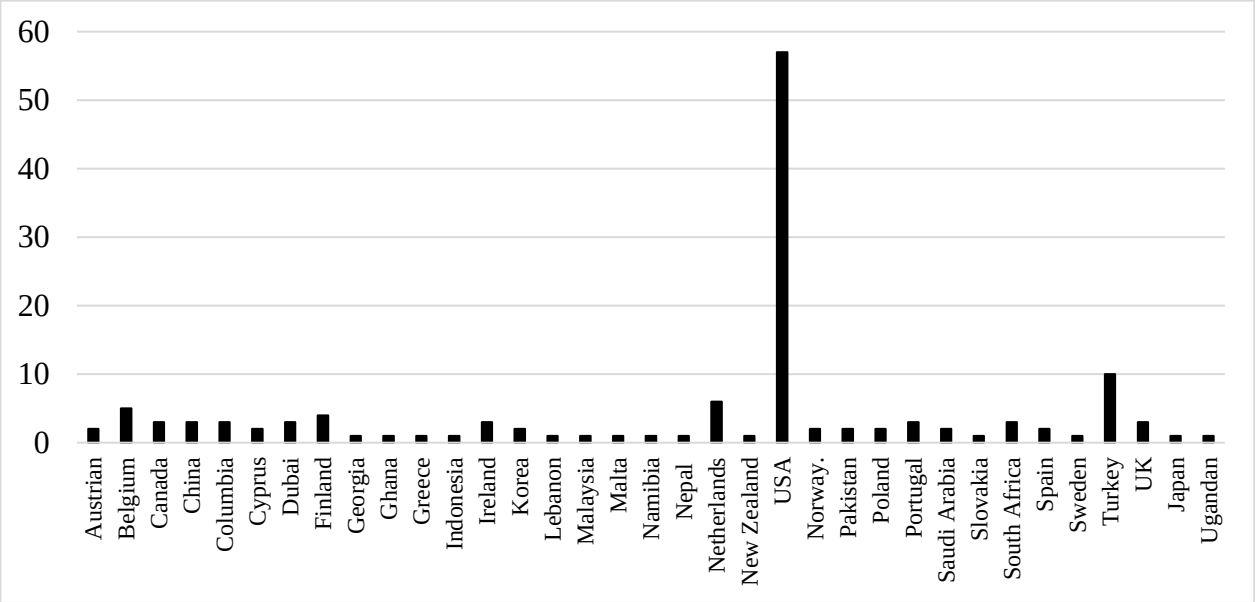
The findings in Table 1indicated the science field was the most frequently field conducted TPD programmes for incorporating IBI (n = 86 studies), and teacher education programmes were also conducted in quite a number of studies (n = 10) to train teachers for IBI. Then mathematics followed with nine studies. In contrast, there were few TPD programmes or studies done in other fields such as history, early childhood education, agriculture, and English. In addition, the data indicated that there were 16 TPD programmes or studies that integrated numerous fields together in order to train teachers for IBI.

3.3. Number of published studies according to countries

The 135 published studies were carried out in 35 different countries around the world. Figure 3 displays the number of studies that were conducted in each country.

Figure 3

Number of studies worldwide



According to the study's findings, the majority of TPD programmes that included IBI were undertaken in the USA (n= 57). In addition, Turkey implemented a comparatively large number of TPD programmes (n = 10) in comparison to other countries. On the other hand, several countries, as shown in Figure 3, have only conducted one or two TPD programmes to implement IBI, and these countries are: Austria, Cyprus, Georgia, Ghana, Greece, and Indonesia. Korea, Lebanon, Malaysia, Malta, Namibia, Nepal, New Zealand, Norway, Pakistan, Poland, Saudi Arabia, Slovakia, Spain, and Sweden Japan and Uganda

3.4. Scope of the study

Table 2 shows the various objectives of implementing IBI within TPD among the 135 studies. These objectives were: impact of TPD on teachers' beliefs about IBI; impact of TPD on teachers' practice and understanding of IBI; teachers' perceptions regarding IBI; teachers' experiences in implementing IBI; teachers' readiness regarding IBI; and the factors that influence teachers' implementation of IBI.

Table 2.

Scope of the study and number of publications

The main aim of research studies	The number of studies
Impact of TPD on teachers' beliefs about IBI	38
Impact of TPD on teachers' practice and understanding of IBI	50
Teachers' Perceptions regarding IB	40
Teachers' experiences in implementing IBI	2
The factors influence teachers' implementation of IBI.	5

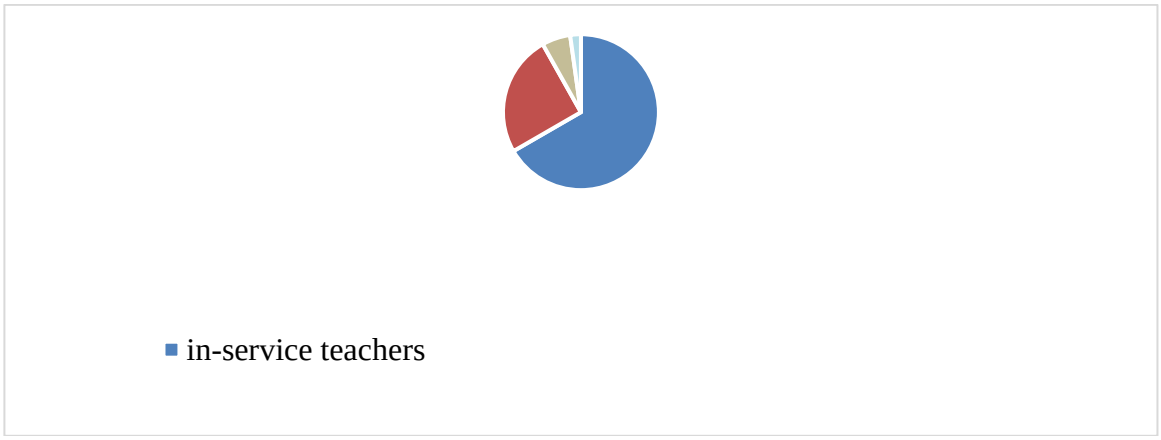
According to the analysis from Table 2, most of the published studies sought to understand the impacts of TPD programmes on teachers' practice and understanding of IBI (n = 50), and many studies investigated the impacts of TPD on teachers' beliefs regarding IBI (n = 38). Additionally, many studies were conducted to

examine teachers' perceptions towards IBI (n = 40). However, few studies (n = 5) aimed at examining the factors that affect teachers' implementation of IBI and determining their experiences during IBI implementation.

3.5. Sample groups

The sample of the 135 studies varied from one to another; therefore, the analysis investigated which groups of teachers were included in the sample group more. Figure 4 shows the group samples and the number of studies conducted for each sample group.

Figure 4
Sample groups among 135 studies



Among the 135 publications, the analysis revealed that in-service teachers represent the largest sample size, whereas lecturers are the least involved in TPD programmes. There are also a significant number of studies that focused on pre-service teachers and eight studies that are including groups of pre-service and in-service teachers as depicted in Figure 4.

3.6. Teaching level

Figure 5 illustrates the level of teaching expertise held by teachers who participated in 135 studies.

Figure 5

Teaching Level among 135 studies

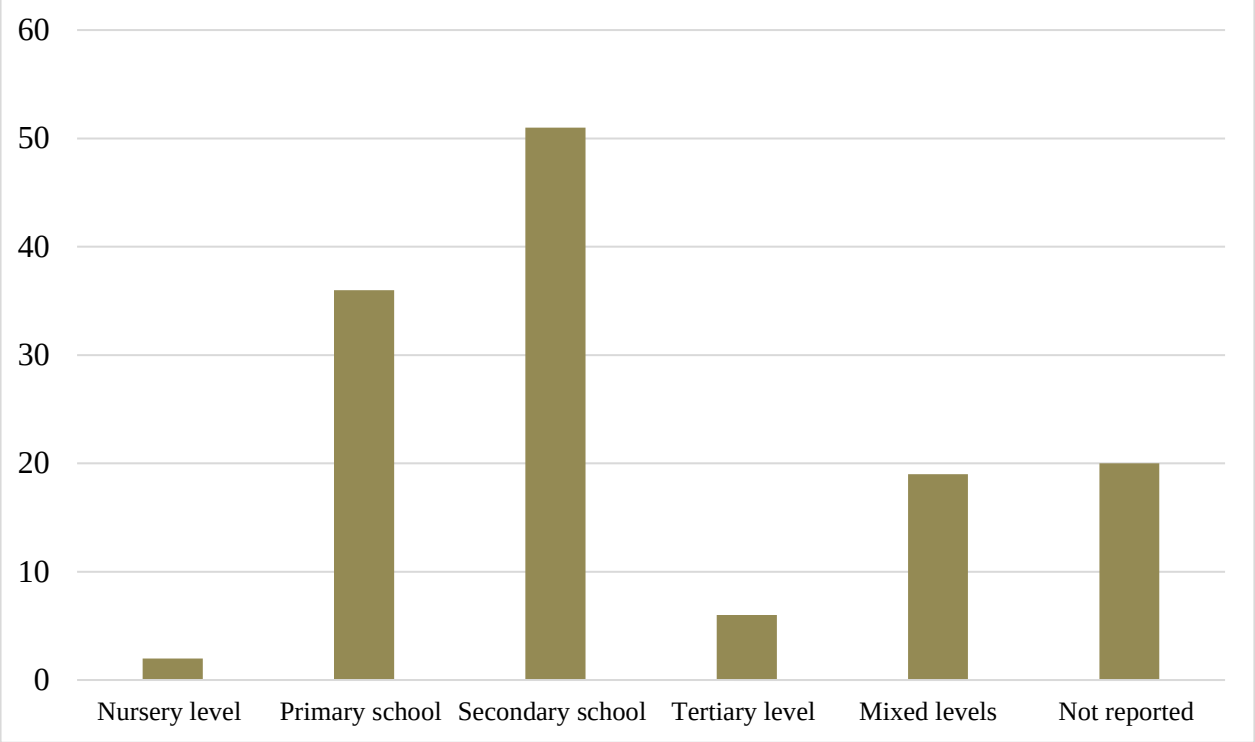


Figure 5 shows that the majority of the 135 studies were carried out with teachers at the primary and secondary school levels, while a small minority were conducted with teachers of younger students or those at the university level. There are also about 20 papers that did not give any information about the teachers' level of instruction.

3.7. Types of TPD

The type of TPD programmes that incorporate IBI among the 135 papers is demonstrated in Table3.

Table 3

TPD type in the published papers

Type of TPD	Number of studies
Collaborative teaching	7
IBI Course	25
Observations	5
No TPD (Exploratory studies)	47
Full TPD program (workshops, seminars, IBI courses and observations)	29
Project	12
Workshops	11

The findings of the analysis indicate that most of the studies (n = 47) were mostly exploratory and weren't aligned to any established TPD types. Additionally, a significant number of studies (n = 29) incorporated IBI into full TPD programmes. Moreover, several TPD programmes utilised IBI courses to educate teachers on

the implementation of it. Furthermore, the TPD encompassed various programmes like projects, workshops, observations, and collaborative teaching, all aimed at preparing teachers with knowledge and skills of IBI.

4. Discussion

In accordance with Harada and Yoshina's (2004) assertion that IBI is one of the most current methods used in education, the number of reviewed studies on TPD for IBI has increased since 2013. However, there has been some variation over the years. Yet, surprisingly, the number of investigations decreased to only nine in 2022. Furthermore, only a few studies were published between 2001 and 2012, which could be attributed to the fact that IBI was uncommon at that time and was not incorporated into the curriculum, making it difficult to conduct a large number of TPD programmes to train teachers on IBI.

Regarding the results of 135 studies' fields, science is the most commonly field used TPD for IBI, supporting previous studies (Rop, 2010; Ross, Skinner, & Fillippino, 2005) that reported that IBI was used mostly in science. This could be because the science curriculum has recently been designed based on IBI, which is consistent with what has been reported previously. As teachers have encountered IBI in their curriculum, researchers can examine this method and conduct scientific research more easily. Conversely, there are few TPD programmes that incorporate IBI in the English language and some other social studies, which could imply that IBI is not widely used in some subjects, making it difficult for researchers to find TPD programmes for teachers who use it in their classes.

Moreover, some studies evaluated TPD for IBI in integrated fields within one study and trained them together on IBI. The authors of those studies might have thought that bringing together teachers from other disciplines would allow them to share knowledge regarding IBI. The findings also show that TPD in the form of collaborative teaching was utilised to increase teachers' knowledge of IBI. Additionally, the USA and Turkey are the two countries with the highest number of TPDs conducted for training teachers on IBI. Only a few research studies are from other countries including Austria, Cyprus, Georgia, Ghana, Greece, and Indonesia. Korea, Lebanon, Malaysia, Malta, Namibia, Nepal, New Zealand, Norway, Pakistan, Poland, Saudi Arabia, Slovakia, Spain, and Sweden Japan and Uganda. It could be argued that TPD is limited because IBI is not commonly practiced in those countries.

Moreover, 47 of the 135 studies were considered exploratory, and no TPD types were found. One possible explanation for this is that few of the 135 goals involved expanding teachers' understanding of IBI beyond discovering what they already knew. Despite that, there were a number of studies aimed at understanding how teachers felt about IBI. In addition, numerous studies have been conducted to determine the effect of TPD on teachers' implementation of IBI. According to Duschl and Grandy (2008), teachers should comprehend the concept of IBI to organise their lessons appropriately (McKeown, 2016; Hofer & Lembens, 2019). There are also several aims, such as the effect of TPD on teachers' perceptions of IBI. This affirms other researchers' assertions regarding the significance of developing TPD programmes not just to alter teachers' perceptions of IBI but to enable them to practice in their classrooms (Fishman et al., 2003; McKeown, 2016; Hofer & Lembens, 2019; Cohen & Hill, 2000; Garet et al., 2001; Kiran, 2022).

Furthermore, the majority of the teachers involved in the 135 studies were found to be in-service teachers, demonstrating that TPD is not restricted to pre-service teachers, as innovative methods require teachers to be trained to implement them in the classroom. This may also suggest that TPD aims to educate both current and future teachers about IBI. The 135 papers also showed that most teachers trained for IBI were in primary and secondary schools. However, the low participation rates among teachers at the university level could lead to the claim that IBI is not as common at universities as it is in schools.

5. Conclusion and recommendations

The study reviewed 135 studies that are related to TPD to train teachers on IBI. Some of these studies were about teachers' perceptions regarding IBI, and some were about the impact of TPD on teachers' implementation of IBI, teachers' beliefs about IBI, and teachers' understanding of IBI. A great number of studies were conducted in the USA in science and focused on in-service teachers who taught at the primary and secondary school levels. The study concludes that TPD for IBI is commonly performed in science. However, there are still few in other fields, such as mathematics, agriculture, social studies, the English language, history, and geography. The studies were limited to only one or two papers in English language education and other social studies. Also, the study showed a need to implement more studies in other countries since the review showed that most of the studies were just in the USA and Turkey, and there is just one study in other countries.

To conclude, there is a need to conduct more TPD programmes to train teachers on IBI, and there is a lack of literature in most of the fields except science. Moreover, there is a need to conduct more studies focusing only on the impact of TPD on enhancing teachers' knowledge regarding IBI Therefore, there is a great need to conduct more studies about IBI in different fields and contexts since it has proven its successful. Further reviewed studies could be done to investigate how IBI is implemented in classrooms, and there is still a need for studies on whether to explore lecturers' perceptions about IBI or implement TPD to enhance their knowledge despite their knowledge about IBI.

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