A SYSTEMATIC REVIEW OF THE EVIDENCE-BASE FOR PROFESSIONAL LEARNING IN EARLY YEARS EDUCATION (THE PLEYE REVIEW)

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Abstract

In response to the current policy drive in the UK to improve the skills level of the Early Years (EY) workforce, raise the quality of Early Years Education (EYE), and reduce the disadvantage gap for young children, a systematic review was conducted on approaches to professional learning and development (PDL) that report impact on outcomes for children in EYE. The aim of the review, funded by the Nuffield Foundation, was to consider the impact of PDL approaches in the current UK context. However, of the 24 studies considered, none were conducted in the UK, suggesting that much more work is needed in this area. The review showed that approaches to PDL which combine coaching, with new knowledge and opportunities for reflection on practice, may be most effective in improving outcomes in EY settings. However, the evidence on duration, frequency and intensity of PDL, though likely to be important factors in the degree of effectiveness, is inconclusive and requires further research.

Key words: Early Years Education, Professional Development and Learning, Systematic review

INTRODUCTION

The early years phase (defined here as the period from birth to six), is currently at the forefront of educational policy in the UK and elsewhere, and is widely viewed as *the* optimum time in which to establish the key dispositions and skills for achievement and success in school (Chambers et al, 2010; Allen, 2011; Rogers, 2016). Further, agreement across all political parties in the UK for continued expansion of provision to meet the increasing demand for childcare places from working parents, policy intervention in the education of disadvantaged two-year-olds, and an increasing focus on an early years curriculum and pedagogy that supports 'school readiness' in England (DfE, 2014), indicate unprecedented interest in early years education, reflecting also wider global trends to develop high quality early years education through improving the knowledge and skills of the workforce. As such, significant demands have been placed upon the sector to increase the number of suitably skilled and qualified staff in order to raise attainment through high quality early education. One policy response to the shortage of suitably skilled and knowledgeable staff in England, has been to

increase the numbers of graduates and qualified teachers in early years settings (DfE, 2017), a move informed by the reported links between higher qualifications, high quality provision and improved outcomes for the most disadvantaged children (Mathers et al, 2014; Mathers and Smees; 2014). Such developments presuppose the recruitment and retention of a workforce that is knowledgeable about child development, curriculum, the types of early learning and pedagogic interactions that support the development of language, early literacy, and executive functioning skills (Sylva, 2014).

Clearly, improving the qualifications and leadership capacity in the early years sector is one important way to tackle the skills challenge. But it takes time to build capacity in this way and this approach does not address the immediate need for a better skilled early years workforce. Furthermore lack of access to both local courses and funding is noted as a significant barrier to qualifications (see for example, Kalitowski, 2012; DfE 2017). For instance, a recent study by Bonetti (2018), which mapped the landscape of the early years workforce, concluded that qualification levels were falling rather than rising across the sector, due to the increasing cost of undertaking higher level studies and the concomitant reduction of Local Authority funding to support qualifications. Other studies suggest that access to study for qualifications may be challenging to a largely female workforce who may also have caring and family commitments (Osgood, 2012). Additionally in a study of teaching assistants (TA), Barkham reports that some TA may not pursue further study due to low self-confidence following extended periods away from education (Barkham, 2008). It may also be the case that some educators simply prefer to remain in supporting rather than leadership roles, valuing the opportunity this affords them to work with individual children and small groups (Barkham, 2008; Osgood, 2012). Against this background, there is some interest in increasing opportunities for ongoing continuing professional development, which could in turn potentially support recruitment and retention rates (DfE, 2017). Much less clear, however, is knowledge about the type of learning approaches that might be most effective in improving outcomes for children.

Taking all this into account, a key question prompting the current reviews: how can we ensure that *all* those who work with young children have access to the most effective professional development and learning opportunities?

In preparation for this review our preliminary 'gap' analysis revealed that 1) to date no *systematic* review of professional learning has been undertaken that reflects the current EYE policy context in the UK and that is aimed at key user groups; 2) a long history of reviews of professional development in the school sector identify generic features of effective CPD, which may in part at least apply to EYE, but do not allow for the highly diverse nature of the EY sector provision and workforce; 3) A significant literature on professionalism, professional development/learning, leadership, qualifications and competency, exists in the UK early years field but it is disparate and complex comprising many small-scale qualitative studies, and a range of conceptual perspectives on the professionalization of the sector 4) Professional learning/development is covered in a number of broad EYE reviews but the scope of these does not allow for a detailed and systematic consideration of the topic (see for example Bertram and Pascal, 2014). There is, then, relatively limited empirical or theoretical work, which attempts to understand the processes that support PDL in EY settings, that can bring about sustainable change in practice and impact positively on children's outcomes, despite the emphasis placed on this in a context of rapid global expansion of EY provision and an explicit focus on 'school readiness' (DfE, 2014; Yoshikawa et al, 2015). There are also challenges in identifying the efficacy of PDL programmes, not least because it is difficult to isolate the multiple variables that comprise a PDL programme to demonstrate causal links between improvements in EYE practice and outcomes for children, a point noted in two international reviews of PDL in preschool (Jensen and Ranmussen, 2016; Zaslow et al, 2010). In the UK specifically a number of high profile reviews of evidence on the impact and efficacy of professional learning in schools and 5-18 education have been conducted recently (see for example BERA/RSA, 2014; Coldwell et al., 2017; Cordingley et al, 2015), but to date none have been conducted to address the complex and diverse learning needs of the UK EY workforce.

Definitions and conceptual model for assessing impact

Our review started with a broad definition of professional development proposed by Snyder et al. (2012). Here professional development is regarded as 'facilitated teaching and learning experiences [that are] designed to enhance practitioners' knowledge, skills, and dispositions as well as their capacity to provide high-quality early learning experiences for young children' (p.188). The terms professional development and professional learning are used interchangeably in the literature, but we initially adopted the term *professional learning* since we associate 'learning' specifically with tangible and sustainable changes in professional thinking and practice, rather than a broader conception of development through a range of experiences and activities (Knapp, 2003). After discussion with the project advisory group, however, we agreed the term 'professional development and learning', abbreviated to PDL. To aid our understanding of the processes that lead to effective PDL we deployed a conceptual model (based on a theory of action approach) that links the aims of a PDL intervention and how it was put into practice, in order to assess whether or not impact was achieved.

In our application of the model we attempted to do three things:

1) Build a theory of action [our conceptual frame] that outlines why and how professional development is effective, and for whom;

2) Understand the ways in which the empirical findings relate to the conceptual frame and the extent to which they augment or challenge it. Does it show observed effects or even, does it provide conflicting evidence on proposed drivers for action;

3) Understand where further empirical evidence is required because it is either absent or lacking in type, amount, or robustness.

To meet the first of these aims, the project team employed the Dialogic Model of Impact (DMI) developed by Brown and (2017) as the basis of a theory of action (ToA) to examine

why and how professional development is effective, and for whom. Theories of action are described by Earl and Timperley (2015) as the reasoning organisations use to describe how they will make change in the world; with the 'theory' aspect of a ToA providing an explanation of why certain things happen. Theories of action can be thought of as a journey guide for impact, that steers educators towards their intended long term outcomes, or the difference an innovation is designed to make for a given group or set of stakeholders. To help educators reach this long-term vision ToAs provide the steps that need to occur along the way. Theories of action can be established a priori or they can be ascertained post-hoc. In either case a framework is required to aid this process. DMI can be used for either approach and is used to establish a theory of action through the examination or consideration of the following eight domains of impact, set out below:

1. The context in which the school or setting is situated
2. The problem or driver for innovation
3. Detail on the innovation and how it was intended to result in change
4. Activities and interactions related to the introduction and roll-out of the approach
5. Learning that results from engaging in these activities/results from interactions
6. Changes in behaviour (and the extent to which something is being used):
7. The difference behavioural changes have made
8. Reframing value: reassessing what is possible in relation to the innovation

As a consequence, by looking at impact and how this impact was achieved we have been able to examine commonalities in the professional learning interventions considered according to the type of impact and the approaches undertaken to secure improved outcomes in early years settings. In applying this conceptual frame to our synthesis and analysis we aim to better understand the relationship between:

- the aims of a professional learning intervention,
- what did it intend to achieve, how and why?

- how it was put into practice and
- what if any impact it achieved and how do we know?

REVIEW QUESTIONS

The aim of the review was to identify approaches to PDL that demonstrate impact on children's outcomes. The review was also underpinned by a strong impetus to engage with and inform policy debates on PDL development. We therefore developed three research questions:

1. What evidence is there of impact of professional learning approaches for improving outcomes for children in EYE?
2. Which approaches are more and less impactful?
3. What are the features of and theories of action underpinning effective professional learning approaches in EYE?

METHODS OF THE REVIEW

Utilising the guidelines and the EPPI-Reviewer 4: software for research synthesis developed by the EPPI Centre (Thomas, Brunton, & Graziosi, 2010), we undertook a systematic review of evidence on the most effective forms of PDL in EYE. The key features of a systematic review or systematic research synthesis, such as the approach developed by the EPPI-centre are that:

- They are explicit and transparent methods are used;
- They comprise a piece of research in its own right that follows a stage process of retrieving, screening and reviewing literature items;
- They can be both replicable and updateable;
- There is a requirement for user involvement to ensure reports are relevant and useful (with user engagement occurring before, during and after the review process). In our

case this comprised a *Review Advisory Group* of key stakeholders with expertise in early years research, policy and practice.

In general terms, systematic reviews aim to find as much as possible of the research relevant to the particular research questions, and use explicit methods to identify what can reliably be said on the basis of these studies. Methods should not only be explicit but systematic, with the aim of producing valid and reliable results: establish selection criteria; conduct searches; assess study quality and bias; extract data and conduct data analysis and synthesis; write the report and disseminate findings. Drawing on the work of Gough et al (2012), our review comprised the following stages: i) developing and executing a search strategy; ii) selecting studies for in-depth review as well as assessing the quality of such studies; and iii) synthesizing the findings of selected studies in order to develop a conceptual model of impact. These stages are explored in detail below.

Search strategy

Our main aim was to identify English language studies, which reported PDL approaches that demonstrated impact on children's outcomes in EYE. The search was undertaken during 2017 and comprised four main approaches in the following order:

a) a search of electronic-databases*:* Academic Search Elite/EBSCOhost; Campbell; Child Care and Early Education Research Connections (CCERC); Dragon (The University of Hong Kong Libraries Catalogue); Danish Education Clearinghouse; Educational Resources Information Center (ERIC); Google Scholar; JSTOR; National Child Care Information Center (NCCIC); Psychology and Behavioral Sciences Collection; PsycInfo; Social Sciences Abstracts; Sociological Collection; Web of Science; What Works Clearing House (WWC) USA

b) hand searches of journals: International Journal of Early Years Education; Early Years; Contemporary Issues in Early Childhood Education; Journal of Early Childhood Teacher

Education; Journal of Educational Psychology; Professional Development; Child Development.

c) specialist website searches: OECD (The Organisation for Economic Cooperation and Development); BERA/TACTYC (British Educational Research Association); NAEYC (National Association of Education for Young Children, USA); NIEER (National Institute for Early Education Research, USA); EPPI-centre reviews.

d) personal contacts/authors and experts in the field: the authors of are all active members of national and international research networks in their respective fields.

We undertook an exhaustive search of studies of PDL in the early years for teachers of children aged birth to six, with a publication date from 2000 to 2017 when the search was conducted. We deliberately selected a cut-off point of 2000 in order to capture current issues and contemporary realities relevant to the early years workforce. From around 2000 there has been rapid expansion and development of the sector and research field in early years education. To illustrate, in 2000 the first national curricular framework designed specifically for children age 3-5 was developed in England and Wales (DCSF, 2000) and with it recognition of the need to invest in new ways to approach workforce development through qualifications and training, including teacher training. Similarly in the USA, the No Child Left Behind initiative (2001) led to investment in professional development programmes to address social and educational disadvantage**.**

We deployed search terms around two core areas relevant to our study:

Early years (e.g. Early years/early childhood, early childhood education, ECEC, kindergarten, childcare, day care, preschool, reception class, nursery, Head Start, language development, literacy development, early intervention, low-income families, teacher-child interactions, child-care assistants, nursery nurses) and

Professional learning/professional development (e.g. professional learning, teacher development, teacher preparation, continuing professional development, CPD, action research, teacher change, professionalism, competence, joint practice enquiry, lesson study, reflective practice).

Finally, the search was conducted using combinations of four key terms: Early Childhood Education; Professional Development and Learning; Early Years; Continuous Professional Development.

Selection of studies for in-depth review

The initial search was conducted using the electronic databases mentioned above. However, we discarded Google scholar; JSTOR; CCERC because they produced a vast number of documents, which were not research articles (i.e. they were editorials, reviews or commentaries of studies). We therefore focused the search on the following databases: Web of Science; Educational Resources Information Center (ERIC) and British Education Index (BEI), followed by hand searches. We found that the databases had picked up all of the published in the journals that we hand searched. The specialist website search and the personal contacts strategies did not provide new material for the review.

From the three databases consulted 1197 articles/documents/reports were identified for screening and uploaded onto the EPPI-Reviewer 4 software. 157 of the documents were straight duplications and were excluded at this stage.

The selection of the studies for final inclusion and in-depth review involved a four-step process:

Stage 1. Single Screening by Title and Abstract (T & A)

In the first stage, the 1197 articles were divided in 3 groups. Each member of the three person research team screened 399 articles according to the following 5 criteria:

1. Study has a publication date including and after 2000
2. Focused on EYE/ECE settings, children in 0-6 age range
3. Subjects of the intervention must be *in-service* EYE workers
4. The methods and/or analytical approaches are described in detail
5. The topic of the study is related to the implementation of professional learning/development

Following this process the project team reviewed ten percent of screened articles (119 articles) to provide an assessment of inter-rater reliability. Given the small number of coders involved we elected to examine the overall proportion of agreement rather than calculate the kappa coefficient. The high level of inter-rater agreement was deemed acceptable according the criteria established by Miles and Huberman (1994) (i.e. should approach or exceed 90 percent). The Stage 1 process led to the inclusion of 124 studies for full text screening.

Stage 2. Triple Full Text Screening

In Stage 2 the three members of the team did a full text screening of the 124 articles selected in the first stage to scrutinise rigour of method and reporting, and topic relevance. Rationale for inclusion and exclusion were discussed, leading to final agreement to exclude 70 studies on the basis that they did not meet the rigour and topic criteria sufficiently. This stage led to 54 studies included for in-depth review in Stage 3.

Stage 3. In-depth review

To address the aims of the review further and in addition to the 5 criteria described above, an additional criterion was added to Stage 3 screening:

6. The study must clearly report on children's outcomes *in a rigorous and robust* way.

We introduced an additional criterion at this stage to ensure we were satisfied that the remaining 54 papers followed a methodologically rigorous procedure in relation to how they

demonstrated impact on children's outcomes. Quality appraisal of this set of included studies followed the EPPI Centre guidelines. These guidelines considered whether the studies reported a method for allocation, control of attrition and selective reporting bias. Additionally, studies were assessed regarding sample justification, i.e. whether the authors justified the sample size *n* and evaluated their power estimate; quantitative impact of the intervention; description of PDL process; report on the methods to establish reliability and validity and, finally, whether the authors included measure of fidelity of treatment (Cordingley et al., 2007; Basma & Savage, 2017; Gough, 2007). Following a team reconciliation discussion to examine differences in whether studies should be included or not, a further 18 studies were excluded. Finally, a further 10 articles were excluded where there were multiple papers reporting on different aspects of one intervention. For example, we considered several papers stemming from the same large intervention study *The Exceptional Coaching for Language and Literacy* (ExCELL) conducted in the USA, but selected one that in our estimation met our criteria in full (Hindman and Wasik, 2012).

Stage 4. Applying the Weight of Evidence Framework to assess quality

A final review of the quality of the remaining 26 studies was made through the Weight of Evidence (WoE) framework proposed by Gough (2007). This framework consists of three dimensions, the first is generic and the second and third are review specific.

1. The quality of execution of the study is in accordance with acceptable standards (for example, what we might expect for a randomised controlled trial).
2. The appropriateness of the study design and analysis for answering the review questions.
3. The study matches the focus of the review topic.

As a result of this process, two further studies were excluded as they achieved a low quality score, leaving a final total of 24 articles to be considered for the synthesis (Cain, Rudd and Saxon, 2007; Campbell and Milburne, 2005). The final set of studies that met

the quality evaluation totalled 24. 23 of these are peer-reviewed articles, 1 is a full report of an intervention published as a chapter in an edited book (Marcon et al, 2012). 22 of the studies considered were conducted in the United States; 1 in Canada; and 1 in New Zealand.

INSERT HERE Table 1. Weight of Evidence Framework

Include Here Figure 1. PLEYE Review Process

SYNTHESIS

The review synthesis represents an integration of our findings and is designed to result in an overarching amalgam that is 'greater than the sum of the individual studies' (Gough et al., 2012, p.283). The initial search resulting in 1197 papers at Stage 1 comprised a diverse mix of theoretical or conceptual studies. It is worth noting that at this early stage, although findings provided by these studies could be qualitative or quantitative we found a rich, mostly qualitative literature on PDL from the UK and European contexts, predominantly focusing on the professionalisation and development of the early childhood workforce rather than on outcomes for children, which was the central concern of this review. In our conclusion we consider the lack of UK studies, which consider the relationship between PDL and children's outcomes.

The final 24 studies, which met our criteria in full and were evaluated as being of acceptable quality, used either experimental or randomised control trial methodologies. As the purpose of the review was to examine the impact of PDL programmes on children (rather than only

practitioners), it is perhaps not surprising that the studies which were able to report this were those that differentiated between treatment and control in order to establish the possibility of impact. The low number of such studies represents the methodological difficulties in conducting this type of approach in educational settings, and distinguishing between quality science (in the conduct of research), and quality reporting, a point noted by several authors (see for example, Evans et al; Torgeson et al, 2005). We would not necessarily agree with Pawson (2006) or Goldacre (2013), for example, that experimental or randomised control trials represent the *gold standard* of educational research, more that such approaches can provide a good indicator of the efficacy of a given approach and thus contribute usefully to the evidence base to inform both policy and practice.

FINDINGS

In the next section we consider our findings, first by characterising the literature, which in itself can give indications of how professional learning is viewed by early years policy makers and 'budget holders' and in so doing highlight challenges in delivering professional learning that is effective in achieving its intentions for impact. We used domains 3 to 7 of the DMI model outlined in the introduction, to deconstruct the interventions specified in our 24 papers, interrogating each study with the following questions:

- What type of professional learning interventions were used? (Domain 4)
- What were the aims of the professional learning intervention? For example, quality of setting, content knowledge; (Domain 3)
- How were the interventions delivered? (Domain 4)
- What changed as a result – teacher's knowledge and practice? (Domains 5 and 6)
- What changed as a result – children's outcomes? (Domain 7)

What type of professional learning intervention was used?

Table 2 provides detail on the type of PDL intervention. Of these, 15 of the 24 interventions considered involved some form of coaching or mentoring; though it is important to note here that these were not always clearly defined (see for example Podhajski and Nathan, 2005). Rather reference was made to generic strategies such as modelling, feedback, support and guidance. Powell et al. (2010) compared on-site and remote online coaching but found no differential effects between these. Where evidence of impact on children's outcomes was reported, coaching and mentoring were used in combination with other aspects (e.g. instructional tools for teachers, Chen and McCray, 2012), with varying degrees of content input and duration. By contrast to intensive coaching programmes, one study offered only a two-hour workshop on literacy but found no evidence of impact on teaching practice or child outcomes, measured eight weeks later (McLachlan and Arrow; 2014), raising questions about the role played by intensity and duration in the effectiveness of PDL programmes. The second most common feature (evident in six interventions) was input on the use of classroom activities (e.g. lesson plans and ideas for developmentally appropriate activities), or the provision of other instructional approaches (new knowledge). Group work and tasks to help educators understand new concepts featured in five studies (see table 2). Four of the interventions involved approaches to develop teacher content knowledge, alongside coaching while two provided scholarships to attend community college courses. The preponderance of coaching in our final set of studies offered approaches with greater flexibility for building on practitioners' existing knowledge and skills along the lines of a social constructivist apprenticeship model widely viewed as an effective and responsive learning approach. This point seems particularly important for a workforce that may include low skills and qualification levels and high staff turnover rates.

INCLUDE HERE TABLE 2. Type of PDL Interventions

What were the aims of PDL interventions used?

Table 3 below shows the aims underpinning the different interventions. Nineteen interventions focused on developing teachers' pedagogical (or instructional), knowledge whilst 15 focused on enhancing teachers' content knowledge. Ten interventions focused on both. Pedagogical knowledge is the specialised knowledge of teachers for creating effective teaching and learning environments for all children, and knowledge of the techniques and strategies used for supporting children's learning of a new skill, concept or information, such as 'scaffolding' or open-ended questions. Content knowledge is knowledge of a particular subject such as mathematics or language development. However, most interventions reported multiple aims to ensure the improvement of children's outcomes. One study included also a focus on teacher's attitudes and beliefs about content knowledge (Chen and McCray, 2012). Three studies included objectives regarding the maintenance and sustainability of the PDL learning within the organisation, focusing on: organisational support, leadership, and participants' responsibilities and accountability; on beginning to create (and eventually institutionalise) a support infrastructure; on developing the necessary support to scale up interventions and build expectation; and camaraderie to support changes in practice (e.g. Sarama et al., 2008; Porche, Pallante and Snow, 2012). Finally, two studies focused on developing explicit strategies for classroom management, for instance helping teachers to reduce children's challenging behaviours (e.g. Lonigan et al., 2011; Conroy et al., 2013).

INCLUDE HERE TABLE 3. Aims of PDL Interventions

How were the PDL interventions delivered?

Table 4 below summarises the different types of the PDL interventions identified in the included studies. As described in Table 2 above, coaching and to a lesser extent mentoring featured most prominently in our final set of included studies. However, little information was

given in the papers to distinguish between them. Each of these approaches imply close and specialised support for practitioners to model best practices and the provision of feedback from either more experienced peers or experts. Along with these elements, 11 studies included a workshop; these were held at the beginning of the intervention or at intervals across the duration of the PDL interventions (e.g. Powell et al. 2010; Lonigan et al., 2011; Milburn et al., 2015). This combination of approaches appears to be effective. 13 studies used research-based interventions about children's development and learning, or content and pedagogical knowledge (e.g. Podhajski and Nathan, 2005; Jackson et al., 2006; Powell et al. 2010 and Kermani and Aldemir, 2015). The teaching methods were varied across the interventions, ranging from attending college-courses and interactive lectures to more participatory strategies including hands-on activities such as constructing material or role-plays (e.g. Sarama et al., 2008; Collins and Dennis, 2009; Powell et al., 2010; Lonigan et al., 2011). Videotaping teachers' practices were used in three interventions to illustrate key strategies (e.g. Sarama, et al., 2008; Downer et al., 2011). Six studies used technology to support practitioners. For instance, Lane et al. (2014) tested a distance-mentoring model in which participants received the lessons by email. Likewise, Porche, Pallante and Snow (2012) supplemented the on-site coaching with teacher-initiated phone and e-mail check-ins. Landry et al. (2009) evaluated an online professional development course and Downer et al. (2011) used a web-based PDL. Three of the included studies offered a collaborative element promoting group work among practitioners during workshops and providing group staff development (Sarama et al., 2008).

At an institutional level, two interventions considered the need to promote organisational support to intensify teachers' learning and engagement and ensure the sustainability of the PDL programme (e.g. Sarama et al., 2008; Porche et al. 2012). Sarama et al. (2008), Gettinger and Stoiber (2008). Meanwhile, Collins and Dennis (2009) augmented this by providing both supportive roles and materials for parents.

Another relevant element to consider regarding the operationalisation of PDL interventions was the frequency and intensity of programmes. This implies on-going on-site support for practitioners throughout the duration of the intervention. Collaboration among key participants and peers features as an important consideration when implementing effective PDL.

INCLUDE HERE TABLE 4. How was the PDL delivered?

What changed as a result? – Teachers' knowledge and practice.

Table 5 shows change in teachers' knowledge and practice. Five key areas of change were identified: 1) changes in teachers' content knowledge; 2) changes to teachers' procedural knowledge; 3) improvements to the organisation of the classroom environment; 4) changes in teacher-child interactions; and 5) changes in joint attention with children under the age of three. Nine studies reported changes to teachers' content knowledge, reporting impact on teachers' vocabulary (as well as that of their children); increased awareness of the way in which they engaged with children; and knowledge of their practices and environment. For example, Jackson et al. (2006) and Collins and Dennis (2009) both combined mentoring and research approaches, and in the case of Collins and Dennis (2009), workshops and college lectures, to achieve change, suggesting that models of PDL that give both new knowledge and 'scaffolded' support are effective at instigating change in practice. In addition, both studies met high levels of frequency and duration in delivery. By comparison McLachlan and Arrow (2014) reported no changes in teacher understanding of phonological awareness and little impact on children's outcomes following an 8-week programme consisting of a 2-hour workshop prior to implementation. They conclude that 'teachers need greater involvement or time for changes in beliefs and practices to occur' (2014, p.835), highlighting also the importance of subject knowledge with ongoing PDL such as coaching and feedback to ensure impact on children's learning. Nine studies showed changes in procedural knowledge with impact on: improved lesson planning; improvement of ECE settings' ability to deliver high-quality, pre-literacy skills; and development instruction. Furthermore there was enhanced practice such as: being more conscious of emphasising sounds in words; pointing out the alphabet to children; emphasising names and writing of names on artwork; encouraging writing of stories; and so on. All final 24 studies focused on children of preschool age (3-6). This finding highlights the lack of research on the impact of professional learning on those who work with the youngest children in EYE.

INSERT HERE TABLE 5. Changes in teachers' knowledge and practices

What changed as a result? – children's outcomes.

Table 6 shows changes to children's outcomes. The studies considered reported on one or more outcome for children across three main areas:

1. Literacy knowledge and skills (16)
2. Mathematical and science knowledge and skills (5) and
3. Socio-emotional/behavioural development (2).

Two of the included studies did not report positive gains in children's outcomes (Porche, Pallante, and Snow, 2012; Piasta et al., 2015). Lonigan et al. (2011) reported positive gains as a result of curriculum change but reported that the impact of professional development was insignificant. Furthermore, in the study by Jackson et al. (2006) gains in child outcomes were mixed so that there were positive gains in children's print recognition and letter knowledge, but there were no measurable changes in phonological awareness or oral language, nor any measurable effect on children's socio-emotional development. In studies which reported positive outcomes, coaching, mentoring and feedback often in combination with other approaches, such as introduction of new knowledge and research evidence appeared to be most effective in impacting positively on child outcomes (e.g.Hindman and Wasik, 2012).

INSERT HERE TABLE 6. Children's outcomes

Characteristics of the studies included

Table 7 facilitates cross-referencing between the characteristics of study design, the type of intervention, focus of PDL, duration and composition of participants. We found no studies

conducted in the UK, which reported impact of PDL on children's outcomes (22 USA, 1 Canada, 1 New Zealand). Each of the included studies reported on interventions that were funded by state or federal government. Most interventions (17) focused on literacy and language and to a lesser extent on other basic subjects such as mathematics and science. Most studies (21) gave detailed information on the participants, the majority of which were a diverse groups of practitioners, with mixed qualifications and experience reflecting the type of EYE workforce also found in the UK. The prevalence of coaching seen in the included interventions (most of which reported gains in child outcomes), highlights again the potential of this responsive approach for a diverse and sometimes hard-to-reach workforce i.e. home-based providers and low qualified practitioners. Absent from this set of interventions, however, is any kind of economic evaluation, so it is difficult to judge the cost effectiveness of this approach, particularly in relation to duration, frequency and intensity. A further factor discussed in many of the included papers is the critical part played by the fidelity of implementation of PDL by participants, in achieving impact. Coaching and regular opportunities for intervention participants to keep in touch and catch up may support higher levels of fidelity and ensure best possible confidence in study findings. Some studies provided information on the level of attrition in study samples. High turnover of staff in EY settings in some cases impacted on the interventions, as did withdrawal from the study. However, regular coaching support appears also to contribute to the reduction in rates of attrition in the workforce and hence ensure greater stability and sustainability of learning settings.

INSERT HERE TABLE 7. Characteristics of the included studies

Having provided descriptive detail on the included studies in relation to the conceptual model adopted we move on to address our three research questions.

1. **What evidence is there of impact of professional learning approaches for improving outcomes for children in EYE? And**
2. **Which approaches are more and less impactful?**

The majority of studies considered, which reported positive outcomes for children, used a combination of PDL approaches, which can be described broadly as knowledge or curricular input and follow up. Input included face-to-face workshops and/or on-line tutoring, coaching, and to a lesser degree mentoring (Podhasjski et al, 2005; Chen and McCray, 2012; Hindman and Wasik, 2012). This finding corroborates evidence from the wider literature regarding the efficacy of coaching as a professional development tool (see for example Cordingley et al, 2015).

In this review we understand coaching to mean a 'process of equipping people with the tools, knowledge, and opportunities they need to develop themselves and become more effective' (Peterson and Hicks, 1996; as cited by Feldman and Lankau, 2005, p. 841). Coaching has been widely adopted in a number of countries (including England, USA, Canada and Australia) as a way of achieving and enhancing professional learning and building capacity for more effective goal attainment, change management and improved educational outcomes (van Nieuwerburgh, 2012). It has also been shown to be effective in helping educators enhance their skills and develop new habits, as well as apply theoretical learning to workplace practice (Creasy and Paterson, 2005; van Nieuwerburgh, 2012), and is considered to be effective because it supports professional development, practice sustainability and continuous improvement (Creasy and Paterson, 2005, p. 5). Moreover, the evidence from our review suggests that compared to other forms of practice support, such as one-off workshops, the active steps involved in coaching, such as goal-setting, action

planning and ongoing assessment and support (e.g. Goff et al., 2014), appear to be more likely to help educators overcome challenges, stay motivated and stay on track as they pursue specific goals.

It is not, however, only the type of PDL that appears to be important in contributing to positive impact on children's learning. How long (duration), how often (frequency) and how much support (intensity) appear also to be relevant, although the degree to which this was discussed is highly variable within the papers considered. It is not possible to say precisely how much or little PDL is optimally effective as this was not considered in most papers (see also table 7 for details of duration of PDL interventions). Marcon et al (2012) conclude that PDL beyond the 7 month period offered in their program would be beneficial particularly for educators without degree level qualification. Podhasjski et al (2005) trained and mentored teachers over a 6 month period, but concluded that longitudinal PDL designs increase sustainability and impact. Moreover, the studies by Piasta et al (2015) and Marcon et al (2012) both note the potential for PDL of longer duration to address high staff turnover characteristic of the early childhood workforce. At the same time, and more positively in relation to retention rates, the study by Marcon et al (2012) also notes that PDL over extended time might lead to educators leaving to pursue qualification routes and more senior roles.

However, one study included in the present review provided some convincing evidence on duration. The Exceptional Coaching for Language and Literacy (ExCELL) intervention (reported in Hindman, and Wasik; 2012), implemented in Head Start preschool settings for disadvantaged children examined whether 2 years of the ExCELL coaching programme was linked to greater gains for teachers and children, than 1 year of coaching. The authors report that whilst 1 year of ExCELL coaching is linked to gains in the quality of teachers' classroom environments and instructional interactions, which in turn promote gains in children's vocabulary, alphabet, and phonemic awareness skills, a second year of coaching is uniquely predictive of additional growth in teachers' instructional interaction quality and in children's

vocabulary gains (2012; p.151). A second factor stemming from this study, especially pertinent to this review, is the relationship between coaching and content or new knowledge. The authors note that coaching focused on the quality of the environment (e.g. availability and use of books, writing materials, and print) may be easily understood and quickly translated into new practices by teachers. On the other hand, changing instructional interactions around these tools (e.g. using rich vocabulary, asking open-ended questions, and providing precise feedback) may 'challenge teachers to alter culturally embedded and sometimes automatic patterns of communication and conversation, thus requiring more time for training and reflection' (2012: p.134). This reflects findings from McLachlan and Arrow (2014) who reported that change in beliefs and practices takes longer, but additionally highlights the need for reflection and feedback during that time. For the purposes of the present review, it is valuable to understand who might benefit most from a longer period of coaching and why. Hindman and Wasik (2012) offer three possibilities:

- teachers who initially demonstrate lower-quality classroom literacy environments or instructional interactions might benefit more from a second year of coaching;
- teachers with higher initial skills might be better placed to take better advantage of coaching and thus widen the gap further with their less-skilled peers over 2 years i.e. the so-called Matthew effect;
- the individualised nature of coaching would allow coaches to start with the professional's specific knowledge and skill level. This might reduce initial individual differences (adapted 2012, p.134).

Although the study was conducted in the USA the workforce diversity and composition bear important similarities with that of the UK. We can see how targeting coaching resources on the least well qualified and skilled would be most beneficial since it could be tailored to meet individual levels of knowledge and skill, rather as in the apprentice model i.e. experts modelling and scaffolding learning. Other papers return similar findings in support of coaching models, which include EY practitioners with a range of qualifications. Future

research might focus on the role played by duration, frequency and intensity in achieving impact from professional learning approaches, particularly in a climate of both financial austerity and an urgent need to find solutions to the skills gap in the EYE workforce.

Consulting the wider literature the impact of duration, there seems little agreement. In contrast to the study by Hindman and Wasik (2012) which found that two years was better than one, a study of duration conducted by Shidler (2009) reported that more time is not always better. Rather it is the type and quality of interaction between coaches and practitioners that becomes a deciding factor in efficacy of coaching. Similarly a systematic review of PDL and student literacy outcomes conducted by Basma and Savage (2017) reported that less rather than more than 30 hours of PDL appeared to be effective at raising literacy standards. However they also note that this may be because extended PDL can take longer to impact on practices and outcomes. Further in a systematic review of effective curricular approaches in EYE, Chambers et al (2010) note that studies of short duration may not allow programmes to show their full effects. Understanding better the effects of duration, intensity and frequency of dosage on the efficacy of PDL programmes would help the EYE sector make informed decision about programme shape and content and offers a potentially fruitful area for future research.

3. **What are the features of and the theory of action underpinning effective professional learning approaches in EYE?**

From the papers considered it appears that the most likely effective approaches to PDL are those that marry the introduction of new knowledge with opportunities for reflection and scaffolded interaction through facilitated workshops and coaching. Often such knowledge is research-based but in all cases must be made accessible such that practitioners will be able to relate it to their current practice and context. Working with a coach to identify how to address areas for development or to enhance how the approach may be further improved appears effective. But peer-to-peer support can act in similar ways to help practitioners

understand how to refine and apply the approach in question. As such it would seem the most effective approaches reflect social constructivist models of effective learning.

What types of professional learning opportunities are available to EYE practitioners and who provides them?

In our original proposal we included a fourth research question, which was concerned with the types of PDL currently available to the EY sector in the UK. However, it became clear at an early stage that this would not be an easy or achievable task. We were unable to find reliable information about the types of PDL currently on offer to the EYE in the UK, and importantly, whether or not it was directly concerned with improving children's learning. Consultation with members of our Advisory group, all of whom work in the sector, confirmed that PDL in the UK is delivered by a wide range of providers and facilitators including academics from higher education institutions, Local Authorities, private consultants who may have previously been teachers and head-teachers, private companies who have developed a particular product or approach, colleagues in settings and schools and increasingly via social media, comprising a mixed offer of one-off workshops, conference days, lectures, staff meetings or bespoke university-led programmes. A more recent report on the EY workforce (DfE 2017) notes that limited budgets mean that PDL is increasingly offered by senior colleagues in the school or setting rather than by external experts. Members of our advisory group also reported that in a climate of limited resources, priority is increasingly given to operational and regulatory training around first aid, health and safety and child protection procedures. Cordingley et al., 2015) note that passive instruction and one off lectures/workshops may be a useful and an efficient, cost-effective way to impart factual information, but that genuine changes in professional practice are unlikely to come about through such methods of delivery and require a different approach (Tillery et al., 2010). The lack of comprehensive and reliable data on the types of PDL already on offer to the sector and the prevalent modes of delivery, raise some important questions:

- What impact if any is the current PDL offer having on improving outcomes for children?
- To what extent are current PDL opportunities in the EYE informed by the best available research evidence?
- Is PDL in the EYE of acceptable quality?

Establishing a reliable quality assurance mechanism for PDL alongside evidence of the types of programmes that work best, would seem to be a critical area for future research and sector debate.

CONCLUSIONS AND IMPLICATIONS FOR FUTURE RESEARCH

When we set out to undertake this review it was on the assumption that it would be a first step in understanding how PDL impacts on children in the EYE sector in the UK context. Our aim is to build on the findings presented here in order to pursue further research and work with the sector to develop evidence-based guidelines for best practice in PDL for setting leaders and policy makers. Much of the literature we reviewed in our initial scoping exercise and subsequent screening of 1197 papers identified a clear focus on outcomes for teachers and other professionals who work with young children rather than on children. Our review has brought together evidence on the impact of PDL interventions specifically on children's outcomes, thus making a valuable contribution to debate in the field. Following a rigorous and systematic screening of 1197 studies we found only 24 that met our criteria and the requirements of our quality assessment protocol. Of the 24 papers we considered in our final included set, we were surprised to find that none were conducted in the UK. There are a number of ways we can interpret this interesting finding. First, evidence-informed practice, although now firmly embedded in policy and practice in the 5-18 school sector, is relatively new in relation to EYE in the UK. As noted in the introduction, several influential reports of PDL have been undertaken in the 5-18 school sector, but none considered interventions in EYE or the specific challenges facing the EYE sector. Secondly, EYE has only relatively

recently come into the centre of policy and received the attention it now benefits from. The research effort in EYE provision in the UK is increasingly achieved through dedicated funding calls from organisations such as the Education Endowment Foundation and indeed, the Nuffield Foundation who funded the review reported here. All this is to the good and will enable the EYE sector in the UK to be informed by a stronger evidence base.

The majority of studies considered were conducted in the USA and most of these were funded by individual state or federal government funding calls, as part of a national strategy to address educational disadvantage. It is clear that without serious investment on the part of government in PDL programmes that can be evaluated and taken to scale, we are unlikely to see significant impact on the skills level of the early years workforce much less, increased quality or provision and improved outcomes for children most at risk of disadvantage. We are mindful about placing too much emphasis on findings gathered in a different national and/or cultural context. That said, although there is much variation in the ways in which early education is provided here in the four countries of the UK, and we have much in common with the USA in regard to the diverse composition of the workforce, current demand for expansion of provision, a skills shortage in the early childhood sector, high staff turnover rates, a policy drive for children to be 'school ready' and the nature and shape of the EY curriculum (see also Chambers et al, 2010). As such, we would argue that, in the absence of studies conducted in the UK, we can learn much from the 24 studies reported in this review.

We suggest also that there are important links between the type of intervention programme on the one hand, and how the workforce is conceptualised by policy-makers, administrators/leaders and parents in terms of its standing, professional status and type of learner on the other. The low status, pay and conditions of the EY workforce is noted in several reports (including Kalitowski, 2015) so it is important that work is undertaken to examine this, to challenge negative and misinformed perceptions concerning the nature of work with young children and support for the EYE workforce in its development as a

profession, particularly when it is *de facto* accountable for school readiness and later achievement in school. In recent decades the professionalization of the global early years/early childhood workforce, to some extent marks a 'coming of age' of the profession, and provides an important context for this review. The significant descriptive and qualitative literature on the concepts of professionalism, professional development/learning, leadership, qualifications and competency, identified in our initial scoping exercise, testifies also to the widespread and enduring interest in the topic and related challenges, within the field. Noteworthy is that relative to this large body of (mainly) qualitative and conceptual studies in the field, the number of studies we have identified, which met our criteria and evaluated the impact of PDL on outcomes for children is strikingly low at 24.

One outcome of this review is to argue strongly for greater attention to be paid to the impact of PDL on children's learning and developmental outcomes. This shift in focus need not exclude enhanced development of practitioner skills. Indeed, in all of our included studies, practitioners' and children's development were more or less interlinked. But a focus on children would encourage a greater focus on building an evidence base on quality provision of PDL.

PDL as a means by which to achieve specific outcomes in teaching quality, particularly in relation to improving children's basic skills in literacy, language and mathematics may appear to be underpinned by accountability to school, district (in the USA) and national agendas for driving up educational standards following. However, we do not see these perspectives as mutually exclusive. Rather we have come to the view, based on the review evidence, that it is possible to achieve positive impact on children's outcomes and at the same time offer a rich and professionally rewarding experience for EYE workers.

The present review has identified coaching models as a potentially important approach to improving children's outcomes in EY settings when coupled with a clear content focus and linked to practitioners' setting contexts and experience. Specialist content coaching

(Cordingley et al., 2015), undertaken by more expert peers, by colleagues situated within collaborative partnerships or networks (Brown and Poortman, 2018), or provided by external coaches, can offer a responsive approach for a diverse workforce with wide variation in skills, knowledge and qualification. Further research, however, is needed on identifying the optimum duration, frequency and intensity to maximise limited resources available to support PDL, the extent to which resources need to be targeted at low qualified and hard to reach groups e.g. home based provision. In the longer term, we recommend that in the UK context, the EYE sector (including schools), might work with Local Authorities, Teaching School Alliances, Multi Academy Trusts and/or government to develop a set of agreed guidelines or minimum standards for the quality assurance of PDL, its pedagogy and the mode of delivery appropriate to the type of learning and content delivery required.

Finally, we strongly recommend that investment in developing high quality PDL opportunities in EYE should be a priority, alongside the qualifications route. Although we recognise that further work is needed to fully understand which types of PDL have the greatest impact and are most cost effective, the review provides useful evidence to show that certain types of PDL can help to improve the quality of pedagogical interactions between adults and young children and enhance subject knowledge, which in turn can significantly benefit children's developmental and learning outcomes seemingly more quickly and cost effectively than formal qualifications. The potential benefits of this to children's school readiness and social-emotional development seem clear. However, arguably the most important factor in ensuring that the positive benefits of PDL programmes have long lasting and sustainable impact is the full commitment and on-going support and investment of school and setting leaders, and ultimately that of policy-makers and government.

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Table 1. Weight of Evidence

							WoE A	WoE B	WoE C	WoE D
Study	Does study justify sample size?	Does study report on method allocation?	Is there a full description of PDL process?	Does study offer a quantitative impact of treatment?	Methods to establish reliability and validity?	Is there a measure of fidelity of implementation?	Did the reported findings in the study answer the research question and was internally consistent?	Is the research design of the study appropriate for the review question?	Was the focus of the study relevant to the review question?	
Bredenfur et al. (2013)	N	Y	Y	Y	Y	N/A	High	High	High	High
Chen and McCray (2012)	N	Y	Y	Y	Y	N	High	High	High	High
Collins and Dennis (2009)	N	N	Y	Y	N	N	High	High	High	High
Conroy et al. (2013)	N	Y	Y	Y	Y	N	High	High	High	High
Downer et al. (2011)	Y	Y	Y	Y	Y	Y	High	High	High	High
Gallagher, Abbott-Smith and VandeWiele (2011)	N	Y	Y	Y	Y	Y	High	High	High	High
Gettinger and Stoiber (2007)	N	Y	Y	Y	Y	N	High	High	High	High
Hindman and Wasik (2012)	Y	Y	Y	Y	Y	Y	High	High	High	High

Jackson et al. (2006)	Y	Y	Y	Y	Y	N/A	High	High	High	High
Kermani and Aldemir (2015)	Y	Y	Y	Y	Y	N	High	High	High	High
Landry et al. (2009)	Y	Y	Y	Y	Y	Y	High	High	High	High
Landry et al. (2011)	Y	Y	Y	Y	Y	Y	High	High	High	High
Lane et al. (2014)	N	Y	Y	Y	Y	N	High	High	High	High
Lonigan et al. (2011)	Y	Y	Y	Y	Y	N	High	High	High	High
Marcon et al. (2012)	Y	Y	Y	Y	Y	Y	High	High	High	High
Martin et al. (2007)	Y	Y	Y	Y	Y	N	High	High	High	High
McLachlan and Arrow (2014)	Y	Y	Y	Y	N	N	High	High	High	High
Milburn et al. (2015)	Y	Y	Y	Y	Y	Y	High	High	High	High
Pianta et al. (2015)	Y	Y	Y	Y	Y	Y	High	High	High	High
Podhajski and Nathan (2005)	Y	Y	Y	Y	N	N	High	High	High	High
Porche, Pallante and Snow (2012)	Y	Y	Y	Y	Y	Y	High	High	High	High
Powell et al. (2010)	Y	Y	Y	Y	Y	Y	High	High	High	High

Sarama et al. (2008)	Y	Y	Y	Y	Y	Y	High	High	High	High
Swaminathan et al. (2014)	N	Y	Y	N	Y	N	High	High	High	High

Table 2. Type of PDL Interventions

Studies	Coaching and mentoring	Learning labs	Classroom implementation	Tasks and group work	Scholarships	On-line PDL
Brendefur et al. (2013)			X			
Chen and McCray (2012)	X	X	X			
Collins and Dennis (2009)	X		X		X	
Conroy et al. (2013)	X					
Downer et al. (2011)						X
Gallagher et al. (2011)	X					
Gettinger and Stoiber (2008)	X		X			
Hindman and Wasik (2012)	X		X			
Jackson et al. (2006)	X	X				
Kermani and Aldemir (2015)			X			

Studies	Coaching and mentoring	Learning labs	Classroom implementation	Tasks and group work	Scholarships	On-line PDL
Landry et al. (2009)	X					X
Landry et al. (2011)	X					X
Lane et al. (2014)	X					
Lonigan et al. (2011)	X					
Marcon et al. (2012)					X	
Martin et al. (2007)					X	
McLachlan and Arrow (2014)		X				
Milburn et al. (2015)	X					
Piasta et al. (2015)			X			
Podhajski and Nathan (2005)	X	X				
Porche et al. (2012)			X			
Powell et al. (2010)	X			X		X

Studies	Coaching and mentoring	Learning labs	Classroom implementation	Tasks and group work	Scholarships	On-line PDL
Sarama et al. (2008)	X		X			
Swaminathan et al. (2014)		X				

Table 3. Aims of PDL Interventions

Studies	Enhance teachers' content knowledge	Improve teachers' attitudes	Develop instructional strategies	Improve quality of settings	Classroom management	Promote children's learning outcomes	Develop organisational support
Brendefur et al. (2013)	X		X			X	
Chen and McCray (2012)	X	X	X				
Collins and Dennis (2009)	X		X			X	
Conroy et al. (2013)			X		X		
Downer et al. (2011)			X			X	
Gallagher et al. (2011)			X			X	X
Gettinger and Stoiber (2008)			X			X	
Hindman and Wasik (2012)	X			X		X	
Jackson et al. (2006)			X			X	
Kermani and Aldemir (2015)	X					X	
Landry et al. (2009)			X			X	

Studies	Enhance teachers' content knowledge	Improve teachers' attitudes	Develop instructional strategies	Improve quality of settings	Classroom management	Promote children's learning outcomes	Develop organisational support
Landry et al. (2011)			X			X	
Lane et al. (2014)	X		X			X	
Lonigan et al. (2011)	X		X		X		
Marcon et al. (2012)	X		X				
Martin et al. (2007)			X				
McLachlan and Arrow (2014)	X						
Milburn et al. (2015)			X				
Piasta et al. (2015)			X			X	
Podhajski and Nathan (2005)	X		X				
Porche, Pallante and Snow (2012)	X		X				X
Powell et al. (2010)	X		X	X		X	
Sarama et al. (2008)	X		X				X

Studies	Enhance teachers' content knowledge	Improve teachers' attitudes	Develop instructional strategies	Improve quality of settings	Classroom management	Promote children's learning outcomes	Develop organisational support
Swaminathan et al. (2014)	X						

Table 4. How was the PDL delivered?

Studies	Coaching	Mentoring	Workshop	Research based intervention	Collaboration	Organisational support	Frequency and intensity of PDL	Use of technology	Work with the family	Video tape lessons	College lectures
Brendefur et al. (2013)			X	X							
Chen and McCray (2012)	X						X				
Collins and Dennis (2009)	X	X	X	X			X		X		X
Conroy et al. (2013)	X										
Downer et al. (2011)	X			X			X	X		X	
Gallagher et al. (2011)		X	X	X	X						
Gettinger and Stoiber (2008)	X			X	X		X		X		
Hindman and Wasik (2012)	X						X				

Studies	Coaching	Mentoring	Workshop	Research based intervention	Collaboration	Organisational support	Frequency and intensity of PDL	Use of technology	Work with the family	Video tape lessons	College lectures
Jackson et al. (2006)		X		X							X
Kermani and Aldemir (2015)				X			X				
Landry et al. (2009)		X	X	X			X	X			
Landry et al. (2011)		X	X	X				X			
Lane et al. (2014)		X						X			
Lonigan et al. (2011)		X	X								
Marcon et al. (2012)											X
Martin et al. (2007)											X
McLachlan and Arrow (2014)			X								
Milburn et al. (2015)	X		X								

Studies	Coaching	Mentoring	Workshop	Research based intervention	Collaboration	Organisational support	Frequency and intensity of PDL	Use of technology	Work with the family	Video tape lessons	College lectures
Piasta et al. (2015)			X							X	
Podhajski and Nathan (2005)		X		X							
Porche, Pallante and Snow (2012)	X			X		X		X			
Powell et al. (2010)	X		X	X			X	X			
Sarama et al. (2008)	X			X	X	X			X	X	
Swaminathan et al. (2014)			X								

Table 5. Changes in teachers' knowledge and practices

Studies	Teachers' content knowledge	Teachers' procedural knowledge	Organisation of classroom environment	Joint attention	Teacher-child interaction
Brendefur et al. (2013)					
Chen and McCray (2012)					
Collins and Dennis (2009)	X	X			
Conroy et al. (2013)					X
Downer et al. (2011)		X			X
Gallagher et al. (2011)		X			
Gettinger and Stoiber (2008)					
Hindman and Wasik (2012)	X		X		
Jackson et al. (2006)	X	X	X		
Kermani and Aldemir (2015)	X				
Landry et al. (2009)	X	X			
Landry et al. (2011)	X	X			
Lane et al. (2014)		X			
Lonigan et al. (2011)					X

Studies	Teachers' content knowledge	Teachers' procedural knowledge	Organisation of classroom environment	Joint attention	Teacher-child interaction
Marcon et al. (2012)	X				
Martin et al. (2007)					
McLachlan and Arrow (2014)		X			
Milburn et al. (2015)	X				
Piasta et al. (2015)					
Podhajski and Nathan (2005)					
Porche, Pallante and Snow (2012)					
Powell et al. (2010)	X	X			
Sarama et al. (2008)					
Swaminathan et al. (2014)					

Table 6. Children's outcomes

Studies	Literacy skills and knowledge	Mathematical abilities	Socio-emotional / behavioural development
Brendefur et al. (2013)		X	
Chen and McCray (2012)		X	
Collins and Dennis (2009)	X		

Studies	Literacy skills and knowledge	Mathematical abilities	Socio-emotional / behavioural development
Conroy et al. (2013)			X
Downer et al. (2011)	X		X
Gallagher et al. (2011)	X		
Gettinger and Stoiber (2008)	X		
Hindman and Wasik (2012)	X		
Jackson et al. (2006)	X		
Kermani and Aldemir (2015)		X	
Landry et al. (2009)	X		
Landry et al. (2011)	X		
Lane et al. (2014)	X		
Lonigan et al. (2011)	X		
Marcon et al. (2012)	X		
Martin et al. (2007)	X		
McLachlan and Arrow (2014)	X		
Milburn et al. (2015)	X		
Piasta et al. (2015)		X	
Podhajski and Nathan (2005)	X		

Studies	Literacy skills and knowledge	Mathematical abilities	Socio-emotional / behavioural development
Porche, Pallante and Snow (2012)			
Powell et al. (2010)	X		
Sarama et al. (2008)		X	
Swaminathan et al. (2014)			X

Table 7. Characteristics of studies included before WoE

Study (by author)	Study design	Elements of PDL	Topic of PDL	Duration PDL	Content group	Composition Workforce
1. **Brendefur et al. (2013)**	RCT	Workshop + classroom activities	Early maths.	6 months	24 teachers. 16T & 111C (intervention) 8T & 33C (control)	36% High-School 17% Associate 31% BA 14% master
2. **Cain, Rudd and Saxon (2007)**	RCT	Workshop + coaching	Joint attention engagement (Language)		48 childcare providers	16 High-School, 28 College 3 Associate 1 BA
3. **Campbell and Milbourne (2005)**	RCT	Workshop + consultation	Quality ECE	3 months training	180 caregivers, 114 ECE rooms,	1% No High-School diploma 78% High-School 3% some college, 10% Associate 7% BA 1% Post-bachelors' work
4. **Chen & McCray (2012)**	Quasi experimental with interventi	Workshop, coaching and classroom implementation	Early maths.	2 years	No info	No Info

		on and control group					
5.	**Collins & Dennis (2009)**	Intervention	Workshop, mentoring and home support	Language, literacy	3 years	8 Head Start classrooms	8 BA 6 masters' degree. 4 assistants 60 hr college credit
6.	**Conroy et al. (2013)**	Descriptive non experimental	Workshop + coaching	Children's behaviour	14 weeks	10 teachers and 19 children	10 BA degree and current teacher certification.
7.	**Downer et al. (2011)**	RCT	Workshop and web-based support	Language, literacy	2 years	161 teachers, 1,338 children	62.1% BA 36% advanced degrees
8.	**Gallagher et al. (2011)**	RCT	Workshop + mentoring	Language	1 school year	16 mentors	62.5% college degrees.
9.	**Gettinger & Stoiber (2008)**	Intervention Experimental	Workshop + coaching	Early literacy	2 years	15 teachers and 15 assistants	15 Associate (ECE)
10.	**Hindman & Wasik (2012)**	RCT	Workshop + coaching	Language and literacy	2 years	16T intervention and 10T control 626C interv. & 357C control	1 working toward Associate 3 Associate 12 BA

						1 Master
11. **Jackson et al. (2006)**	Experimental	Workshop + mentoring	Literacy	15 weeks	22 teachers 17 control	No info
12. **Kermani & Aldemir (2015)**	Quasi experimental	Workshop and support from research team	Science, math	6 hrs of PDL	4 teachers	4 BA
13. **Landry et al. (2009)**	RCT	Online training + mentoring	Language, literacy	2 years	262 teachers	146 High School/CDA 73 Two-year college; 181 4+ years college
14. **Landry et al. (2011)**	RCT	Online training + mentoring	Language, literacy	2 years	209 teachers in intervention (+)1200 teachers control.	Different groups
15. **Lane et al. (2014)**	Experimental	Online PDL	Language	24 weeks	27 teachers	18 High-School 41 Associates 36 BA/BS 4 Ma/MEd
16. **Lonigan et al. (2011)**	Cluster-randomized	Workshop + mentoring	Language, literacy	1 year	739 children	No Info
17. **Marcon et al. (2012)**	RCT	Workshop + technical assistance	Language	7 months	181 teachers intervention and 20 control	No Info

18. **Martin et al. (2007)**	Experimental	Coaching + materials + parent's education	Language	2 years	Approx. 100 children. 11 classrooms	No Info
19. **McLachlan and Arrow (2014)**	Quasi experimental	Workshop	Literacy	8 weeks	32 teachers 103 children	3 No Qual 5 BA 3 Diploma in teaching 2 Graduate Diploma in 3 in training
20. **Milburn et al. (2015)**	RCT	Workshop and coaching	Literacy	6 months	31 teachers and 121 children	No Info
21. **Piasta et al. (2015)**	Quasi experimental	Workshops and video	Maths and Science	18 months	Mixed Early Childhood Centres	31% Non-grad 55% Degree 13% Masters
22. **Podhajski and Nathan (2005)**	Experimental	Workshop and mentoring	Literacy	2-day workshop6 monthly 45 min mentoring visits	Mixed childcare providers incl home-based	45% non-teaching qual 55% Degree+teaching qual
23. **Porche, Pallante and Snow (2012)**	Experimental	Workshop + coaching	Literacy (CLLIP)	1 year	124 kindergarten, 148 Grade 4	Kindergarten and Elementary teachers
24. **Powell et al. (2010)**	RCT	Literacy coaching	Early literacy	36 hours	749 children (experimental and control groups)	Teachers 2 and 4 year degree plus
25. **Sarama et al. (2008)**	RCT	Distance learning, in-class coaching	Maths. (TRIAD)	1 year	25 teachers 209 children	Pre-K Teachers

26.	**Swaminathan et al. (2014)**	Evaluation; pre-post test	Workshops, reflective shared learning	School readiness, Language & Cogn. Develop.	10 months, 15 hours	No info	Mixed assoc. degree

Figure 1: **PLEYE Systematic Review Process**