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Professional Development for Leaders and Specific Contexts and Disciplines: Literacy (including Gaeilge and Digital Literacy) and Numeracy

A Review of the Literature

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Summary of Findings

The aim of this report is to support the development of pedagogies for literacy including Gaeilge, digital literacy and numeracy, with reference, as appropriate to different settings (ECEC, schools, DEIS, Special Needs); supporting school leaders to implement change in literacy, numeracy and digital literacy. This research is guided by the following research questions:

- What systematic reviews or meta-analyses have been conducted that are relevant to the area of professional learning for leaders in educational settings and for literacy including Gaeilge, digital literacy and numeracy?
- How can professional learning support school leaders, teachers and early childhood educators to implement change in relation to literacy, numeracy and digital literacy outcomes?
- What professional learning practices and activities are identified to support school leaders, teachers and early childhood educators' development of pedagogies in relation to literacy, numeracy and digital literacy across the education settings?

One of the key findings to emerge from this research is that the two concepts of professional learning and leadership are inextricably linked to school effectiveness and improvement (Poekert, 2012). Sebastian et al. (2016) conceptualise school leadership more broadly than the 'principal' to include the teachers as leaders. Professional learning is required in supporting teachers to become leaders who will drive and share pedagogy in educational settings. While a review of 26 systematic reviews and meta-analyses did not garner findings on professional learning and leadership in specific educational contexts, settings or disciplines, it does infer that professional learning can enable leaders to implement change across literacy, numeracy and digital literacy.

Independent of the education context, setting or discipline, the reviews underpinning this report emphasise a multifaceted approach to professional learning as a means of improving pedagogy and student learning (Ansyari et al., 2020; Surrette & Johnson, 2015). However, the interconnectedness between the systems and policies within which teachers operate; the knowledge, beliefs and attitudes held by teachers; and the impact of the teachers' instructional practice on student learning also influences a teacher's professional learning (Goldsmith et al., 2014; Ciesielski & Creaghead, 2020). A teacher's own attitudes and beliefs to achieve the desired outcomes of improved teacher knowledge and skills is suggested as being a driver for professional learning (Rosli, 2021). Equally, it is argued that professional learning can play a significant role in challenging teachers' existing beliefs and fostering new beliefs (Cremin & Oliver, 2017; Pettit, 2011) and in doing so, foregrounds the incremental, iterative, multi domain nature of teacher professional learning (Goldsmith et al., 2014).

Features of effective professional learning include content focus, active learning, coherence, duration, collective participation/collaboration, using models of effective practice; providing coaching and expert support; offering feedback and reflection (Darling Hammond et al., 2017; Desimone, 2009) and these features are evident in the various approaches or programmes identified in this research. An analysis of the 26 systematic reviews and meta-analyses identify common professional learning practices and activities that are typically applicable across the disciplines of literacy, numeracy and digital literacy; however no reviews fulfilling the search criteria where specific to professional learning and Gaeilge; or professional learning and digital literacy.

The importance of discipline-specific content knowledge underpinning professional learning emerges strongly from the reviews. Yigit (2014) appear to indicate that the extent of

teachers' pedagogical content knowledge in the disciplines of literacy and numeracy is limited and that in pre-service and in-service contexts, the systematic and explicit instruction in the provision of foundational skills in literacy and numeracy is paramount (Meeks et al., 2017; Stahnke et al., 2016). This requires that teacher content knowledge and pedagogies in relation to the disciplines, as well as supporting teachers to embed literacy instruction cross disciplines (Scott et al., 2018), must be ingrained in pre-service and in-service teacher education. This alludes to professional learning as an iterative process that occurs at various stages of the teacher's career (Muijs et al., 2014; Bruns et al., 2021).

Effective approaches to professional learning identified in the reviews typically incorporated a range of pedagogies including experiential/active learning and teacher inquiry. The centrality of experiential learning was underscored repeatedly in the reviews. When teachers experience this as professional learning pedagogy, they are more likely to embed the learning in their practice (Stahnke et al., 2016). For example, in providing opportunities for a teacher to develop their own sense of selves as writers (Cremin & Oliver, 2017) or to develop as mathematicians through pedagogies such as lesson study and task design (Ausiku & Matthee, 2021; Huang and Shimizu, 2016), the potential to shift their beliefs and practices and equally, develop empathy for the student learner is enhanced.

In terms of professional learning, studies on disciplinary literacy (Lammert, 2020) and mathematics (Goldsmith et al., 2014) spotlight the importance of pre-service and in-service teachers experiencing inquiry. Teacher inquiry as a pedagogical approach to professional learning allows the learner "to gain insight into how questions are asked and examined and how conclusions are drawn, supported, communicated, contested and defended (Moje, 2015, p. 257). Closely linked to teacher inquiry, is practice-based research (Lammert, 2020) and cycles of teacher-led research (Goldsmith et al., 2014). Edwards (2021) found that action research as a form of professional development has considerable benefits for language teachers in terms of both cognitive and identity-related development, as well as teaching and research-related development and learning. The collaborative nature of action research with its opportunities for partnerships between teachers and researchers and mentoring offers teachers a tool for systematic reflection on practice but also the professional learning of colleagues, and even to promote new or revised cultures and systems.

Building on the notion of collaboration as a feature of effective professional learning, establishing communities of practice and engaging in coaching and mentoring was highlighted in both literacy and numeracy interventions (Didon et al., 2020; Kutsyuruba et al., 2020; Blitz, 2013). Coaching and mentoring as transformative activities in practice were predominantly associated with early childhood settings (Brunsek et al., 2020; Elek & Page, 2019; Markussen-Brown et al., 2017; Schachter, 2015).

From the systematic reviews and meta-analyses (Ciesielski & Creaghead, 2020; Basma & Savage, 2018), it would appear that intensity and duration of professional learning practices and activities surface as a somewhat contested topic. There is suggestion that shorter courses which have a specific focus (e.g. phonics) can potentially account for an increase in outcomes for students, whereas longer, more extended periods of time, focussing on complex areas like comprehension or problem solving, may arguably take longer to bear fruit. It is however heartening to note that shorter, well designed, well executed professional development interventions can have small but reasonably robust measurable effects of student literacy outcomes.

Stahnke et al. (2016) identifies the small-scale nature of many situated interventions as an impediment to reporting on outcomes. While these small-scale interventions are useful to the extent they are context sensitive and may be used as the basis of replication in similar settings, the results are not generalisable. A 'logical, rather than a statistical connection' therefore can be drawn between the findings and their application more broadly (Cohen et al.,

2011, p. 294). Therefore, given the many contested variables inherent in the design and implementation of professional learning practices and activities, challenges arise in evaluating the effectiveness of approaches and programmes. This is typified by McMaster et al. (2020) who suggest that in exploring professional development for intensive reading programmes, the lack of specificity in terms of the content of the interventions renders it difficult to draw conclusions with regards to what it actually influences teachers' practice.

Professional learning is seen as a promising way to develop critical teachers (Markussen-Brown et al., 2017) and the potential to improve student achievement and learner outcomes (Brunsek et al., 2020; Schachter, 2015). Consequently, there are increasing demands to evaluate and examine the specific conditions and elements of professional development programmes that yield better and more sustainable outcomes (Kraft et al., 2018; Goldsmith et al., 2014). Egert et al. (2018) posit that the impact of professional learning is more evident in teacher quality outcomes rather than in child learning outcomes, which suggests that improvements are required first at teacher level. Ultimately, it is the nonlinear, recursive and interactive relationships between the critical features of professional development, increased teacher outcomes, changes in pedagogy and improved student learning outcomes (Desimone, 2009) that must be considered in planning and evaluating the impact of professional learning.

Recommendations

In light of the research conducted to investigate the research question, 'what systematic reviews or meta-analyses have been conducted that are relevant to the area of professional learning for leaders in educational settings and literacy including Gaeilge, numeracy and digital literacy? The following recommendations are made in response to the sub-questions as per the applicable pillars from The National Strategy: Literacy and Numeracy for Learning and Life 2011-2020 (Department of Education & Skills, 2011):

Pillar 2: Professional Development

- Adopting the term 'professional learning', as opposed to professional development, is cognisant of the varying practices and activities that teachers actively engage in throughout the learning stages of their career (Kutsyuruba et al, 2020; Poekert, 2012; The Teaching Council, 2011).
- No one form of standalone professional learning is effective; and approaches such as coaching, mentoring, collaborative learning, experiential learning should be implemented as part of a broader programme of support for teachers (Ansyari et al., 2020; Kraft et al., 2018; Surrette & Johnson, 2015).
- There is a need for teachers to acknowledge the influence of their own attitudes and beliefs and to challenge these so as to achieve the desired outcomes of improved teacher knowledge and skills (Rosli, 2021; Cremin & Oliver, 2017; Goldsmith et al., 2014; Pettit, 2011)
- Teacher inquiry, including practice-based research as a pedagogical approach to professional learning, can be a driver for change and agency (Lammert, 2020; Goldsmith et al., 2014) so as "to gain insight into how questions are asked and examined and how conclusions are drawn, supported, communicated, contested and defended (Moje, 2015, p. 257), leading to critical thinkers (Markussen-Brown et al., 2017). In terms of professional learning, studies spotlight the importance of teachers experiencing inquiry, so that they will be able to enact it.
- Professional learning in literacy and numeracy should incorporate an element of experiential learning that involves enacted pedagogy as 'teachers as writers' and 'teachers as mathematicians' (Ausiku & Matthee, 2021; Cremin & Oliver, 2017; Stahnke et al., 2016)
- Professional learning is effective when teachers are involved in some form of active learning experiences with others (Ciesielski & Creaghead, 2020; Didon et al., 2020; Cremin, 2017; Blitz, 2013).
- While professional learning elements of duration and intensity are contested, the duration of coaching and other approaches should be aligned with the complexity of the content and learning outcomes for teachers (Ciesielski & Creaghead, 2020; Basma & Savage, 2018).
- Professional learning should enable the participant to actively influence the coaching process and this includes observation, feedback, collaboration and discussion (Darling Hammond et al., 2017).
- Coaching as an effective form of professional learning should provide opportunities for teachers/educators to practise reflect and set goals in a collaborative way; apply new skills; reflect on practice and develop self-directed goals (Elek & Page, 2019; Kraft, 2018).
- Mentoring, as a form of professional learning, emerged as an effective approach for school leaders and for early career teachers (Kalinowski et al., 2020; Kutsyuruba et al., 2020).

- Collaborative learning is a core feature of effective professional learning (Huang and Shimizu, 2016). Collaboration takes many forms, community of practice (Lave and Wenger, 1991); community of interest (Fischer, 2001); communities of Inquiry (Jaworski, 2006) or Professional Learning Communities (PLCs) (Richmond & Manokore, 2011). The availability of technical and logistical support is critical to the success of PLCs (Richmond & Manokore, 2011) and all collaborative endeavours. Time, space, access to learning resources and dedicated staff with expertise contribute to the effectiveness of the PLCs.
- Online collaboration can be successful where there is diversity within the group in terms of roles, areas and levels of expertise; where there is a moderator and where there are opportunities to meet or socialise in person (Surrette & Johnson, 2015; Blitz, 2013).

Pillar 3: Leadership

- Professional learning should be considered on a continuum, where a teacher's own professional knowledge develops as the teacher moves through a number of learning stages of their career, ultimately leading to leadership in teaching and learning (Kutsyuruba et al, 2020; Poekert, 2012).
- With the enactment of leadership, it consequently promotes continuing learning for the teacher as leader and so it may be inferred that leadership embedded in the education context leads to professional learning for colleagues and for teachers themselves, and in turn, manifests in improved student learning and achievement (Sebastian et al., 2016; Muijs et al., 2014) .
- There must be a culture of mentorship at an institutional level and this supports both the retention and development of teachers. While school leadership should be conceptualised more broadly than the 'principal' to include the teachers as leaders (Sebastian et al., 2016), principals play a key role in establishing and resourcing mentoring structures, time for mentoring, resources for mentoring, places and spaces for mentoring (Kutsyuruba, 2020).
- Teachers who become leaders should be encouraged to facilitate effective, setting-based professional learning with their peers and in doing so, collaboratively and collectively examine teaching practices and classroom instruction through ongoing reflection, inquiry and criticality (Sebastian et al., 2016; Poekert, 2012).

Pillar 4: Curriculum and the Learning Experience

- Embedding content-area instruction within professional learning enables teachers/educators to experience positive results while also gaining new knowledge about both themselves and their students (Scott et al., 2018). Further research is required into teacher-preparedness for supporting early literacy development, as research suggests that beginning teachers have limited knowledge of both the content of early literacy and of the explicit, systematic pedagogy that supports student learning (Meeks et al., 2017).
- Professional learning for teachers must include a disciplinary focus to enable teachers to integrate a rich understanding of the content and pedagogical approaches in mediating this content to learners (Santagata et al., 2021; Ausiki, 2021; Bruns et al; 2021; Stahnke et al., 2016). There is a positive correlation between subject specific knowledge and student outcomes (Brusnek et al., 2020; Stahnke et al., 2016).
- Professional learning should support teachers enact their learning within their respective disciplines and across all levels of education, early childhood -primary-post primary (Cremin & Oliver, 2017).
- Teachers should be supported to embed literacy instruction across disciplines (Ciesielski & Creaghead, 2020; Scott, 2018). The majority of the studies in this

review supported the conclusion that preservice teachers' beliefs are strongly impacted by the instructional context of content and literacy-focused methods courses. By applying literacy to a content area, preservice teachers were provided opportunities to gain knowledge from text, make sense of content, and engage directly with curriculum (Cremin & Oliver, 2017).

- Supporting the teachers to embed inquiry as a central pedagogy for literacy development and enacting literacy across disciplines and lack of this in the mathematics education (Lammert, 2020).
- Need for further research - Limited meta-analyses or systematic reviews, no systematic reviews specific to Gaeilge and digital literacy

Pillar 6: Assessment & Evaluation

- While Didion et al. (2020) argue that research has yet to agree on the level of intensity needed to change teacher knowledge and instructional practices, Sigvardsson (2017) highlights that a high-stakes testing and pervasive cultures of accountability within the education system can pose a significant threat to professional learning-efforts. Teacher education is key to developing critical teachers who are aware of political and economic trends.
- Lack of detail with regard to the content of professional learning interventions suggest that more research is warranted. The lack of specificity in terms of the content of the interventions renders it difficult to draw conclusions with regards to what it is that actually influences professional learning.

Narrative Report

Introduction

In teacher education, the term ‘professional development’ is often associated with pre-service training and education, while the term ‘continuing professional development’ is assumed to refer to the professional development that takes place after initial teacher education (DES, 2011). Given that this report will focus on the continuum of teacher education and the educator’s professional practice, the term ‘professional learning’ (Boylan et al., 2018; King, 2014) will be used to reflect “the full range of educational experiences designed to enrich teachers’ professional knowledge, understanding and capabilities throughout their careers” to include pre-service and in-service teacher education (The Teaching Council, 2011, p. 19). Such professionalising experiences which lead to learning, may be formal (arising from professional development workshops, courses, programmes) and informal (such as on-the-job learning from activities and social interactions with others) (Spillane et al., 2011). Additionally, when the term ‘teacher’ is referred to in this report, it should be noted that it may be applied to educators working in a range of educational settings: early childhood education and care (ECEC), primary and post primary. The themes that emerged from this exploration of systematic reviews and meta-analyses relate to the pedagogies that are specific to literacy, digital literacy and numeracy teaching and learning, built upon the principles of professional learning identified by King et al. (2022). With the influencing role of professional learning in educational and teacher effectiveness well documented (Muijs et al., 2014), the aim of this research is to investigate the professional learning practices and activities that are promoted as a means of supporting leaders to implement change; and those pedagogies which have been found to improve literacy, numeracy and digital literacy teaching and learning in various educational settings. Therefore, this report will document the findings in response to the overarching research question:

Research Question

What systematic reviews or meta-analyses have been conducted that are relevant to the area of professional learning for leaders in educational settings and literacy including Gaeilge, numeracy and digital literacy?

This research identified 26 systematic reviews and meta-analyses, which were conducted in the area of teacher professional learning as it relates to literacy, numeracy and digital literacy since 2011. Other key studies, literature reviews and policies were also drawn upon to support arguments put forward in this research report and to situate the findings from the systematic reviews and meta-analyses. The methodology and search strategy is detailed in Appendix A and Appendix B provides a tabulation of the findings from the search. Arising from the focus of the research on professional learning as it pertains to literacy, numeracy and digital literacy, the following sub-questions were generated to guide the search strategy and this report:

- How can professional learning support school leaders, teachers and early childhood educators to implement change in relation to literacy, digital literacy and numeracy?
- What professional learning practices and activities are identified to support school leaders, teachers and early childhood educators' development of pedagogies in relation to literacy, numeracy and digital literacy across the education settings?

Professional Learning Leading Teaching and Learning

The National Strategy: Literacy and Numeracy for Learning and Life 2011-2020 (DES, 2011) highlights the need for providing teachers' with professional development opportunities in literacy and numeracy pedagogies, based on the premise that improving teachers' professional learning can lead to "better teaching [which] will support better learning" (p. 30). Additionally, the Strategy seeks to improve the understanding and support for Principals and Deputy Principals of the most effective approaches for improving the teaching of literacy and numeracy with a view of becoming a school leader. Therefore, professional learning should be considered on a continuum as a teacher's own professional knowledge develops as the teacher moves through a number of learning stages of their career (Kutsyuruba et al, 2020), from those associated with teacher knowledge in relation to the

teaching of literacy and numeracy to those more associated with developing metacognition. Muijs et al. (2014) argue that teachers who are able to reach the latter stages of professional learning may enact leadership to obtain better learning outcomes for the students and children involved. Demonstrating leadership in teaching and learning is not exclusive to principals but rather Sebastian et al. (2016) conceptualise school leadership more broadly than the 'principal' to include the roles of teachers and the model of distributed leadership within and across the school.

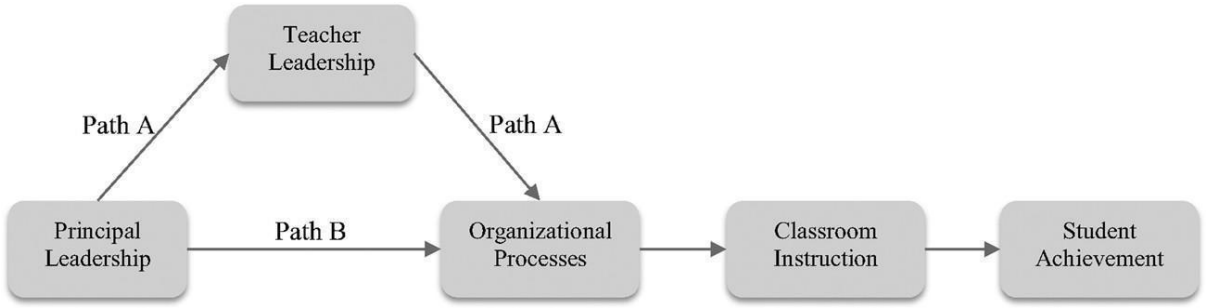

Fig. 1.

Sebastian, Allensworth, & Huang (2016) pathways from leadership to student achievement

While a review of the 26 systematic reviews and meta-analyses did not garner findings on professional learning and leadership specific to educational contexts, settings or discipline but rather to teaching and learning in general, it may be inferred that professional learning can enable leaders to implement change across literacy including Gaeilge, numeracy and digital literacy. Leadership can be said to contribute to educational reform and change in teaching which can be accomplished through ongoing, school-based professional learning for teachers (Poekert, 2012). Poekert's systematic review of 29 studies indicates that "professional development leads to teacher leadership, which leads to further professional development for the teachers enacting leadership and their colleagues" (p. 169) and therefore the two concepts of leadership and professional learning are inextricably linked to school effectiveness and improvement. Professional learning is required to develop teachers as leaders and to drive and share pedagogical practices in educational settings in an effort to improve student outcomes. Teachers who become leaders should be encouraged to facilitate effective, setting-based professional learning with their peers and in doing so, collaboratively and collectively examine teaching practices and classroom instruction through ongoing reflection, inquiry and criticality. With this enactment of leadership, it consequently promotes

continuing development and learning for the teacher as leader; and so it may be inferred that leadership embedded in the education context leads to professional learning for colleagues and for teachers themselves, and in turn, may support improved student learning and achievement (Sebastian et al., 2016) in disciplines such as literacy including Gaeilge, numeracy and digital literacy.

Professional Learning Practices and Activities to Improve Literacy, Digital Literacy and Numeracy

Ansyari et al. (2020) supports Desimone's (2009) seminal proposition that the main features of effective professional development include content focus, active learning, coherence, duration and collective participation. Surrette & Johnson (2015) research of 20 empirical studies indicate the online environment as an increasingly popular mechanism to support professional development to teachers but the online environment must be able to facilitate the five critical features of professional development. Darling Hammond et al. (2017) identify seven design features of effective professional development that improve pedagogy and student learning: content focus; active learning; supports collaboration; uses models of effective practice; provides coaching and expert support; offers feedback and reflection; and is of sustained duration. While these primarily reflect Desimone's (2009) five core features generally accepted as orthodoxy in many countries, they also emphasize the importance of models of effective practice, coaching and expert support, and feedback and reflection.

In relation to mathematics teachers' professional learning, Goldsmith et al.'s (2014) synthesis of 104 qualitative and mixed methods studies refers to Clarke and Hollingsworth (2002) four key influential domains; the External domain represents the systems and policies within which teachers operate; the Personal domain represents affective issues such as knowledge, beliefs and attitudes held by teachers; the domain of Practice is constituted by teachers' instructional practice; while outcomes such as students learning stemming from teachers' pedagogy falls under the domain of Consequence. The interconnectedness of these domains is most evident in Ciesielski & Creaghead (2020) systematic review of 23 studies examining the effectiveness of professional development on the phonological awareness outcomes of preschool children. They found that professional development was most effective for children's learning if it is consistent with the teacher's current knowledge and beliefs as well as school and state policies. Similarly, Rosli's (2021) systematic review of 40

studies of mathematics teachers determined that professional learning begins with the teacher driven by strong motivation and positive teacher attitudes and beliefs to achieve the desired outcomes of improved teacher knowledge and skills, improved teaching practices and student outcomes. Drawing on a review of 23 studies, Pettit (2011) highlights the strong link between teachers' beliefs and practices in relation to teaching English Language Learners (ELL) in mainstream classes. The review identifies a number of 'beliefs for successful inclusion of ELLs' which includes having high expectations for ELLs, accepting responsibility for ELLs, encouraging native language use both at home and in the classroom and being aware of the time it takes ELLs to learn academic English. Pettit (2011) argues that professional development can play a significant role in challenging teachers' existing beliefs and fostering these new beliefs regarding ELLs and in turn, may be applicable to diverse language learning contexts.

Clarke & Hollingsworth's (2002) four domains underpin many of the systematic reviews referenced in this report and each of the domains are typically addressed in tandem. Equally, similarities can be drawn in the features of professional development identified earlier and in the practices and activities that aim to develop teacher knowledge and provide opportunities for collaboration as a means of supporting pedagogies to improve teaching and learning. However, the analysis of the 26 systematic reviews and meta-analyses reveal that professional learning practices and activities tend not to be specific to educational contexts or settings but rather were common to the disciplines of literacy and numeracy.

Develop Teacher Knowledge

The systematic reviews and meta-analyses which underpin this report, strongly indicate the need to address specific disciplinary considerations to include teacher content knowledge and meaningful task design. Since the emergence of the concept of content knowledge for teaching by Shulman (1986, 1987), categories have expanded and the interactions and interdependencies between them have become more nuanced. There is a need for opportunities in teacher education to actively engage the various types of teacher knowledge - to include Technological and Pedagogical Content Knowledge (TPCK) (Mishra & Koehler, 2006), which informs their professional judgement to facilitate learning and assessment. Yigit (2014) identifies the development of the kinds of knowledge required - the development, understanding and communication of types of representations, the knowledge of the relative level of challenge presented by various concepts, and an awareness of how to

use technology to aid learning present a considerable challenge in the design and the assessment of how well these many complex elements are addressed, and the literature has not thus far presented a coherent picture of implementation and evaluation of preservice professional development in this area. The development of this kind of knowledge may well go beyond initial teacher education but rather reiterates the need for professional learning to be considered on a continuum of teacher education.

Discipline knowledge. Given the disciplinary focus of this research, it is perhaps unsurprising that the importance of discipline-specific content knowledge emerges strongly from the data and is relevant for early childhood, primary, post-primary teachers. Studies (Bruns et al., 2021; Ciesielski & Creaghead, 2020) appear to indicate that the extent of teachers' pedagogical content knowledge in the areas of literacy and numeracy is limited and that in pre-service and in-service contexts, the systematic and explicit instruction in the provision of foundational skills in literacy and numeracy is paramount. Bruns et al. (2021) in a systematic review of 36 studies emphasise that it is important for young children to have experiences and to develop early competencies across different domains in early childhood education, be that literacy or numeracy. They highlight that both content knowledge (knowledge about concepts, rules and facts) and pedagogical content knowledge (knowledge of effective teaching) are required by early childhood educators. However, one challenge is to conceptually and operationally define content knowledge while another is that early childhood educators must be able to relate their knowledge to the teaching process. Overall Bruns et al. found (2021), a strong link 'between the early childhood educators' content knowledge and children's learning gains' (p. 31). In terms of developing discipline knowledge, Ciesielski & Creaghead (2020) noted pre-school teachers with lower levels of education benefited more from more prescriptive professional development provision, where the content focus of the professional development intervention is one of the most influential factors in the success.

In a systematic review of 13 studies in the US and Australia, Meeks et al. (2017) investigated the degree of preparedness of pre-service teachers to teach early reading. The emphasis in the review was on code based (phonic), rather than whole-language approaches. Balanced approaches were not considered in the systematic review due to a lack of clarity around what these comprise. While teachers were found to have a positive attitude towards code-based approaches, they were shown to have limited competence in implementing these. The review decried the lack of scientifically-based reading research in reading programs in initial teacher education. The result, the authors argue, is that beginning teachers have limited

knowledge of both the content of early literacy and of the explicit, systematic pedagogy that supports student learning. These findings raise questions about the adequacy of teacher preparation programs for early reading as poor teacher knowledge and skills in the use of appropriate early literacy instruction may be considered a contributing factor to early reading difficulties. The systematic and explicit instruction in foundational literacy skills were combined with a supervised clinic or practicum, as well as one-on-one tutoring experiences. The results of post-tests for knowledge and ability as cited in these studies were high. Meeks et al. (2017) calls for more research into teacher-preparedness for supporting early literacy development.

Equally, the importance of supporting teachers to embed literacy instruction across disciplines was underscored by Scott et al. (2018). In a review of 53 studies, they found that embedding content-area instruction within the application of tutoring or a field-based class enables preservice teachers to experience positive results while also gaining new knowledge about both themselves and their students. Scott et al. (2018) argue that literacy researchers and educators should move forward by addressing specific disciplines, texts, literacy strategies, and the instructional methods of delivery that enable students to develop into capable readers and writers across and within all disciplines. Studies largely indicated that when preservice teachers receive instruction through coursework and practicums, their perceptions toward providing literacy instruction in future teaching contexts became more positive. The majority of the studies supported the conclusion that preservice teachers' beliefs are strongly impacted by the instructional context of content and literacy-focused methods courses. By applying literacy to a content area, preservice teachers were provided opportunities to gain knowledge from text, make sense of content, and engage directly with curriculum.

Similarly, for Pre-K12 teachers of mathematics, Stahnke et al. (2016) notes the positive correlation between subject specific knowledge and student outcomes, and acknowledges the complexity of in-the-moment decision making in mathematics teaching. There is an indication of connections between pre-service and early career teachers' relatively underdeveloped skills in interpreting students' work as a result of deficiency in mathematical knowledge. Of the 20 studies focusing on professional development interventions, many of these studies reported that teachers' noticing can be successfully fostered by video-based training tools. This finding supports Santagata et al. (2021) systematic review of 35 studies which argues for the use of video-based professional learning programmes to develop the noticing competencies in pre-service and in-service mathematics

teachers. Therefore, a strong focus on professional learning for teacher of mathematics must include a disciplinary focus to facilitate prospective and practicing teachers to integrate a rich understanding of the content knowledge and pedagogical approaches to mediate this content to learners (Yigit, 2014).

Schachter (2015) calls attention to the interrelatedness of professional development on early childhood educators' development of skills, knowledge and dispositions in that interventions which focused teachers' knowledge were also considered to be targeting teachers' skills. Similarly, interventions that attended to teachers' dispositions, extended teachers' knowledge. Thus, strengthened the notion of professional learning being multifaceted and iterative in its approach (Kutsyuruba et al., 2020; Goldsmith et al., 2014).

Experiential and Active Learning. Studies suggest that teachers' identities as disciplinary-competent actors impact on their capacity to deliver rich learning experiences within disciplines. Professional learning which provides discipline-specific experiential learning experiences for teachers may have an important role to play in this regard. This is congruent with Ciesielski & Creaghead (2020) finding that professional learning was most effective when the teachers were involved in active learning experiences that provided opportunities to adapt the practices of phonological awareness to their unique preschool contexts. In a systematic review of 22 studies, Cremin & Oliver (2017) investigate the apparent truism that effective teachers of writing 'must be writers'. While the adage is highly contested, with a dearth of concrete empirical evidence to point to a direct causal link between teachers as writers and enhanced student outcomes, there is evidence to suggest that irrespective of phase or experience, focused opportunities to participate in a community of practice, or to write in a range of forms can 'transform' teachers' attitudes, self-esteem and sense of self as a writer. Teachers' who perceived themselves as writers' were seen to offer richer classroom writing experiences and generated increased 'enjoyment, motivation and tenacity in their students than non-writers' (Cremin & Oliver, 2017, p. 286). The authors argue that both pre-service and in-service formal programmes have an important role to play in developing teachers' conceptions of writing. Sustained opportunities to engage in a community of practice, where personal writing histories are reflected upon, opportunities to write are provided and discussions of textual practices are facilitated, can 'influence teachers' self-assurance as writers and their pedagogical approaches' (p. 292).

In connecting the situated and cognitive perspectives, Stahnke et al. (2016) critiques the traditional focus on the cognitive perspectives outside the classroom and argues that the acquisition of knowledge should be considered in conjunction with the consideration of

enacted pedagogy. To some extent, this can be seen in a number of the reviews referenced in this report. According to Ausiku & Matthee's (2021) systematic review of 30 studies which examines the preparedness of primary teachers to teach computational thinking concepts and skills, they propose that in addition to educational policies promoting professional development that embeds computational thinking, that both pre-service and in-service teachers need to develop their pedagogy in authentic contexts. Task design provides a particularly rich opportunity to develop teachers own mathematical and pedagogical competencies (Jones & Pepin, 2016). Rich mathematical tasks challenge learners to consider uses, make sense of and consolidate their mathematics. In working to design, adapt and resource these tasks, teacher's agency and competence has been improved, and in many cases this work has been supported by a collaborative element, variously described and theorised as community of practice (Lave and Wenger, 1991), community of interest (Fischer, 2001), or communities of Inquiry (Jaworski, 2006). The benefits of teachers working not just as teachers of mathematics but as those who do mathematics in their own right is emphasised in Jones & Pepin (2016). Benefits of teachers' own engagement with high-quality mathematical tasks intended to develop their own mathematics, both at pre-service and in-service career stages have been noted by Mason (2008) to include the promotion of teachers' own mathematical thinking and reflective practices in presenting, adjusting and evaluating mathematical tasks. Huang & Shimizu (2016) identify lesson study as a practice-based, research oriented, collaborative professional development pedagogy which facilitates the deep exploration of mathematical tasks addressed in the process. Huang & Shimizu's (2016) systematic review of 53 studies on lesson study with in-service mathematics teachers credit the benefits of lesson study in terms of highlighting "teacher learning, improving teaching and student learning, implementing curriculum, sharing instructional products, and the dynamic between theory and practice" (p.398).

Teacher Inquiry. Linked to the importance of experiential learning experiences in professional learning are studies that focus on forms of teacher inquiry In terms of professional learning, studies spotlight the importance of teachers experiencing inquiry as pedagogical approach allowing the learner "to gain insight into how questions are asked and examined and how conclusions are drawn supported, communicated, contested and defended" (Moje, 2015, p.257). This report draws attention to the compartmentalisation of literacy and numeracy learning in school and the need for deep disciplinary literacy (Lammert, 2020); and numeracy which focussed on taking an inquiry stance towards teaching (Goldsmith et al., 2014). In a systematic review of 55 studies, Lammert (2020) explored

embedding inquiry in literacy pre-service teacher education. Time spent by pre-service planning for and engaging with young people through inquiry was seen to be particularly important. These experiences were shown to help challenge pre-service teachers' dominant beliefs about teaching, learning and perceptions of their students. While preservice teachers reported several challenges with inquiry as a method, the analysis of the 55 studies identified in the overwhelmingly suggested inquiry can be personally transformational for literacy preservice teachers.

Goldsmith et al. (2014) found that 8 of 36 studies documented the impact of professional learning on mathematics teachers' inquiry stance, with teacher learning tending to occur incrementally and iteratively through repeated cycles of inquiry. Goldsmith et al.'s (2014) review corroborates Clarke & Hollingsworth's (2002) observations that professional development is more likely to proceed through a series of incremental changes in knowledge, beliefs, dispositions, and classroom practices—changes that eventually lead to improved outcomes for students—than to be a direct path from a single professional learning experience to a change in practice to improvement of student outcomes.

Closely linked to teacher inquiry, is teacher research (Cochran-Smith & Lytle, 2009). Edwards (2021) findings from 11 studies show that action research as a form of professional development has considerable benefits for language teachers in terms of both cognitive and identity-related development, as well as teaching and research-related development and learning. As in the case with many of the reviews referenced in this report, Edwards (2021) deduces that the benefits of the language teachers conducting action research goes beyond the individual teacher's professional learning in a single discipline and has the potential impact to influence the external domains of the mesosystem (teachers' institutions) and the macrosystem (educational sectors). The collaborative nature of action research with its opportunities for partnerships between teachers and researchers and mentoring offers teachers a tool for systematic reflection on practice but also the professional learning of colleagues, and even to promote new or revised cultures and systems.

Collaborate with Others

Effective professional learning happens when teachers together frame their own learning by identifying goals for both themselves and their students; creating partnerships with those with expertise to ensure their learning is focused and likely to achieve the desired goals. Therefore, collaborative approaches to professional learning have implications for both what it means to be professional and the role of school and teachers (Didon et al., 2020), and

is conducive to developing leadership (Sebastian et al., 2016). Collaborative learning manifests itself in various forms and can be distinguished as a form of professional learning in its own right. Of the 106 studies reviewed related to the professional learning of in-service teachers of mathematics (Goldsmith et al., 2014), 39 had results that were classified as teacher collaboration which included lesson study groups and video clubs, courses and workshops with collegial work online or in person, one-on-one coaching, and multifaceted programmes that included school wide, and sometimes cross-school, collaboration. Goldsmith et al. (2014) note that very few of the interventions described in the studies could be classified by a single collaborative approach to professional development such as ‘‘lesson study’’ or ‘‘site-based collaboration,’’ but rather the studies were classified as teacher collaboration either because the study reported an impact on teacher collaboration or an impact of teacher collaboration shaping teacher knowledge (17 studies), teacher beliefs (16 studies), and teacher practice (11 studies).

Professional Learning Communities. Professional learning communities (PLCs) is used to describe the many ways in which people with shared interests come together (Talbert, 2010) and more specifically is understood in education as teams of teachers who get together regularly to exchange ideas with the ultimate goal of improving student outcomes (Blitz, 2013). However, Timperley et al. (2007) argue that, collaboration in itself and in the absence of opportunities to build or challenge ideas about teaching, does not automatically produce change. They contend that “participation in some form of learning community was a necessary but not sufficient condition’’ for teachers’ learning (p. 88). Collaboration differentiates PLCs from other more general forms of professional learning. Typically, within an effective PLC participants share common beliefs, values and visions and require supportive school leadership, but that too is contested (Richmond & Manokore, 2011) in terms of whether top-down or distributed leadership is more effective. Secondly, the availability of technical and logistical support is critical to the success of PLCs (Richmond & Manokore, 2011). Time, space, access to learning resources and dedicated staff with expertise all contribute to the effectiveness of the PLCs. Finally, the school or setting culture influences the working and outcomes of the PLCs.

Across 74 peer reviewed literature, relating specifically to online PLCs, Blitz (2013) highlighted that there is some evidence that virtual communities can achieve the goals of PLCS and that online engagement facilitates the development of a sense of community and improves participant’s knowledge of content and pedagogy. However, online collaboration is most successful where its composition is diverse in terms of roles, areas and levels of

expertise; where there is a moderator and where there are opportunities to meet or socialise in person (Blitz, 2013).

While the research on the effectiveness of PLCs is fragmented and frequently consist of case studies though not specific to a discipline or educational setting, Huang & Shimizu (2016) point to the benefits around collaboration and the developments of learning communities to develop professional knowledge and practice, as well as an increased focus on pupil learning and improved teaching of mathematics. Didon et al.'s (2020) meta-analysis of 28 studies reported professional development having a moderate and significant, positive average effect (g=0.18) on kindergarten-8th grade students' reading achievement where the format delivery variables were whole group, summer coursework, PLC, coaching, and online learning. While PLCs were employed in 6 studies, it was not observed if the format influenced the impact of the professional development, as 19 out of the 28 studies used one or more of these formats together. Didon et al. (2020) infer that the influence that these formats may have on one another is as important as how each supports collaborative learning as part of professional development..

Coaching. Professional learning aims to bring about sustained, transformative changes to practice, and coaching appears to have the potential to impact on practice and student learning (Elek & Page, 2019; Schachter, 2015). In education, coaching involves a collaborative relationship between an expert and a teacher with the aim of developing specific pedagogical knowledge and skills (Neuman & Cunningham, 2009). Didion et al. (2020) further refine the concept of coaching as 'master teachers who offer ongoing, in-person support either one-on-one or in small groups' (p. 32). Coaching incorporates elements of collaboration and feedback, along with the targeted development of specific knowledge and skills. In addition, coaching provides opportunities for reflection, which is a critical component in sustained change (Brunsek et al., 2020). However, Elek & Page (2019) posit that there are gaps and inconsistencies in how coaching of early childhood educators is defined. According to them, the critical features of coaching may be framed by the structure or process of coaching. In terms of structure, the exact duration of an effective coaching element is not agreed and equally, these details are not systematically outlined in many studies reviewed. However, a consistent pattern that emerges from the Markussen-Brown et al. (2017) meta-analysis review of 25 studies on the effects of language and literacy focused professional development on early educators and children is that coaching is of little benefit when it is under a year in duration and that benefits accrue only when intensity is high and/or duration is long. However, this finding is contested in that other factors such as content area,

goals of coaching or educator's characteristics or skills also influence the impact. Overall, Elek & Page (2019) suggest that to be effective, the duration of coaching should be aligned with the complexity of the content and learning outcomes, and draws parallels to Kraft et al. (2018) characterisation of coaching as being 'individualized, time-intensive, sustained over the course of a semester or year, context specific and focused on discrete skills' (p. 548). The second important process of coaching relates to active engagement, whereby the participant can actively influence the coaching process (Knowles et al., 2015) and this includes observation, feedback, collaboration and discussion (Labone & Long, 2016). Active learning within a coaching context is practical and participatory, reflective and emotionally engaging and is self-directed or collaborative, and Elek and Page (2019) propose that 'the chance to practise, reflect and set goals in a collaborative way should continue to be emphasised in coaching' (p.579).

Brunsek et al. (2020) meta-analysis and systematic review of 64 studies to investigate the associations between professional development of early childhood educators and children's outcomes, found that there were significant and positive associations for professional development that incorporated a coaching element. Similar to Didon et al. (2018) finding that frequent professional development is facilitated through multiple formats, Kalinowski et al. (2020) found that coaching to support teachers' efficacy and implementation of instructional methods was particularly effective for developing K-12 students' language and literacy proficiency across the curriculum. Equally, Schachter's (2015) review of 73 studies of the effects of professional development for early childhood educators noted that a total of 35 different mechanisms were utilized to support professional development, but coaching was found to be a common activity in 40 of the studies when targeting teachers' skills, knowledge and disposition.

Mentoring. Mentoring has been evidenced across many disciplines including ECEC as an effective mechanism to impact on learning (Ciesielski & Creaghead, 2020) with its success dependent on relationships or interpersonal interactions and the context within which it occurs (Du & Wang, 2017). Despite the benefits of mentoring, studies examined by Ciesielski and Creaghead (2020) reveal minimal benefits. Mentoring alone was found to be insufficient but overall it was found that mentors were effective. However, the efficacy of mentoring remains contested within the corpus of literature, with Lonigan et al. (2011) suggesting that mentoring was not an efficient means of ensuring child outcomes. Pianta et al. (2017) suggested that while there were no direct links between mentoring and children's literacy gains, other skill improvements were evident as a result. Across a systematic review

of 113 entries, mentoring emerged as an effective tool for school leaders and an effective approach for early career teachers (Kutsyuruba et al., 2020). In the case of new teachers, formal and informal mentoring has facilitated the mutual sharing of ideas and just-in-time support. Research has shown that to be effective in education, there must be a culture of mentorship at an institutional level and this supports both the retention and development of new teachers (Kutsyuruba et al., 2020). Leadership is relevant for all teachers but principals play a key role in establishing mentoring structures, time for mentoring, resources for mentoring, places and spaces for mentoring (Kutsyuruba et al., 2020).

Intensity and Quality of Professional Development

A number of interesting findings emerge, which appear to stem from the narrower, disciplinary focus employed in the current review. In contrast to the findings of key seminal studies (Desimone, 2009; Timperley et al., 2007), intensity surfaces as a somewhat contested topic in terms of formal professional development activities. In a systematic review of 17 studies, Basma & Savage (2018) argues that the literature does not support the claim that teacher professional development with more than‘30 hours results in positive literacy achievement in students’ (p. 468). High quality studies identified in the review were most likely to have less professional development hours. Both the duration and quality were deemed to be significant factors in terms of professional development influencing student reading achievement. The results suggest that shorter courses had a specific focus (e.g. phonics). This focus could account for the increase in literacy outcomes. Longer, more extended periods of time, focussing on complex areas like comprehension, may arguably take longer to bear fruit. However, it is heartening to note that shorter, well designed, well executed professional development interventions can have small but reasonably robust measurable effects of student literacy outcomes. Studies that focussed on teachers reflecting on their practice rather than traditional workshops produced the highest effect sizes in this context.

Ciesielski & Creaghead (2020) promulgate that where professional development combined content focused input and active learning, such as small-group collaborative work or some form of mentoring, supported teachers teaching of phonological awareness. They propose that professional development needs to be of a sufficient duration and amount to be influential such as 20 contact hours over a semester, or 30 hours or more. They also determined that professional development appeared more effective where there was some sort of follow-up; in the form of mentoring and/or coaching that extended formal interventions

allowed teachers time to digest new knowledge and practice new techniques. However, mentoring alone proved not an efficient means of ensuring child outcomes.

Coaching models were reported to be high quality on the 'weight of evidence' measure and used shorter professional development hours. Thus, there may be a connection between professional learning format, hours and the quality of the study. There is however insufficient evidence to draw strong empirically based conclusions. Didion et al. (2020) argued that research has yet to agree on the level of intensity needed to change teacher knowledge and instructional practices. The variation, they propose, suggests that there are other components of professional development, irrespective of intensity, affecting student outcomes.

Evaluating Professional Learning

Professional development programmes and provision are seen as a promising way to improve student achievement and learner outcomes given the cost effectiveness of its outreach (Brunsek et al., 2020). Consequently, the effectiveness and impact of professional learning is called into question, and in doing so, brings increasing demands to examine the specific conditions and elements of professional development programmes that yield better and more sustainable outcomes (Kraft et al., 2018; Schachter, 2015; Goldsmith et al., 2014). Schachter's (2015) systematic review categorised 73 studies into studies (n=63) which reported the effectiveness of the implementation of professional development and those (n=10) which reported the process of implementation. Of these studies, over half of the studies (n=39) addressed teachers' skills, knowledge and dispositions in terms of language and literacy intervention, and 4 studies targeted mathematics instruction. This review investigated the reported 'change' as it related to the implementation of professional development with findings 18% (n ¼ 13) measured changes in teachers' knowledge, 40% (n ¼ 29) measured changes in children's learning, and 11% (n ¼ 8) measured changes in children's behaviour.

The effectiveness of professional development for intensive reading programmes is investigated by McMaster et al. (2020) in their systematic review of 28 studies to explore the effectiveness of professional development intensive reading programmes. They argue that while most studies clearly implicate ongoing and active learning, less detail was provided with regards to their content focus, opportunities for collective participation and coherence. The lack of specificity in terms of the content of the interventions renders it difficult to draw conclusions with regards to what it actually influences teachers with regard to intensive

reading programmes. Studies on the external domain - such as large-scale or national models of professional development, and specific attention to outcomes such as improvements in literacy, digital literacy and numeracy learning were limited and less comprehensively addressed in the reviews that this report draws upon. Examples of effective professional learning interventions which emerged from the systematic review may be categorized as small scale and situated, and while it seems likely that these are likely to be viewed positively by participants, they categorically do not present an opportunity for comparison or analysis of student learning outcomes due to the small scale nature of many situated interventions as an impediment to reporting on outcomes (Stahnke et al., 2016).

Brunsek et al.'s (2020) meta-analysis of professional development on children outcomes in early childhood education and care settings highlight that language and literacy tended to be a frequent focus of the 64 studies (n=26) and they come to the consensus that this be relative to the public agenda on raising literacy standards (Markussen-Brown et al., 2017). This is comparative to 3 studies which focus on young children's acquisition of math, science and STEM concepts which were evaluated but were not systematically reviewed. Results of these reviews suggest that professional development of teachers is a viable method for improving language as evidenced by small-to-moderate associations that were found across different measures (e.g., expressive and receptive language, sound knowledge, phonological awareness) which were directly related to evidence-based content of the professional development programme.

Ansyari et al. (2020) suggest evaluating the data deriving from professional development interventions as a means of instructional improvement. While the research suggests that data use from professional development interventions have promising results on teacher satisfaction, their findings of 17 studies conducted in primary and post-primary settings indicate that the effects on student outcomes are not straightforward but rather are influenced by teacher outcomes, practices of data use and changes in pedagogy. They found that there was no evidence in the studies that professional development pathways were evaluated to support claims on their effects on student outcomes in mathematics and reading. Consequently, if data from professional learning is to be considered to inform pedagogy and improve student learning, then this would suggest that there are implications for developing appropriate assessment practices and improving teachers' data literacy skills (Hoogland et al., 2016).

In terms of evaluating professional learning interventions, Egert et al. (2018) suggest that the impact of professional development and learning are more evident in teacher quality

outcomes rather than in child learning outcomes, which suggests that improvements are required first at teacher level. In the case of teachers of mathematics, professional learning is considered to be an interactive and dynamic enterprise which does not emerge in a linear fashion and from which direct and automatic improvements in learners' performance cannot be inferred (Goldsmith et al., 2014). This corroborates with Desimone's (2009) model which outlines the interactive relationships between the critical features of professional development, increased teacher outcomes, changes in classroom practice and improved student learning outcomes. Researchers argue that professional development is key to developing critical teachers who are aware of political and economic trends, and have the capacity to critically shape their responsiveness to the pervasiveness of a neoliberal policy agency and the dominance of market-forces (Markussen-Brown et al., 2017).

While the reviews referenced in this report point to the centrality of professional learning for supporting effective teaching and learning in literacy and numeracy, it is plausible to question the high-stakes testing and pervasive cultures of accountability that can pose a significant threat to professional learning efforts (Sigvardsson, 2017). Student learning and well-being cannot be seen as by-products of effective professional learning, but rather as the reason to engage, the basis for understanding what needs to change, and the criteria for deciding whether those changes have been effective. It is therefore of primary importance to evaluate the impact of professional learning in a rigorous and reliable way, for example, by using Guskey's (2001) evaluation framework, with its focus on the ultimate primacy of student outcomes.

Conclusion

To conclude, it is clear from the systematic reviews, meta-analyses and supplementary literature reviewed for this report, that in order to improve student achievement and learner outcomes in literacy including Gaeilge, digital literacy and numeracy, the professional learning of the teacher must be considered on a continuum which ultimately attends to leadership in teaching and learning (Poekert, 2012). This requires that key pedagogies and knowledge in relation to literacy, digital literacy and numeracy must be embedded in pre-service and in-service teacher education to support professional learning. The reviews underpinning this report emphasise a multifaceted approach to professional learning as a means of improving pedagogy to affect student learning (Ansyari et al., 2020; Surrette & Johnson, 2015). The findings in this report are concurrent to Timperley et al. (2007) in that no singular practice or activity can conclusively be determined more effective than others in

improving literacy, digital literacy and numeracy outcomes. Also, the interconnectedness between the systems and policies within which teachers operate; the knowledge, beliefs and attitudes held by teachers; and the impact of the teachers' instructional practice on student learning also influences a teacher's professional learning (Goldsmith et al., 2014; Ciesielski & Creaghead, 2020). A teacher's own attitudes and beliefs to achieve the desired outcomes of improved teacher knowledge and skills is suggested as being as a driver for professional learning (Rosli, 2021). Equally, it is argued that professional learning can play a significant role in challenging teachers' existing beliefs and fostering new beliefs (Cremin & Oliver, 2017; Pettit, 2011) and in doing so, foregrounds the incremental, iterative, multi domain nature of teacher professional learning (Goldsmith et al., 2014).

References

**denotes literature included in the tabulation (Appendix B)*

*Ansyari, M. F., Groot, W., & De Witte, K. (2020). Tracking the process of data use professional development interventions for instructional improvement: A systematic literature review. *Educational Research Review, 31*, N.PAG-N.PAG. https://doi.org/10.1016/j.edurev.2020.100362

*Ausiku, M., & Matthee, M. (2021). Preparing primary school teachers for teaching computational thinking: A systematic review. 202–213. https://doi.org/10.1007/978-3-030-66906-5_19

*Basma, B., & Savage, R. (2018). Teacher professional development and student literacy growth: A systematic review and meta-analysis. *Educational Psychology Review, 30*(2), 457–481.

*Blitz, C. L. (2013). Can online learning communities achieve the goals of traditional professional learning communities? What the literature says. REL 2013-003. *Regional Educational Laboratory Mid-Atlantic*.

Boylan, M., Coldwell, M., Maxwell, B., & Jordan, J. (2018). Rethinking models of professional learning as tools: a conceptual analysis to inform research and practice, *Professional Development in Education, 44*(1), 120-139.

*Bruns, J., Gasteiger, H., & Strahl, C. (2021). Conceptualising and measuring domain-specific content knowledge of early childhood educators: A systematic review. *Rev. Educ., 9*(2), 500–538. https://doi.org/10.1002/rev3.3255

*Brunsek, A., Perlman, M., McMullen, E., Falenchuk, O., Fletcher, B., Nocita, G., Kamkar, N., & Shah, P. S. (2020). A meta-analysis and systematic review of the associations between professional development of early childhood educators and children's outcomes. *Early Childhood Research Quarterly, 53,* 217–248. https://doi.org/10.1016/j.ecresq.2020.03.003

*Ciesielski, E. J. M., & Creaghead, N. A. (2020). The effectiveness of professional development on the phonological awareness outcomes of preschool children: A systematic review. *Literacy Research & Instruction, 59*(2), 121–147.

Clarke, D., & Hollingsworth, H. (2002). Elaborating a model of teacher professional growth. *Teaching and Teacher Education, 18*(8), 947–967.

Cochran-Smith, M., & Lytle, S. L. (2009). Teacher research as stance. *The Sage Handbook of Educational Action Research.* Sage.

*Cremin, T., & Oliver, L. (2017). Teachers as writers: A systematic review. *Research Papers in Education, 32*(3), 269–295.

Darling-Hammond, L., Wei, R., Andree, A., Richardson, N. & Orphanos, S. (2009). *Professional learning in the learning profession: A status report on teacher development in the United States and abroad.* Retrieved https://edpolicy.stanford.edu/sites/default/files/publications/professional-learning-learning-profession-status-report-teacher-development-us-and-abroad_0.pdf

Department of Education & Skills (DES). (2011). *Literacy and numeracy for learning and life The national strategy to improve literacy and numeracy among children and young people 2011-2020*. DES. https://assets.gov.ie/24521/9e0e6e3887454197a1da1f9736c01557.pdf.

*Didion, L., Toste, J. R., & Filderman, M. J. (2020). Teacher professional development and student reading achievement: A meta-analytic review of the effects. *Journal of Research on Educational Effectiveness, 13*(1), 29–66.

Du, F. & Wang, Q (2017). New teachers' perspectives of informal mentoring: Quality of mentoring and contributors. *Mentoring & Tutoring: Partnership in Learning. 25*(3). 309-328.

Edwards, E. (2021). The ecological impact of action research on language teacher development: A review of the literature. *Educational Action Research, 29*(3), 396–413.

Egert, F., Fukkink, R. G., & Eckhardt, A. G. (2018). Impact of in-service professional development programs for early childhood teachers on quality ratings and child outcomes: A meta-analysis. *Review of educational research*, *88*(3), 401-433.

*Elek, C., & Page, J. (2019). Critical features of effective coaching for early childhood educators: A review of empirical research literature. *Prof. Dev. Educ., 45*(4), 567–585. https://doi.org/10.1080/19415257.2018.1452781

*Goldsmith, L. T., Doerr, H. M., & Lewis, C. C. (2014). Mathematics teachers' learning: A conceptual framework and synthesis of research. *J Math Teacher Educ, 17*(1), 5–36. https://doi.org/10.1007/s10857-013-9245-4

Guskey, T.R. (2001). Mastery learning. In N.J. Smelser & P.B. Baltes (Eds.), *International encyclopedia of social and behavioral sciences* (pp. 9372-9377). Elsevier Science Ltd.

Fischer, G. (2001). Communities of interest: Learning through the interaction of multiple knowledge systems. In S. Bjornestad, R. Moe, A. Morch & A. Opdahl (Eds.) *Proceedings of the 24th IRIS Conference* (pp. 1–14). Ulvik, Department of Information Science, Bergen, Norway, August 2001.

*Hoogland, I., Schildkamp, K., van der Kleij, F., Heitink, M., Kippers, W., Veldkamp, B., & Dijkstra, A. M. (2016). Prerequisites for data-based decision making in the classroom: Research evidence and practical illustrations. *Teaching & Teacher Education, 60,* 377–386.

*Huang, R., & Shimizu, Y. (2016). Improving teaching, developing teachers and teacher educators, and linking theory and practice through lesson study in mathematics: An international perspective. *ZDM, 48*(4), 393–409.

Jaworski, B. (2006). Theory and practice in mathematics teaching development: Critical inquiry as a mode of learning in teaching. *Journal of Mathematics Teacher Education, 9*(2), 187–211.

Jones, K., & Pepin, B. (2016). Research on mathematics teachers as partners in task design. *Journal of Mathematics Teacher Education, 19*(2/3), 105–121.

*Kalinowski, E., Egert, F., Gronostaj, A., & Vock, M. (2020). Professional development on fostering students' academic language proficiency across the curriculum—A meta-analysis of its impact on teachers' cognition and teaching practices. *Teaching & Teacher Education, 88,* N.PAG-N.PAG.

King, F. (2014). Evaluating the impact of teacher professional development: An evidence-based framework. *Professional Development in Education*, *40*(1), 89–111.

King, F., French, G., & Halligan, C. (2022). *Professional learning: Principles and practices*. Dublin City University.

Knowles, M., Holton, E. and Swanson, R. (2015). *The definitive classic in adult education and human resource development.* 8th Ed. Routledge.

*Kraft, M. A., Blazar, D., & Hogan, D. (2018). The effect of teacher coaching on instruction and achievement: A meta-analysis of the causal evidence. Rev. *Educ. Res., 88*(4), 547–588. https://doi.org/10.3102/0034654318759268

*Kutsyuruba, B., Godden, L. & Walker, K. (2020). The effect of contextual factors on school leaders' involvement in early-career teacher mentoring: A review of the

international research literature. *Research in Educational Administration & Leadership, 5*(3), 682-720. https://doi.org/10.30828/real/2020.3.3

Labone, E. and Long, J. (2016). Features of effective professional learning: A case study of the implementation of a system-based professional learning model. *Professional Development in Education, 42*(1), 54-77

*Lammert, C. (2020). Becoming inquirers: A review of research on inquiry methods in literacy preservice teacher preparation. *Lit. Res. Instr., 59*(3), 191–217. https://doi.org/10.1080/19388071.2020.1730529

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.

Lonigan, C., Farver, J., Phillips, B., & Clancy-Menchetti, J. (2011). Promoting the development of preschool children's emergent literacy skills: A randomized evaluation of a literacy-focused curriculum and two professional development models. *Reading and Writing: an Interdisciplinary Journal, 24*(34), 305-337. https://doi.org/10.1007/s11145-009-9214-6.

*Markussen-Brown, J., Juhl, C. B., Piasta, S. B., Bleses, D., Højen, A., & Justice, L. M. (2017). The effects of language- and literacy-focused professional development on early educators and children: A best-evidence meta-analysis. *Early Childhood Research Quarterly, 38,* 97–115. https://doi.org/10.1016/j.ecresq.2016.07.002

Mason, J. (2008). Being Mathematical with and in Front of Learners: Attention, Awareness, and attitude as sources of differences between teacher educators, teachers and learners. https://doi.org/10.1163/9789087905521_004.

*McMaster, K. L., Baker, K., Donegan, R., Hugh, M., & Sargent, K. (2020). Professional development to support teachers' implementation of intensive reading intervention: A systematic review. *Remedial and Special Education*, 0741932520934099. https://doi.org/10.1177/0741932520934099

*Meeks, L., Stephenson, J., Kemp, C., & Madelaine, A. (2016). How well prepared are pre-service teachers to teach early reading? A systematic review of the literature. *Australian Journal of Learning Difficulties, 21*(2), 69–98.

Moje, E. (2015). Youth cultures, literacies, and identities in and out of school. In J. Flood., S. Heath & D. Lapp (Eds.). *Handbook of research on teaching literacy through the communicative and visual arts* (pp. 207-220). Routledge.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A new framework for teacher knowledge. *Teachers College Record* 108 (6), 1017-1054.

Muijs, D., Kyriakides, L., van der Werf, G., Creemers, B., Timperley, H., & Earl, L. (2014). State of the art—teacher effectiveness and professional learning. *School Effectiveness and School Improvement, 25*(2), 231–256.

Neuman, S., & Cunningham, L. (2009). The impact of professional development and coaching on early language and literacy instructional practices. *American Educational Research Journal, 4*6(2), 532-566. https://doi.org/10.3102/0002831208328088.

Pettit, S. (2011). Teachers' beliefs about english language learners in the mainstream classroom: A review of the literature. *International Multilingual Research Journal, 5*(2), 123–147.

Pianta, R., Hamre, B., Downer, J., Burchinal, M., Williford, A.,m LoCasale-Crouch, J. & Scott-Little, C (2017). Early childhood professional development: Coaching and coursework effects on indictors of children's school readiness. *Early Education and Development, 28*(8), 956-975. https://doi.org/10.1080/10409289.2017.1319783.

Poekert, P. E. (2012). Teacher leadership and professional development: Examining links between two concepts central to school improvement. *Professional Development in Education, 38*(2), 169–188. https://doi.org/10.1080/19415257.2012.657824

Richmond, G. and Manokore, V. (2011). Identifying elements critical for functional and sustainable professional learning communities. *Science Education, 95*(3), 543-570.

*Rosli, R., & Aliwee, M. F. (2021). Professional development of mathematics teacher: A systematic literature review. *Contemporary Educational Researches Journal, 11*(2), 81-92. https://doi.org/10.18844/cerj.v11i2.5415

*Santagata, R., König, J., Scheiner, T., Nguyen, H., Adleff, A. K., Yang, X., & Kaiser, G. (2021). Mathematics teacher learning to notice: A systematic review of studies of video-based programs. *ZDM–Mathematics Education, 53*(1), 119-134.

*Schachter, R.E. (2015). An analytic study of the professional development research in early childhood education. *Early Education and Development, 26*(8), 1057-1085, https://doi.org/10.1080/10409289.2015.1009335

*Scott, C. E., McTigue, E. M., Miller, D. M., & Washburn, E. K. (2018). The what, when, and how of preservice teachers and literacy across the disciplines: A systematic literature review of nearly 50 years of research. *Teaching & Teacher Education, 73,* 1–13.

Sebastian, J., Allensworth, E., & Huang, H. (2016). The role of teacher leadership in how principals influence classroom instruction and student learning. *American Journal of Education*, *123*(1), 69-108. https://doi-org.dcu.idm.oclc.org/10.1086/688169

Shulman, L.S. (1986). Those Who Understand: Knowledge Growth in Teaching. *Education Researcher, 15*(2), 4-14.

Shulman, L.S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57,* (1).

Sigvardsson, A. (2017). Teaching poetry reading in secondary education: Findings from a systematic literature review. *Scandinavian Journal of Educational Research, 61*(5), 584-599.

*Stahnke, R., Schueler, S., & Roesken-Winter, B. (2016). Teachers' perception, interpretation, and decision-making: A systematic review of empirical mathematics education research. *ZDM: The International Journal on Mathematics Education, 48*(1–2), 1–27.

Spillane, J. P., Healey, K., Parise, L.M., & Kenney, A. (2011). A Distributed perspective on learning leadership. In: J. Robertson and H.S. Timperley. Leadership and Learning. Sage Publications (pp. 164-176).

*Surrette, T. N., & Johnson, C. C. (2015). Assessing the ability of an online environment to facilitate the critical features of teacher professional development. *School Science and Mathematics, 11*5(6), 260–270. https://doi.org/10.1111/ssm.12132

Talbert, J. (2010). Professional learning communities at the crossroads: How systems hinder or engender change. In A. Hargreaves, A. Lieberman, M. Fullan & D. Hopkins (Eds.). *The Second International Handbook of Educational Change* (p.555-571). Springer.

The Teaching Council. (2011). *Policy on the continuum of teacher education*. The Teaching Council.

Timperley, H., Wilson, A., Barrar, H., & Fung, I. (2007). *Teacher professional learning and development. Best evidence synthesis iteration (BES)*. https://www.educationcounts.govt.nz/__data/assets/pdf_file/0017/16901/TPLandDBESentireWeb.pdf

Yigit, M. (2014). A review of the literature: How pre-service mathematics teachers develop their technological, pedagogical, and content knowledge. *International Journal of Education in Mathematics, Science and Technology, 2*(1), 26–35.

Author Bios

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Marlene McCormack *is the current Chair of the Bachelor of Early Childhood Education Programme in DCU, Senior Fellow of Advance HE (SFHEA) and the Vice Chair of Plé, The Irish Association of Academics in Early Childhood Education and Care in Higher Education. She has worked extensively in practice, as educator, manager and Director in both the community and private sectors. Marlene has a long history in the Voluntary Sector, leading a multi-professional team with responsibility for research, policy and communications. Much of her work continues to focus on advocacy for children and for the educators that work with them. Marlene is an Assistant Professor in Early Childhood Education and her current research interests are in the areas of professional placement, mentoring, pedagogical documentation and play*

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Miriam Ryan *is an Assistant Professor in Mathematics Education, School of STEM Education, Innovation & Global Studies, DCU Institute of Education, Dublin City University. Miriam has an expertise in designing robust mathematical assessment tasks through working on the Prisons Assessment Project. She is experienced in devising high-quality, authentic mathematical problems through co-authoring Scope, 2011 – 2019. Miriam also has experience of working in collaboration with primary teachers to design and facilitate self-directed professional development. Her doctoral thesis will examine the role of the immersion teacher in supporting high quality bilingual mathematical practices.*

Appendix A: Search Strategy

Broad Research Question

What systematic reviews or meta-analyses have been conducted that are relevant to the area of professional development and learning for leaders in specific contexts and disciplines (literacy including Gaeilge, digital literacy and numeracy?

Key Search Terms in relation to the Broad Research Question

In searching for relevant systematic reviews, meta-analyses and other literature to answer the research question, three databases (EBSCO Education Research Complete, EBSCO ERIC, Scopus) were searched using the key terms and strategy detailed below. 'Grey' literature was identified through hand searches via Google Scholar.

S1. DE "CAREER development" OR DE "PROFESSIONAL education" OR DE "TEACHER development" OR DE "CONTINUING education" OR DE "Professional development"

S2. "Teacher development" or "continu* education" or "career development" or "professional education" or "teacher professional learning" or "continu* professional development in education" or "continuing education" or "teacher learning" or "in-service training" or "teacher training" or "teacher education" or "early childhood educator professional development" or "early childhood educator professional learning" or "pre-school educator professional development" or "leadership in professional development" or "leading professional development" or "leading professional learning" or "leadership training" or "teacher leader*" or "principal leader*"

S3. S1 OR S2

S4. S3 AND TI ("systematic review" or "meta-analysis" or "systematic literature review" or "systematic research review" or "meta-review" or "international review" or "research synthesis" or "best evidence" or "review of the literature")

S5. S3 AND AB ("systematic review" or "meta-analysis" or "systematic literature review" or "systematic research review" or "meta-review" or "international review" or "research synthesis" or "best evidence" or "review of the literature")

S6. S4 OR S5

S7. S6 NOT ("medical" or "medicine" or "health" or "science" or "patient" or "healthcare" or "sport" or "financ*" or "distance education" or "physical education" or "psychology training" or "social work")

S8. S7 AND AB (“literacy” or “reading” or “reading skills” or “literacy skills” or “writing” or “writing skills” or “dialogue skills” or “oracy” or “oral language” or “language” or “language development” or “early communication” or “early literacy” or “emergent literacy” or “literacy development” or “emergent literacy” or “digital literacy” or “new literacies” or “multiliteracies” or “digital literacies” or “computer literacy” or “digital play” or ”Irish” or “Gaeilge”)

S9. S7 AND AB (“emergent math*” or “early numeracy” or “early math*” or “numeracy” or “math*” or “math* education” or “computation” or “number sense” or “pattern” or “problem solving” or “data literacy” or “computational thinking” or “STEAM” or “STEM”)

S10. S8 OR S9

Exclusion Criteria

Date limit 2011 onwards, limited to ‘peer review’ and limited to English language where necessary. As indicated in the PRISMA diagram (Figure 1) an initial search yielded 336 articles when duplicates were removed. The exclusion criteria that were applied to the screening of the Title and Abstract of articles were the following: pre-2011, not systematic review or meta-analysis, not applicable if solely focusing on higher education.

PRISMA Chart

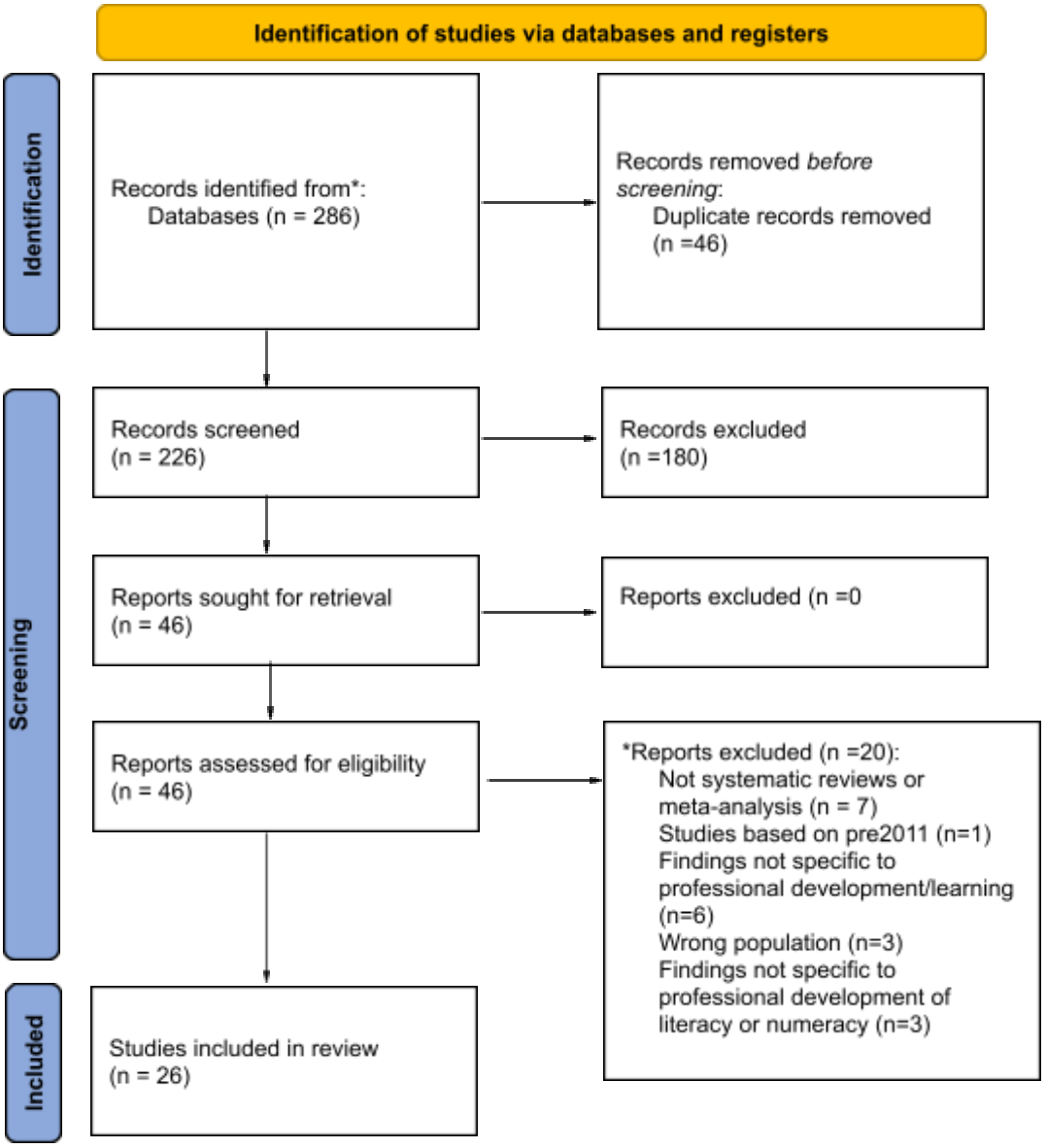

Figure 1. PRISMA diagram summarising the review process

Appendix B: Tabulation of Findings

Author(s)/Date	Title of Review	No. of Studies	Age Range/Educational Setting	Effect Size	Relevant Themes/Ideas	Discipline and/or Context	Key Findings
Ansyari, M. F., Groot, W., & De Witte, K. (2020).	Tracking the process of data use professional development interventions for instructional improvement: A systematic literature review.	17 (2009-2019)	Primary& Post Primary	not reported	Use of data/assessment to inform practice; Investigated the effects of professional developments interventions on teacher and student outcomes"	Teachers' data literacy	Data literacy as a teacher professional outcome plays a significant role in using data for instructional improvement.
Ausiku, M., & Matthee, M. (2021).	Preparing Primary School Teachers for Teaching Computational Thinking: A Systematic Review	30 (2014-2020)	Primary and prospective primary teachers	not reported	Primary teachers development to teach computational thinking.	Primary teachers' practices in teaching computational thinking	Computational thinking (CT)is a valuable higher order skill connected but not confined to computer studies. There is an acknowledged gap in preparing primary teachers to address CT in primary schools. Programming (generally in scratch) is generally the most common approach followed by robotics. The use of 'unplugged' activities is advocated. To support teachers, most studies introduced modules within teacher-education curriculum or a professional development course for in-service teachers.
Basma, B., & Savage, R. (2018).	Teacher Professional Development and Student Literacy Growth: a Systematic Review and Meta-analysis.	17	Elementary School	g = 0.225 moderated by no. of hours. Fewer than 30 hrs was significant (g = 0.367, p less than 0.001). More than 30 hours was not	Impact of PD. Does it play a 'cascading causal role' in changing teachers' actions which in turn changes learning outcomes; Reflection and coaching/mentoring	Reading achievement - Literacy	Data based on the literature, as it currently stands, clearly do not support the claim that teacher PD with more than 30 hours results in positive literacy achievement in students' (p. 468). High quality studies were almost always those with shorter PD hours. PD length as a moderator could suggest that both PD length and PD quality are significant factors of student reading achievement. It is impossible to tell whether shorter PD are actually more effective (potentially due to their more limited focus) or whether the shorter studies are merely easier to execute. Longer PD, focussing on complex areas like comprehension may arguably take longer to bear fruits. However, it is heartening to note that shorter, well designed, well executed PD interventions can have small but

				significant (g = 0.143, p less than 0.5)			reasonably robust measurable effects of student literacy outcomes. The type of PD approach appears to have promise in impacting students reading outcomes. Studies that focussed on teachers reflecting on their practice rather than traditional workshops produced the highest effect sizes. Coaching models were also reported to be high quality on the WOE (weight of evidence) measure and used shorter PD hours. Thus, there may be a connection between PD approaches, PD hours and the quality of the study. Though there is insufficient evidence to draw strong empirically based conclusions
Blitz, C. L. (2013).	Can Online Learning Communities Achieve the Goals of Traditional Professional Learning Communities? What the Literature Says. Summary. REL 2013-003	74	K-12 Educators / teachers in PLCs from multip type schools	not reported	Online learning communities	Math or science; Language arts; Social studies	Indicates that effective PLCs will have a positive impact on participating teachers, contribute to productive team collaboration, and improve student achievement through collaboration and teachers' professional development. As noted, however, the literature is mute on the impact of online PLCs on student achievement and largely silent on the impact of collaborative teamwork. Challenges include lower motivation to engage initially and this is possibly due to isolation. Creating opportunities for members to socialize is important for identification and community building, and the literature suggests that hybrid PLCs may be better suited for fostering community.
Bruns, J., Gasteiger, H., & Strahl, C. (2021).	Conceptualising and measuring domain-specific content knowledge of early childhood educators: A systematic review	36	Study as it relates to those educators working with children birth-6 years.	not reported	Content knowledge - domain specific knowledge (literacy, mathematics or science) and pedagogical content knowledge (how to teach)	General domain learning	content knowledge in early childhood settings could be defined rather differently than in research related to primary or secondary, as the central tasks and challenges differ. Secondly, the question is raised, is more practice related content knowledge always enough to foster children's competencies successfully? There is a need to explore the measures used to examine content knowledge more closely. Overall, the balance of content knowledge is an issue that needs to be addressed in research and practice.
Brunsek, A., Perlman, M., McMullen, E., Falenchuk,	A meta-analysis and systematic review of the associations between professional development of early	64	Early Childhood Educators	Effect sizes were small, ranging	professional development & academic, social and emotional outcomes for preschool children.	language and literacy	Purpose of the study was to make visible associations between the different foci of PD and children's cognitive, academic, motor, health and social/emotional /behavioral functioning. Findings suggest a significant positive associations were often present for outcomes that were

O., Fletcher, B., Nocita, G., Kamkar, N., & Shah, P. S. (2020).	childhood educators and children's outcomes.			from 0.03 to 0.26.			directly linked to the content arera of the PD program. Results indicate the importance of identifying key outcomes for children and choosing PD programs that specifically target those skills. There were significant associations for programs that included a coaching component. Findings support the integration of coaching in PD programs for educators. In terms of dosage, a greater number of positive associations for longer programs(up to one year). Shorter PD programs may be more effective when the target of the program is a defined set of specific skills. Overall PD opportunities matter.
Ciesielski, E. J. M., & Creaghead, N. A. (2020).	The Effectiveness of Professional Development on the Phonological Awareness Outcomes of Preschool Children: A Systematic Review.	23	Preschool children	not reported	Professional Development /	Phonological awareness / Literacy	PD most effective where * participants are involved in active learning experiences that provided opportunities to adapt the practices to their unique classroom situations; * where PD combined didactic training and active learning such as small-group collaborative work or some form of mentoring; * PD needs to be of sufficient duration and amount , e.g., 20 contact hours over a semester (or 30 +) * PD appeared more effective where there were some sort of follow-up; *mentoring and/or coaching contributed to the effectiveness of PD; * PD more effective if it is consistent with teacher's current knowledge and beliefs as well as school / state policies; * Educators with lower levels of education benefitted more from more prescriptive / scripted PD; * Content focus of the PD is one of the most influential factors in the success of the PD; * Educational programs that were highly structured, providing specific, defined activities including scope, sequence, and wording were more successful; * How the PD was configured is important - shorter trainings on a regular basis, extended formal allows participants time to digest new material and practice new techniques- short training followed by a regular visit; * mentoring alone was not an efficient means of ensuring child outcomes but mentors were effective. There was a lagged effect of coaching
Cremin, T., & Oliver, L. (2017).	Teachers as writers: a systematic review.	22	primary, secondary and preservice teachers in mainstream education	not reported	teacher competencies, beliefs, attitudes and dispositions. Does	Writing (literacy)	Irrespective of phase or experience, teachers of literacy differ in their attitudes towards writing and in the extent to which they view themselves as writers, but tend towards

					developing teachers competence in the subject area influence student outcomes; Developing teachers as writers		negativity. Teachers identities as writers were powerfully affected by early experiences at school and these often informed their subsequent self-identification as 'writer' or 'non writer' (p. 283). Studies that examine initial teacher education and professional development initiatives suggest that focused opportunities to participate in a community of practice, or to write in a range of forms, can 'transform' teachers attitudes, self-esteem and sense of self as a writer. Teachers concepts of writing can also be 'transformed' when they are engaged in sustained writing intensive professional development. There is some evidence to suggest that teachers who perceived themselves as writers offered richer classroom writing experiences and generated increased enjoyment, motivation and tenacity among their students than non-writers (p. 286). Interventions that included attention to teachers' own writing development, and offered regular writing and reflection opportunities, impacted on teachers' projected practice (this was only projected however, and the results weren't followed up on). Teachers own writing experiences and attitudes had strong repercussions for classroom practice. Findings suggest there is a link, but are inconclusive with regard to the impact on students writing of teachers' sense of self as writers and personal writing practices. 'Pre-service and in-service training programmes appear to have important roles to play in developing teachers' conceptions of writing and sense of self as writer.
Didion, L., Toste, J. R., & Filderman, M. J. (2020).	Teacher Professional Development and Student Reading Achievement: A Meta-Analytic Review of the Effects.	28	k-8	g = 0.18, p <.001, 95% CI of (0.09, 0.27)	(a) whole group, defined as large group PD delivered in some form of lecture that may include active and/or collective participation; (b) summer coursework, defined as any workshop or institute delivered during summer months; (c) professional learning communities,	Reading	Results indicate that PD had a significant positive, average effect on student outcomes in reading. Further, there was variation in the effect sizes calculated. It is expected that code-focused instruction would promote comprehension and vocabulary to an extent, but teachers still need more instruction on providing explicit meaning-focused instruction to improve student out- comes. Without direct focus on improving the instructional strategies teachers use to improve reading comprehension (and vocabulary), it is likely that the teachers returned to their traditional practices after PD was complete (p. 55). Research has yet to agree on

					defined as small group PD incorporating reflective dialog with opportunities to participate, action research projects, or teacher work groups; (d) coaching, defined as continual support given by PD staff in small group or 1:1 meetings		the level of intensity needed to change teacher knowledge and instructional practices to produce improved student outcomes. This variation suggests that there are other components of PD affecting student outcomes regardless of intensity.
Elek, C., & Page, J. (2019).	Critical features of effective coaching for early childhood educators: a review of empirical research literature	53	Early Childhood Educators	not reported	Prof. Deve. to support pedagogical practice; Professional development / Coaching	General domain learning	Observation, feedback, goal-setting and reflection are common elements of a successful coaching programme. The amount and content of coaching should be aligned with educators' characteristics, skills and context. Effective coaching should allow educators opportunities to apply new skills and support them to reflect on their practice and set self-directed goals.

Goldsmith, L. T., Doerr, H. M., & Lewis, C. C. (2014).	Mathematics teachers' learning: a conceptual framework and synthesis of research	106 (1985-2008)	Mathematics teachers	Mainly qualitative or mixed-methods studies.	A synthesis of knowledge on practising teachers career-long learning (pre-service teacher were excluded).	Mathematics	Based on Clarke and Hollingsworth (2002), a review of the research found that Learning tends to occur incrementally and iteratively, Intervention impact varies across individuals and contexts, Existing research tends to focus on program effectiveness rather than on teachers' learning. Four recommendations for future efforts to investigate mathematics teachers' learning; Develop common, rigorous reporting practices; Develop standards for descriptions of professional development programs; Develop shared conceptual frameworks, constructs, and measures; & Support varied types of studies.
Hoogland, I., Schildkamp, K., van der Kleij, F., Heitink, M., Kippers, W., Veldkamp, B., & Dijkstra, A. M. (2016).	Prerequisites for data-based decision making in the classroom: Research evidence and practical illustrations.	29 (1999-2014)	Primary & Secondary teachers	An interrater agreement level of >0.80 and a Cohen's Kappa of 0.62. interrater agreement of 0.78 (Cohen's Kappa = 0.77)	Use of data from formative assessment to inform practice; Data literacy	General domain learning	Professional development as a requirement for implementation of data-based decision making to improve student learning. can take place at the school, classroom and student level. The results of this study show that professional development related to data use is urgently needed. DBDM requires (new) knowledge and skills, ranging from data literacy to PCK. This study suggests that professional development should focus on both teachers and school leaders, should focus on data literacy related to PCK, should pay attention to the teachers' attitude, and should involve collaboration around the use of assessment data'.

Huang, R., & Shimizu, Y. (2016).	Improving teaching, developing teachers and teacher educators, and linking theory and practice through lesson study in mathematics: an international perspective.	Lit review rather than meta -analysis 52 articles reviewed	Mathematics teachers	not reported	Lesson study as CPD for Maths ed	Mathematics	Benefits of implementing lesson study into four categories: teacher collaboration and development of a professional learning community, development of professional knowledge, practice and professionalism, more explicit focus on pupil learning, and improved quality of classroom teaching and learning. By focusing on LS with in-service mathematics teachers, it is highlighted that teacher learning, improving teaching and student learning, implementing curriculum, sharing instructional products, and the dynamic between theory and practice.
Kalinowski, E., Egert, F., Gronostaj, A., & Vock, M. (2020).	Effective Professional Development for Teachers to Foster Students' Academic Language Proficiency across the Curriculum: A Systematic Review	38 (2002-2015)	Kindergarten/primary teachers	not reported	Professional Development / Coaching / supporting students academic language	General domain learning	Forms of PD likely to affect teachers and students are long-term and intensive forms that include multiple learning opportunities aimed at elaborating and practicing newly learned knowledge and strategies, provide practical assistance, enable and encourage teachers to work together, and consider teachers' needs as well as students' learning process and home languages. Effective PD requires comprehensive preparation as well as structures and resources that allow for the integration of multifaceted and complex professional learning processes into teachers' working lives.
Kraft, M. A., Blazar, D., & Hogan, D. (2018).	The Effect of Teacher Coaching on Instruction and Achievement: A Meta-Analysis of the Causal Evidence	60	Prekindergarten and elementary school	not reported	Coaching	General domain learning	Large positive effects on instruction and smaller positive effects on achievement, highlighting the need to build apable coaches whose expertise is well matched to the diverse needs of teachers in a school or district. Web-based virtual coaching might provide one model for addressing the need for high-quality coaches amid resource constraints. Another challenge is the need for teacher buy-in when considering scaling -up coaching programs. Improving the teacher workforce will require continued innovation in in-service PD programs. Questions remain whether coaching is best implemented as a smaller scale targeted program tailored to local contexts or if it can be taken to scale in a high-quality and cost-effective way.
Kutsyuruba, B., Godden, L., &	The Effect of Contextual Factors on School Leaders'	113	early career teachers	not reported	Leadership/Mentoring	General domain learning	Contextual factors, such as culture, political systems, social practices and organisational structures influence the early career teaching and describe the implications of these

Walker, K. (2020).	Involvement in Early-Career Teacher Mentoring: A Review of the International Research Literature						contextual factors for school leaders' involvement in mentoring programs. Literature reveals 5 categories of contextual factors in mentoring, social; political; cultural; personal/individual; organisational. Findings included: Social context - ECTS valued social peer relationships and supports, formal and informal mentoring relationships and 'just-in-time' assistance. Political - ECTS were affected by micropolitics related to resources, workload and relationship issues. Cultural context - Research studies highlight the need for the culture of mentorship and the key role of mentors in creating such culture for ECTs at the institutional level. A positive correlation was found between school climate and teachers' retention decisions. Personal/individual context - studies found that personal efficacy, confidence, and competence of novice teachers increased when mentors and experienced colleagues validated and respected their decisions. Mentoring support - literature revealed that the Principal played a more in supporting ECTS through the set up of mentoring structures, time for mentoring, resources for mentoring, places and spaces for mentoring
Lammert, C. (2020).	Becoming Inquirers: A Review of Research on Inquiry Methods in Literacy Preservice Teacher Preparation	55	Predominantly ITE for primary school but some studies of early childhood and secondary sectors also	not reported	Inquiry	literacy, disciplinary literacy and multimodality	Reflects on the compartmentalisation of literacy learning in primary schools and excavates the need for deep disciplinary literacy learning focussed on inquiry. The importance of students experiencing inquiry, so that they will be able to enact it, is underscored. Field experiences, and time spent planning for and engaging with young people through inquiry were seen as particularly important. These challenge students' dominent beliefs about teaching and learning. Inquiry which linked literacy with artistic endeavours were seen to be particularly effective at promoting social justice. Engaging in inquiry also challenged student teachers perceptions of their students. In 36 studies, teacher educators used inquiry as a practice to support preservice teachers' thinking and reflection about their own schooling experiences, the community, their future career as teachers, and what constitutes literacy (p. 204). Preservice teachers reported several different challenges, ranging from

							procedural to conceptual, as they engaged in the inquiry process.
Markussen-Brown, J., Juhl, C. B., Piasta, S. B., Bleses, D., Højen, A., & Justice, L. M. (2017).	The effects of language- and literacy-focused professional development on early educators and children: A best-evidence meta-analysis	25	Early Childhood	not reported	Effectiveness of PD on pedagogical approaches in suport language and emergent literacy. IMpact of PD on educator knowledge	Language and literacy	The study focused on the impacts of language and literacy focused PD within the early childhood context. Overall results indicate that current offerings of language and literacy-focused PD increase process and structural quality but do not improve educator knowledge. Coaching was associated with larger effects for both structural and process quality. In general, intensity, duration and the number of PD components were all positively related to educator outcomes. The number of components in the PD was significantly associated with process quality.
McMaster, K. L., Baker, K., Donegan, R., Hugh, M., & Sargent, K. (2020).	Professional Development to Supportâ€™ Implementation of Intensive Reading Intervention: A Systematic Review	26	Primary School	not reported	Effectiveness of PD for Intensive	Reading Instruction programmes /SEN	Draws on Desimone's (2009) seminal distinction of the key features of effective professional development. Sessions typically focused on phonics, word reading and fluency and took place 4-5 times a week at an average of 39 mins. PD was typically (n=20) 1 or 2 day workshops. Others had a combination of pedagogies. Most included an element of coaching and mentoring. or ongoing coaching; n = 20) and active learning (n = 16). Perhaps because many studies focused on evaluating the efficacy of interventions, little information was included on the PD practices used to train implementers (p. 7). Most studies (n = 20) included an initial workshop that was usually led by a researcher and typically lasted 1 to 2 days. Some studies (n = 14) included follow-up support beyond the initial training; however, few details about this additional support were provided. Only a few studies (n = 9) focused primarily on the effects of PD on implementation of intensive intervention, which may explain the detailed descriptions of PD as compared with studies testing intervention efficacy. This lack of detail makes it difficult to draw conclusions about what makes PD effective for intensive intervention implementation (p. 8). While most studies included ongoing and active learning, it is less clear whether PD included coherence, content focus, or opportunities for collective participation.

Meeks, L., Stephenson, J., Kemp, C., & Madelaine, A. (2016).	How well prepared are pre-service teachers to teach early reading? A systematic review of the literature.	13	preservice early childhood educators and primary school educators	not reported	Teacher knowledge	Early reading	Few PSTs had explicit knowledge of phonics terminology, phonics instruction and English language structure. In terms of both preparedness to teach and knowledge of early literacy instruction preservice teachers were generally found to be strong in some areas, but overall underdeveloped and insufficient (p. 86). Most PSTs had a positive attitude to including explicit code instruction/phonics in beginning reading K-2, and were less supportive of meaning-based instruction in these early years. It was surprising to find that many PSTs demonstrated limited knowledge of literacy termi-nology and limited skills in applying that knowledge in practice. Many teacher education courses do not appear to include scientifically-based reading research in their programs, resulting in beginning teachers having limited knowledge of both the content of early literacy and of the explicit, systematic pedagogy that supports student learning instruction is critical for student success throughout schooling, it must follow that explicit and systematic instruction in the provision of these foundational skills is also critical for primary and early childhood PSTs.
Rosli 2021	Professional Development of Mathematics Teacher: A Systematic Literature Review	40	mathematics teachers' setting not specified but I'm inferring secondary	not reported	Seeks to analyse Mathematics PD programmes and identify factors for effective mathematics PD,	Mathematics teachers PD	It was noted that teacher motivations, attitude, commitment and self-efficacy were required for successful PD, again this was not connected to the disciple in the analysis or discussion.
Santagata, R., König, J., Scheiner, T., Nguyen, H., Adleff, A. K., Yang, X., & Kaiser, G. (2021).	Mathematics teacher learning to notice: A systematic review of studies of video-based programs.	35	25 articles involved pre-service, eight in-service, and two both preservice and in-service teachers	not reported	the development of noticing competencies and the use of video	Mathematics	the benefits of using video as a tool, particularly for anchoring discussions of teaching and learning around specific evidence. Viewing frameworks offer essential guidance, and the nature of the prompts matters and is consequential for teacher learning. Video allows for rich discussions and for supporting the development of an appreciation for the complexity of ambitious mathematics instruction. Evidence of program effects on responding and decision making, and on instructional practice, is limited and should be extended in the future. Video software was rarely used, video annotation features were seldom utilized, and the potential of technology for supporting the development

							and for studying mathematics teacher noticing was under-examined
Schachter, R.E. (2015).	An Analytic Study of the Professional Development Research in Early Childhood Education.	73	early childhood educators of children 0-5	not reported	the design, delivery, and measurement of the effects of professional development on educators skills, knowledge and dispositions	n = 39) targeted some form of language and literacy instruction, whereas only 5 studies targeted math	There are 4 major ways in which PD for early childhood educators can be developed. Researchers and providers of PD should (a) continue to draw from multiple resources to inform PD implementation designs, (b) include more diversity in the content of instruction targeted by PD, (c) experiment with innovative formats for delivering PD, and (d) create better means of evaluating PD.
Scott, C. E., McTigue, E. M., Miller, D. M., & Washburn, E. K. (2018).	The what, when, and how of preservice teachers and literacy across the disciplines: A systematic literature review of nearly 50 years of research.	53 (1969-2017)	Preservice teachers	not reported	Literacy instruction as embedded within other disciplines. Teacher education should focus on developing literacy through particular disciplines	Literacy	When preservice teachers receive instruction through coursework and practicums, their perceptions toward providing literacy instruction in future teaching contexts became more positive. Findings suggested that embedding content-area instruction within the application of tutoring or a field-based class enables preservice teachers to experience positive results while also gaining new knowledge about both themselves and their students.
Stahnke, R., Schueler, S., & Roesken-Winter, B. (2016).	Teachers' Perception, Interpretation, and Decision-Making: A Systematic Review of Empirical Mathematics Education Research	60	pre- to secondary school or in tertiary education. Thus, studies focusing on other subjects (e.g. science, engineering, arts or social studies), on special education or mathematic education for other professions (e.g. medicine) were excluded (in sum 173 articles).	not reported	connecting the cognitive and the situated perspective on teacher knowledge. Critique the cognitive focus on teachers' professional knowledge as disconnected from classrooms, though work on situated perspoctives is often with very small groups or samples	science, engineering, arts or social studies	Teachers' noticing or teachers' professional vision, and teachers' (situated) professional knowledge were found to be the most frequent frameworks. (1) Teachers' expertise and experience positively influence noticing and teachers' noticing can be successfully fostered by (video-based) professional development programs. (2) Pre-service teachers struggle with perceiving and interpreting students' work. Thereby, their mathematical knowledge plays an important role. (3) Teachers' in-the-moment decision-making is influenced by their knowledge, beliefs and goals. (4) Teachers' knowledge and belief facets predict their situation specific-skills which in turn correlate with aspects close to instructional practice. (5) Teachers have difficulties interpreting tasks and identifying their educational potential.

Surrette, T. N., & Johnson, C. C. (2015)	Assessing the Ability of an Online Environment to Facilitate the Critical Features of Teacher Professional Development	20 (2000-2012)	pK–12th grade	not reported	web-based teacher professional development programmes	general domain learning	Online environment as an increasingly popular mechanism to deliver PD to educators but must be able to facilitate the five critical features of PD.