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Professional learning to support digital transformation and change in education: an integrated, systematic literature review

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Abstract

Digital technologies have been identified as critical in facilitating the development of contemporary, inclusive educational systems that support the UN sustainable development goals (ITU, 2023). Internationally governments have developed ambitious polices and competency models to support educators and teachers to develop the relevant knowledge, attitudes and behaviors to critically engage with learners in an educational environment that is extensively impacted by a digital society. Despite the prevalence of digital learning technologies, education has been slow embrace these at a systematic level, with research highlighting the lack of professional learning opportunities to support educators to make change. There is a disconnect between education and society regarding the adoption of digital technology. This paper sought to investigate the research around professional learning and digital transformation over a ten-year period (between 2013 and 2023). It aims to answer the question, what elements of professional learning support educational professionals to facilitate digital transformation and change? It found that professional learning longer than 12 months that had clear goals and incorporated a variety of models was more likely to support educators to transform their contexts.

KEYWORDS: Professional Learning, Digital Transformation, Change.

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1. Introduction

At policy level nationally and international, digital education has been recognised as means to enable governments to meet their educational targets. For example, action 2 of the European Digital Education Action Plan, sets out how digital learning can facilitate flexible forms of learning, leading to a more inclusive educational system (European Commission, 2020). In addition, many national policies also acknowledge the potential for technology to support diverse learning approaches, for example as the Digital strategy for schools in Ireland (Pillar 1, Department of Education 2019). In addition, digital skills have been acknowledged as critical to support sustainability and climate action (Usero, 2022) Digital competence is a critical part of the future educational landscape. This is evident throughout the literature and national policy with surveys indicating the digital competency of teachers facilitates more equitable and inclusive access to digital learning (OECD, 2022).

Despite dialog at policy level, little has changed in terms of digital competence levels. A common theme is that educators lack the professional learning to enable them to teach digital skills (EIT Digital, 2022; OECD, 2020; Montero-Mesa et al, 2023). Many digital competence frameworks are focused on the integration of technology and the associated levels of integration (for example, TPACK and SAMR: Koehler & Mishra 2009; Puentedura, 2006). However, it is not known how to support educators or educational leaders to progress to higher levels of technology integration or leadership competency levels. This research aims to contribute to this gap in the literature by seeking to understand the characteristics of professional learning that can support educators and educational leaders to progress to higher levels of technology integration in their practice. It also considers how these characteristics can support the

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progression to leadership competency levels and facilitate systematic change. A shift to digital learning requires a change in identity, mindset as well as practice/role and so professional learning needs to encourage educators to consider the societal, professional, technological and cultural context of change as well as the broad learning environment both formal and informal and how it influences students. In addition, professional learning needs to enable educators to keep pace with change that is ever increasing today. This requires educational institutes to engage in collaborative professional learning beyond their immediate context to keep informed of such change. Therefore, digital competence frameworks need to consider what professional learning characteristics support teachers to make the required changes to practice, who they need to collaborate with and how.

Teacher Professional Learning (TPL) has been widely studied in the literature not only at school level but also within the Early Learning and Care (ELC) context and higher education. Several studies have also systematically explored the impact of professional learning on digital competence, with others considering the role of professional learning (PL) on student and teacher outcomes.

Regarding student outcomes research has illustrated that professional learning supports more inclusive education (Poekert et al 2022). However other systematic literature reviews demonstrated it was difficult to measure student outcome as it was so varied and due to the lack of measurable instruments (Ventista & Brown, 2023). This aligns to a more recent systematic study that explored to how professional learning was evaluated and found lack of rigorous and reliable approaches to measuring impact (Ahadi et al, 2024).

Systematic approaches that explore the impact of the data used from PL on teacher outcomes found that it can change teachers attitudes and beliefs and instructional change (Ansyari et al, 2020). However, it did not consider the characteristics of professional learning that supported this. Other studies looked at the role of professional learning and social capital and found that it increased the teacher's network and access to knowledge (Demir, 2021). Considering online professional learning and teacher outcomes, Bragg et al. (2021) conducted an SLR of 11 papers they found that online professional learning largely improved teachers content knowledge and their instructional practice. However, the elements of the professional learning that supported such was not examined.

Regarding the characteristics of successful PL that supports to digital competence or change, one systematic review was identified that explored the characteristics of studies around professional learning and educational technology as well as the role of the academic in the context of educational technology, however this was in a Higher education (HE) context. It was highlighted that within HE, academics in professional learning have different guises such as a learner, designer, and a researcher, and these are reflected in PL (Lindolf & Pasco, 2020). In terms of the types of studies most of these were qualitative. Qualitative studies were also prominent in a review of studies in digital competence and professional learning (Fernades et al., 2022).

Another characteristic explored was that of the length of professional learning, which was examined in an ELC context, it identified that found short term PL had very little impact on practice (Machado & Oliveira, 2024).

Most systematic approaches to examining the research and literature are concerned with professional learning and impact broadly and do not specifically examine the elements of professional learning that support educational change. Although educational change has been widely studied in the literature, theories of change highlight the need for contextual consideration, individual negotiation, incremental pace, and continued support to enable individuals reflect on beliefs and attitudes as well as time for practical experimentation (Ajzen, 1991; Hall, 1998; Clarke & Hollingworth, 2002). However, the language used to describe technological change centers around fast, constant and radical transformation which contradicts such theories. Little research has been conducted in professional learning that supports digital transformation and change. Despite the widespread availability of digital competence frameworks and dialog at national and international level there is no common understanding of how to support change in the context of digital learning.

This research aims to consolidate existing studies in professional learning and change to identify the elements of professional learning that support change and digital transformation. This research will provide guide the development of professional learning activities to support the implementation of digital competency model. It is expected that it will facilitate teachers on the journey of PL and how to leverage from professional learning to support teachers to evolve as digital leaders.

2. Methodology

2.1 Purpose and scope of the research

Significant research has already been conducted on professional learning within the teaching profession, therefore, it is important to consolidate and build on this in the context of supporting transformation. In addition, research has also been conducted on digital transformation, however the majority of such is in the private sector. There are several successful frameworks adopted with regards to supporting technology integration in education such as digital competency frameworks (DigCompEdu and many more), TPACK and SAMR models, and how they have been used to support professional learning. However, it is not clear what professional learning activities support change Therefore it was decided to adopt a systematic approach

to understand the professional learning elements favorable to digital transformation and change.

The purpose of this research is to determine:

RQ: What elements of professional learning that support educational professionals in digital transformation and change?

Much of educational research is qualitative as a result it was decided to include studies that describe the professional learning model and how the professional learning has change practiced. Therefore, the studies included were:

- Quantitative studies quasi experimental, observational analytic studies, and longitudinal studies
- Qualitative studies qualitative design, case study design, ethnography, phenomenology, narrative analysis (grounded theory will not be included, unless it has undergone a quant study) and longitudinal studies

2.2 Search strategies

Databases in education and business were both included in the search strategy. This is because digital transformation has not been widely researched in the education context and professional learning models in other contexts with a view to supporting change may be used to inform educational models. Also, it was decided to include professionals in the search terms to enable the team to leverage from practices in other contexts. In Table 1 is an overview of the search strategy.

Table 1 - Search strategies.

Databases
Academic Search Complete Business Source Complete Education source ERIC EBSCO ProQuest
Search Strings and Filters
(Professional* OR “Teachers” OR “Educators” OR “Teaching” OR “Training” OR “Trainers”) AND (“informal learning” OR “formal learning” OR “Teacher education” OR “Teacher Pedagogy” OR “Teacher Training”) AND (“Digital” OR “Technology” OR “Technological”) AND (“Change” OR “Innovation”)) (Professional* OR “Teachers” OR “Educators” OR “Teaching” OR “Training” OR “Trainers”) AND (“Professional Development” OR “Professional learning” OR “continuous professional development” OR “continuing professional development” OR “learning and performance” OR “Training and development” OR “learning and development”) AND (“Digital” OR “Technology” OR “Technological”) AND (“Change” OR “Innovation”)) Filters: Peer Reviewed, Full Text, Academic Journal articles, English Language, Year 2013-2023

2.3 Screening

The team screened, analyzed and reported through four phases, identification, abstract screening and full screen, data extraction.

In total four databases were searched Academic Search Complete; Business Source Complete; Education source; ERIC; EBSCO using the search terms outlined in section X.X. A total of 1, 971 articles were found. Of these 37 were duplicates. The remaining 1, 934 went through an initial screening of titles and abstracts using the screening criteria in Table 2.

In this process (Figure 1) 1491 articles were excluded, and 443 articles were fully screened. From the full screening stage (In which full articles were reviewed using the screening criteria) 265 articles were excluded. In total 178 articles were analysed for the integrated literature review and were part of the extraction stage.

Within the screening process below is an overview of the inclusion and exclusion criteria applied. It was important that professional learning models and their impact on change was evident in the research. Furthermore, given the context of change and the nature of educational research it was critical that qualitative studies that described models and approaches and the associated impact were included in addition to quantitative studies.

2.3 Data extraction

Following screening data was extracted for each article using the Table 3 below. This provided an overview of the characteristics of the research, a critical analysis of the research and the characteristics of the professional learning and associated impact.

The reason for extracting the pedagogical pathway was to determine the proficiency level that the participants attain through engaging in professional learning. This is based on existing proficiency levels identified in competence frameworks such as DigCompEdu as well as other models of levels of technology integration.

Regarding competency frameworks, DigCompEdu (Punie & Redecker, 2017) uses 6 levels of proficiency: Newcomer (A1); Explorer (A2); Integrator (B1); Expert (B2); Leader (C1); Pioneer (C2). Whereas UNESCO use three levels knowledge awareness, knowledge deepening and knowledge creation (UNESCO, 2018).

Many of these proficiency levels map to phases of technology integration such as that outlined by (Christensen et al, 2001); Stage 1 Awareness, Stage 2 Learning the process, Stage 3 Understanding and application of the process, Stage 4 Familiarity and confidence, Stage 5 Adaptation to other contexts, Stage 6 Creative application to new contexts. The SAMR model- Substitution, Augmentation, Modification and Redefinition (Puentedura, 2006). Both of which end with redefining and remodeling learning through technology.

Table 2 - Screening criteria.

Inclusion	Exclusion
Terms: IMPACT/EFFECT study explores impact/effect of professional development models in a rigorous manner. -There are details about advancement during professional development? There are elements of explanation of the impact and change. - Context and socio-technical environment is considered There is an empirical evaluation of the professional learning	**Rigor** Recommendations or discussions are not evidence based **Rigor:** Not a peer reviewed journal article **Terms:** Study Does not measure impact/effect of the proposed intervention in a rigorous manner.
Terms: MODE/CHARACTERISTICS of professional learning studies At least one of them: - The type of Professional Learning - The characteristics of the Professional Learning - A description of the Professional Learning environnent - The means / tools used (type of platform, media or other)	**Terms:** Study does not include details of the characteristics of professional learning
Sample type: All professionals	**Sample type:** students that are in higher education or schools
Qualitative studies - Sample size: Above 2 - Type of study: qualitative, phenomenology, case study, ethnography, narrative and longitudinal - Year: post 2013 - Rigour: Studies that address validity and reliability in particular bias that may impact the study	**Qualitative studies** - Sample size: 2 minimum - Type of study: Grounded Theory that has not been tested in other studies - Year: pre 2013
Quantitative studies - Sample size: Above 200 - Type of study: experimental, quasi experimental, observational analytic studies, and longitudinal studies - Year post 2013 - Rigour: Studies that address validity and reliability through statistical measures	**Quantitative studies** - Sample size: below 200 - Type of study: experimental - Year: pre2013

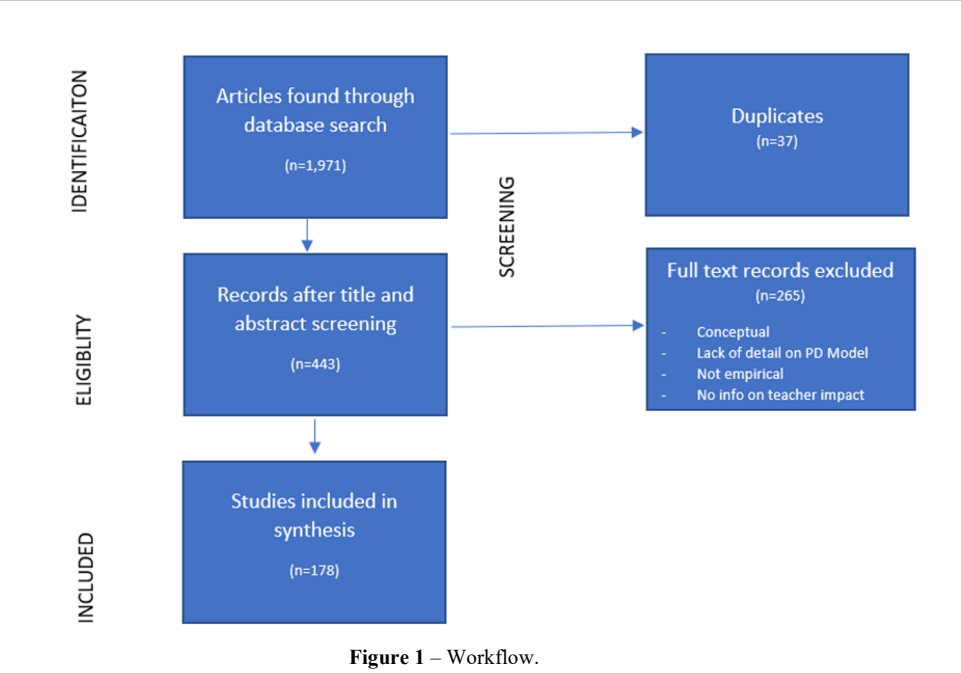

Figure 1 – Workflow.

Table 3 - Data extraction table.

Theme	Data extracted
Type of study	
Country	
Sector	
Level of education	
Duration of Professional learning	
Strengths of research	
Weaknesses of research	
Characteristics of model	
Impact of model	
Enablers to implementation/success	
Pedagogical learning pathway the professional learning model aligns to Knowledge Awareness/Knowledge Deepening/ Leadership	

They also relate to elements outlined within theories regarding models of change such as the stages of concern in the Concerns Based Adoption Model (CBAM), which again an outline six stages ranging from awareness to refining or developing new ideas (Hall & Hord, 2020).

It has been acknowledged in the research that change is complex and often not linear, in addition sometimes people need to be reassured, and information or awareness may need to be provided, thus phases may overlap. (Sansom, 2020; Fullan, 2016). It is important that this is considered within the analysis. Furthermore, apart from DigCompEdu many of these descriptors do not consider the progression to leadership or innovators. To enable overlap between the levels and map profession to leadership it was decided to map existing models to three levels Knowledge Awareness, Knowledge Creation and Leadership.

This amalgamates the proficiency levels in the DigiCompEdu framework, to create consistency between frameworks and allow for broader definitions to remove the concept of linearity. It also considers models such as technology integration levels SAMR. See Table 4 for an overview of these.

3. Findings

3.1 Study characteristics

The number of studies in professional learning and innovation/change/digital transformation has increased exponentially over the past ten years-peaking in 2021. It is important to note that COVID had a significant impact on the number of articles being published in digital leaning and professional learning (Figure 3).

Many studies were US based, followed by international or cross-country studies and thirdly studies in Australia (see Figure 4).

Qualitative studies dominated the literature followed by mixed methods. There was only one experimental study in the articles that were screened (see Table 5). This data is reflective of the discipline of the research which is education or social science based.

Table 4 - Pedagogical Pathways Descriptors for Data extraction.

	Outcome	Extraction criteria
Knowledge awareness	Awareness of the pedagogical and professional potential of digital learning technologies	Evidence of • An understanding of the role of digital learning technologies in education, • Applying professional learning directly • Skills development • Seeking more knowledge, • Sharing experiences.
Knowledge deepening	Engage in critical discourse with stakeholders regarding the selection and application of digital learning. They will discuss with peers, students, and other stakeholders about their experiences with digital learning to date, empathize with these and adapt their practice based on this dialog, observations of their own experimentation and reflection	Evidence of • Reflecting on practice, • increase in self efficacy, • innovating practice at an individual level • Sharing innovative practices • Identifying further opportunities for change.
Leadership	Critical thought leaders Question the adequacy of contemporary digital and pedagogical practices and challenge current systems. Support culture of innovative practice within and beyond their own context	Evidence of • Supporting innovative practice at a whole school, district of sector level • Supporting other teachers to lead change • Collaborating with other stakeholders to make change e.g. students, in other sectors, schools etc • Significant transformation to practice (redefinition of SAMR) e.g. learning environment, role of the teacher etc • Culture change.

Of those articles the average Qualitative study had a sample of 42 with mixed studies having an average sample of 72. As expected, Quantitative studies averaged significantly higher.

Of the studies the majority impacted the participants knowledge deepening level of proficiency in that those that engaged with the professional learning discussed resulted in the ability to adapt learning and apply to their own practice in a collaborative and critical manner through dialog, observations of their own experimentation and reflection (see Table 6: studies by level of proficiency).

Studies that considered the experiences of in-service teachers dominated the research with 71% of papers exploring professional learning for this cohort. Only 33 papers of 178 considered the experiences of preservice teachers (Figure 5).

Those studies that considered pre-service professional learning impacted the knowledge awareness and deepening levels of proficiency with few progressing to the leadership stage (Figure 6).

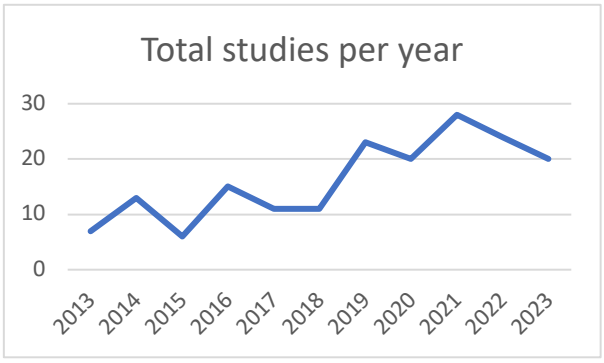

Figure 3 - Studies published by year between 2013-2023.

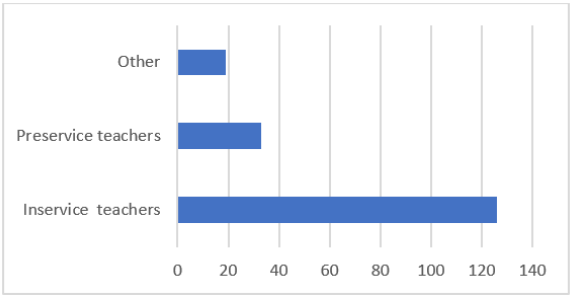

Figure 5 - Papers by research participants.

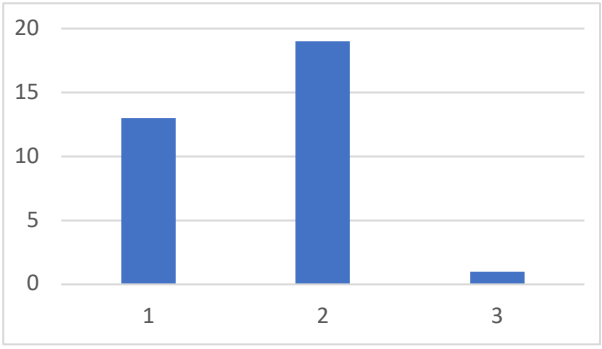

Figure 6 - Studies with pre-service teacher as research participants by level of proficiency.

3.2 Theoretical frameworks

A review of the theoretical frameworks' studies leveraged from was conducted in the analysis. Many of the studies did not have a theoretical frame. Of those that did the majority leveraged from TPACK (Technological, Pedagogical and Content Knowledge), particularly regarding content design and evaluation. In addition, social learning models such as the

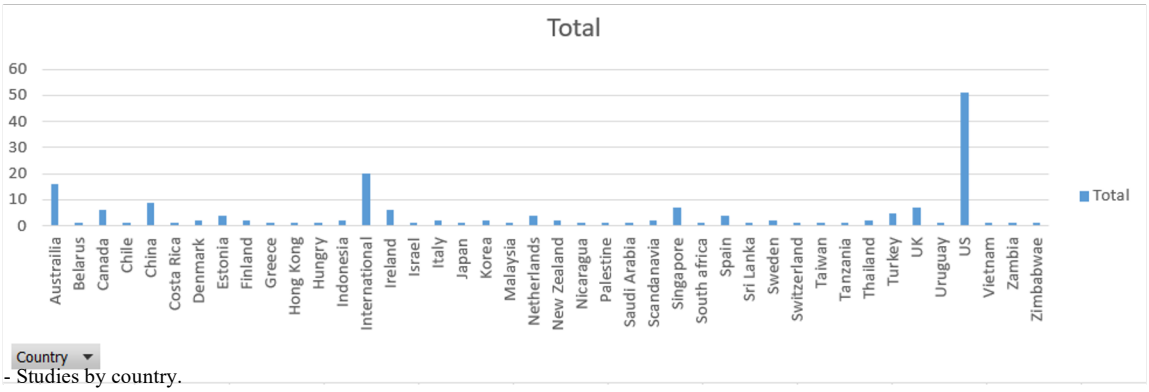

Figure 4 - Studies by country.

Table 5 - Types of study and sample size.

Type of study	*No of publications*	*Average of Sample Size*	*Type of study*	*Number of publications*	*Average of Sample Size*
Experimental	1	4	Qualitative	101	42
Mixed	56	72	Quantitative	20	2428
Total			*178*	*Total Average sample*	*319*

communities of practice, inquiry and learning communities featured quite highly. Theories of change and innovation including the Interconnected model of professional growth and other models for example Rodgers Diffusion of Innovation theory (Rodgers, 2003), mentored innovation model (Kárpáti & Dorner, 2008) teacher centered systematic reform (Gess-Newsome et al., 2003) were also considered within studies. As the studies were about professional learning for change, transformation and impact it is expected that these models would inform many of the studies.

Table 6 - Studies by level of proficiency.

	No of studies	% of studies
Knowledge awareness	60	34%
Knowledge deepening	95	53%
Leadership	23	13%
Total	178	100%

Table 7 - Summary of theoretical frameworks informing the study.

Theoretical frame	*Number of studies*
None	90
TPACK	15
Communities of Practice/Communities of Inquiry/Learning communities	13
Interconnected model of professional growth (IMPG)	6
Change/innovation theories (other than IMPG)	6
Social learning/network theory/networked learning	6
Design based research	5
Schon reflective learning	4
Cognitive apprenticeship, social cognition, social constructivism	4
Learning culture/organisational learning	2
Technology acceptance model	2
Culture context theory	2
Identity formation	2
Other	21
Total	178

3.3 Characteristics of Professional Learning

Regarding the characteristics of professional learning that support change, transformation or impact practice an analysis of studies under the categories of Knowledge Awareness, Knowledge Deepening and Leadership were constructed. An overview of these descriptors used for the analysis is available in Table 8.

One of the characteristics explored was who do teachers collaborate with during their professional learning (Table 9). This varied between those at different levels of competency. For those engaging with learning at the level of knowledge awareness collaboration was within their own organisation or international – note many of the international research was around Massive Open Online Courses (MOOCs) and so this may have been international collaboration driven by individual's interest. In addition, this cohort engaged in more individual learning. In comparison those at the knowledge deepening level of proficiency engaged in more collaborative professional learning across their own organisations, locally or nationally. Finally, those engaging in the leadership proficiency level were more likely to engage in professional learning nationally, with students, industry and other external partners. This aligns to research that highlights those with a greater social network are more likely to innovate (Kim et al., 2021; Cangialosi et al., 2023; Konstantinidou et al., 2022).

Table 8 - Descriptors of criteria for knowledge awareness, deepening and leadership.

Proficiency level	Description
Knowledge awareness	Awareness of the pedagogical and professional potential of digital learning technologies
Knowledge deepening	Engage in critical discourse with stakeholders regarding the selection and application of digital learning. They will discuss with peers, students and other stakeholders about their experiences with digital learning to date, and adapt their practice based dialog and reflection
Leadership	Collaborate with organizations at national and international levels both in education and beyond to develop novel pedagogical and professional practices within education within whole organisations (schools or educational institutes) and across the sector.

Table 9 - Professional learning collaboration by level.

Type of collaboration	*Knowledge awareness*	*Knowledge Deepening*	*Leader ship*
Cross org industry partner; Uni Partner	2%	1%	0%
Cross org local	10%	22%	20%
Cross org national	16%	17%	28%
Cross org national; Industry partner	0%	0%	4%
Cross org national; Student	0%	0%	8%
Cross org National; NI partner	0%	4%	4%
Cross sector	2%	1%	0%
Individual	11%	4%	0%
International	23%	9%	8%
Interprofessional	0%	3%	0%
Within own org	36%	37%	24%
Within own org; Student	0%	1%	4%

The average duration of professional learning across all levels was 11.6 months. When broken into the levels of proficiency, those at the more advanced leadership levels had a longer duration and sustained professional learning experience (Figure 7). Within leadership levels professional learning averages at 19 months compared to an average of 6 months at knowledge awareness levels. This aligns to existing research that advocates for sustained long term professional learning models, as often change happens over time rather than in a transformational manner (Prestridge, 2017; Nespor, 1987, Darling-Hammond, Hyler & Gardner, 2017; Becker & Reil, 2000).

Figure 7 - Average duration of professional learning by level (in months).

The average duration of pre-service training was 6 months. Most professional learning for pre-service teachers is in the form of Initial teacher education within a university course and so often digital learning is 3-month modules. Of the 33 pre-service studies 25 of these were three months or less.

Furthermore, the characteristics or types of learning activities individuals engage with at levels of professional learning varies. Those at the higher levels of proficiency engaged in a larger number of activities in their professional learning; those at the knowledge awareness level engaged in an average of 3.22 activities, knowledge deepening an average of 4.53 and leadership 5.07 activities.

In addition, there was a broader range of learning activities in the deepening level of proficiency compared to the awareness and leadership levels. For Deepening the activities ranged across 39 different types compared to 28 at knowledge awareness and 34 at leadership.

The type of activities had some similarity with formal and reflective based activities being widely used across all three levels of proficiency. Innovation and co design activities were more prevalent at knowledge deepening and leadership levels. With dissemination, piloting, leading professional learning and modelling activities being adopted mainly at leadership levels. This indicates as levels of proficiency increase so does collaboration networks and outward dissemination and knowledge sharing.

Furthermore, it must be noted that there was no specific sequence for these activities, some started with formal learning others initiated professional learning through reflection or collaboration. Bolstering the need for non-linear professional learning activities.

On review of the qualitative comments regarding each study a thematic analysis was conducted (Figure 8). The main impacts of the professional learning were adaptations to practice (36), application to practice (11), increase in self-efficacy (17), understanding the complexity of technology and learning (8), sharing (6). In some instances, it was noted the impact was different depending on the beliefs or broader contextual factors of those engaging in the professional learning indicating that professional learning impact is nuanced and complex (Sansom, 2020).

For much of the formal learning it took place in dedicated blocks either during summertime, weekends or dedicated periods that released educators. Furthermore, professional learning was routine and regular, even though formal learning was in dedicated blocks other activities such as discussion, meetings, reflection took place weekly or monthly. For all levels

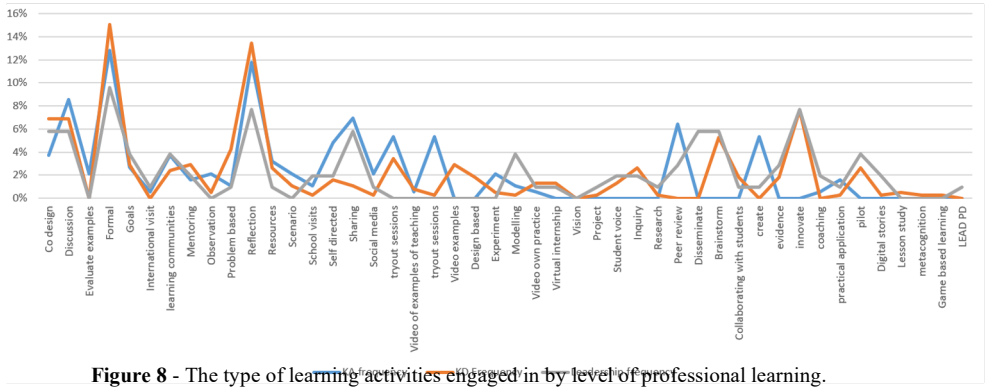

Figure 8 - The type of learning activities engaged in by level of professional learning.

of proficiency participants engaged in several activities. These were mostly prescribed however in some cases participants had a choice of activities they wanted to engage in. This enhanced agency and autonomy, key to this was balancing autonomy and structure as often choice can lead to an additional cognitive load and decision for participants who are already overwhelmed. Critical to this was goal setting or creating a vision for both individual participants and the communities for which they are part of this should be aligned to the digital learning goals of the educational organisation of which they are part of to ensure harmony and consistency as well as opportunities to apply learning in practice (Hubers et al., 2022; Fullan, 2016).

4. Discussion

From the review it is evident that the elements of professional learning that support educational professionals to facilitate digital transformation and change requires sustained, varied activities (that support innovation to practice, dissemination and collaboration with a variety of individuals). Professional learning that was regular and had clear goals supported educators to progress to to higher levels of proficiency and change practice. This correlates to findings associated with existing SLRs that explored challenges associated with educational change and transformation, these highlight importance of clear goals and professional learning to support change. (McLure &Aldrige, 2022; Yuliandari et al., 2023). Furthermore, SLRs that have considered the impact of professional learning on students found that frequent CPD over a sustained period had the most impact on students learning. However, this was largely focused on work-based learning and CPD (Ventista & Brown, 2023).

This research provides additional insight to complement such research by exploring the types of professional learning activities that can support educational change. It found that there are few studies to date that illustrate how professional learning can support leadership levels of proficiency around change. Also, many papers lacked theoretical underpinnings which capture the complexity associated with supporting change. However, the limitations of the SLR must be acknowledged, the review was conducted by an individual researcher as part of a wider project, due to time commitments it did not exploit reliability measures such as inter-reviewer reliability and so may be subject to bias, particularly regarding the interpretation of the proficiency level element of the data extraction phase. Although extraction criteria were applied there is potential for bias regarding interpretation of these.

Based on the findings it is recommended that professional learning supports teachers across a continuum of change, it encourages them to engage in incremental continuous change that is supported over time. Critical is dialog at various levels, it can be seen from the study that collaboration at various levels individual, organizational, cross organizational and interdisciplinary is required. The types of learning activities that support change in the study are indicative of this and requires a variety of professional learning activities that provide support for dialog and experimentation including openness about negative experiences and the wider environment that might influence different outcomes associated with change.

This research aimed to depict the trajectory of the professional learning journal in terms of change and what elements of successful elements of professional learning are conducive to leadership and change in a digital context. It is evident that professional learning needs to relate to an overall goal or vision for an individual, school and educational system, that needs to be negotiated at each of these levels. Policy needs to recognise that professional learning (PL) is multilevel and needs to balance the needs of the individual teacher with that of the school and overall educational change within the system, articulating a long-term vision and the role of PL in supporting the attainment of this is key. A sustained approach to PL that encourages a variety of learning approaches to encourage teachers to experiment in a safe space is critical to change and supporting transformation in a digital context. It is also evident from the review that educational research with regard the use of professional learning to support change is largely qualitative, and lacks experimental data, in our review only one experimental study was found. There were several quantitative studies however many of these were based on self-assessment questionnaires regarding the professional learning. Further experimental studies that compare different professional learning characteristics and their impact on practice is critical.

5. Acknowledgements

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