A Model for A Data-Informed Professional Learning Cycle

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Introduction

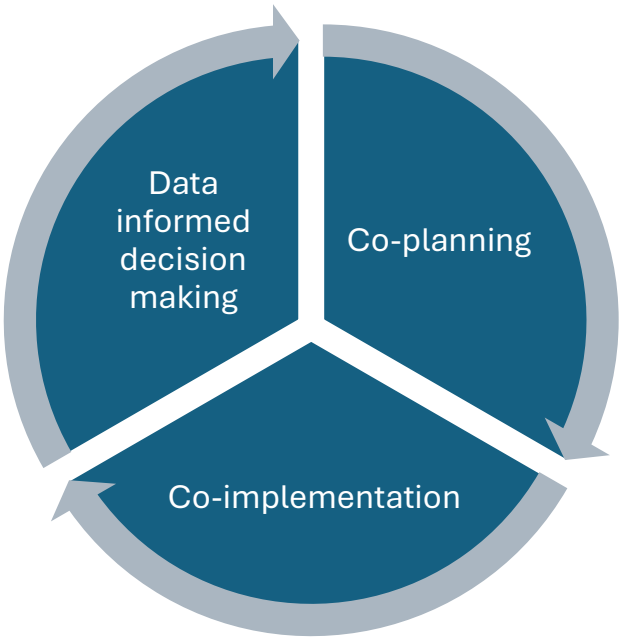
As demands for students to acquire 21st century key competences such as critical thinking, complex problem solving, and effective communication and collaboration increase, so too does the need for teachers to keep learning and constantly improving their teaching practices Darling-Hammond, Hyler, & Gardner (2017). With the assumption that changing teacher practices will bring about positive changes in educational standards Day and Sachs (2004), a key question for policy makers and school leaders in their attempts to promote school improvement and national reforms, therefore, is how to provide professional development opportunities for teachers in ways that enable them to engage in collaborative conversations, experiment with alternative pedagogical practices, and critically reflect on their teaching experience to induce changes in their practice and improvement in students' academic achievements As a result, governments worldwide have invested billions in teacher professional development with the intention to enhance teachers' knowledge and practice Gore & Rosser (2022).

In Australia, teacher professional learning is seen as both a policy problem and policy solution jointly shaped by the interconnected discourses of teacher quality, teacher standards and accountability, and teacher professionalism Mockler (2013). As such, teacher professional learning emerges as a key means through which teacher quality is raised, professional standards are maintained, and teacher professional identity is formed and mediated. The introduction of policy interventions such as the NAPLAN test, the My School website, and the Australian Institute for Teaching and School Leadership (AITSL) has signaled the combination of "regulatory authority over aspects of teacher education, accreditation and accountability with the responsibility for teacher growth and learning" (Mansfield & Thompson, 2016). However,

the use of teacher professional learning to enhance teacher quality has met with the problematic history of school-based professional development characterised as detached, top-down, fragmented, and ineffective Burns Thomas and Niesz, (2012, p. 683). The challenge for teacher professional learning is, therefore, to address problems of authenticity, relevance, practicality, and sustained impact on teacher practice and student learning. in this paper, we propose a model of teacher professional learning that builds upon current understanding of effective teacher professional learning, the substantial body of research on teacher learning and professional practice, and the policy climate of teacher accountability and quality in Australia. We first present an overview of the teacher professional learning landscape, with a particular focus on models of teacher professional learning, elements of effective teacher professional learning, impacts of teacher professional learning on teachers and students, and conditions that enable the functioning of teacher professional learning. Based on this review, we then propose an overarching conceptual model of teacher professional learning that can be tailored to suit the local school contexts and that has potential to enhance teacher quality and student learning in response to the pressure of external accountability systems.

Figure 1

The Data-Informed Professional Learning Cycle



1. Models of teacher professional learning

The proliferation of research on teacher Professional Learning (PL) in recent years is reflected in the introduction of numerous professional learning models with various characteristics, structures, design elements, specific contents, expected outcomes and effects. Due to the context and content-specific nature of these PL models, researchers have attempted to synthesise extant literature to come up with typologies of PL models that help inform teachers, researchers, leaders, and policy makers of the decision-making process regarding what models to choose, what resources to provide, what sort of trade-off to make, and how to evaluate the impacts on teacher and students. In an early attempt to provide a typological account of PL research, Kennedy (2005) proposed a framework that integrated nine PL models: the training model – PL delivered to teachers by an expert with the agenda determined by the expert and teachers taking on a passive role; the award-bearing model – teachers complete award-bearing programs of study validated by universities; the deficit model – PL program offered to address a specific deficit in teacher performance; the cascade model – teachers participate in PL programs and disseminate the information to colleagues; the standards-based model – PL programs designed to help teachers satisfy the standards required by external systems of accountability and quality assurance; the coaching/mentoring model – one-to-one skill-based or professional friendship forms of collaboration between two teachers to support each other; the community of practice model – teacher learning through interactions within a community where collective knowledge is generated; the action research model – teachers understand their classroom and improve teaching practices through their involvement as classroom researchers; and the transformative model – combination of processes and conditions of the other models to support a transformative agenda. Although these models differ in terms of structures, content, and implementations, they can be considered as serving two overarching purposes: preparing teachers to implement reforms (i.e., transmission models) and empowering teachers to contribute to and shape reform policies (transformative models). The former is aligned with the training, award-bearing, and deficit models whereas the latter is aligned with the action research and transformative model. The remaining models are considered transitional models because they enable the transition from a strict adherence to external accountability, standards and performance management to a more flexible teacher learning agenda. Along this continuum of progressively transformative practices, increasing capacity for teacher professional agency is required to enable the transformative agenda.

Marra et al. (2011) took a different approach to the categorisation of PL models. Based on Shulman's (1986) pedagogical content knowledge model, Marra et al. proposed the notion of orientation to PD that categorise PL models into 5 types representing teachers' knowledge and beliefs about the goals and purposes of PL programs. These include *activity-driven* models which engage teachers in hands-on activities intended for use with their students; *content-driven* models which enhance teachers' understanding of new content and laboratory techniques; *pedagogy-driven* models which help teachers acquire specific instructional strategies for the benefit of their students; *curriculum materials-driven* models which guide teachers to develop lessons and units from field-tested curriculum materials and use them in their classroom; and *needs-driven* models which involve teachers in the design and delivery of instruction based on analysis of their needs.

Recently, Koellner & Jacobs (2015) proposed an adaptability continuum wherein PL models with various levels of specificity and adaptability are located. Rather than considering sets of features or effective characteristics in the classification of models, they construe PL as systems with a structure that incorporate goals, expectations and contextual elements enabling the differentiation of models in ways that are highly relevant to diverse audiences. Within this continuum, highly specified models are located on one end and highly adaptive models are located on the other while models with different levels of adaptability are located in between. Specified models are those that require commitment and adherence to a predetermined structure with precise specifications, including predetermined duration, content, resources, learning goals, and outcomes. Conversely, adaptive models are those that follow a fluid structure and require commitment, ongoing and sustained time, in-house personnel, and flexible resources. These models do not have a specified structure as they involve an ongoing cyclical process of observation, analysis and reflection to inform professional practices. By situating PL models along a continuum of adaptability, policy makers, principals, and PL leaders are able to make informed decisions on what PL model works best for the local context and what adjustment can be made on a continual basis to harness the available resources at the local level for the benefit of teachers and students.

2. Elements of effective professional learning

In addition to effort to synthesise and profile PL models, researchers have also attempted to identify elements of effective professional learning to inform the design and implementation of PL models in various contexts, making this line of inquiry arguably the most active and well-

established body of research in teacher professional learning. key elements of effective professional learning programs consistently reported in the literature include 1) a focus on content, 2) active learning, 3) job-embedded collaborative learning, 4) models and modelling of effective practices, 5) coaching and mentoring, 6) feedback and reflection, and 7) sustained duration. A *focus on content* enables teachers to align the content of their professional learning with the district or school priorities, usually through discipline-based, job-embedded practices. This type of professional leaning usually takes place within the teachers' classroom with their own students, allowing them to gain a richer understanding of their student performance, test out new curriculum, or apply a new pedagogical approach to maximise student learning in a certain content area. PL that incorporates elements of *active learning* shift the focus from traditional learning mode of lecture-based knowledge transfer to the active exploration and transformation of practices that are highly contextualised and directly relevant to the teacher classroom. *Collaboration* is a key ingredient of PL as feedback, new knowledge and ideas do not only stem from individual learning but from dialogue and interaction with others (Chou, 2011). By working with others in pair, groups, or schoolwide collaboration initiatives, teachers learn and problem-solve together, producing collective knowledge and contribute to student achievements. *Models and modelling* of effective instructional practices provide teachers with vicarious experience, enabling them to build a vision of what effective teaching is and to stimulate self-reflection. Effective professional learning requires *guidance from experts* who provide professional learning strategies, engage teachers in collaborative learning and problem solving, model effective practices and share expertise about content and practices. *Feedback and reflection* are an integral part of the professional learning process as teachers need to receive input on, think about, and improve their practices to gain a vision of expert practices. Finally, effective professional learning requires *sustained duration* as short term, one-off professional learning is not likely to produce desired learning experience or to build a culture of practice that fosters long term learning.

Although the identification of key elements helps inform policy makers and school leaders' decision-making regarding the design and implementation of effective professional learning programs, this approach is not without limitations and criticisms. As acknowledged by Darling-Hammond et al. (2017), this method of profiling effective professional learning does not provide conclusive evidence for the impact of each individual element on student learning outcomes as it focuses on a rich description of the comprehensive professional learning models that are deemed effective. Sims et al. (2023) referred to this approach as the "consensus view",

highlighting its limitation in teasing out the causally active ingredients from causally inactive ones in effective professional learning programs. By drawing on analogical abduction reasoning and performing a meta-analytic review of 104 studies in various domains, Sims et al. (2023) proposed and tested a new theory of effective teacher professional learning including 4 purposes and 14 relevant causally active mechanisms that has potential to better inform policymakers and school leaders decision-making process. The 4 purposes include *instilling insight, motivating changes, developing technique, and embedding practices*. *Insight* refers to the need for PL to help teachers gain a rich understanding of how teaching and learning happen in the classroom. To achieve this purpose, PL needs to optimally *manage the cognitive load* for teachers and provides opportunities for them to *revisit materials* through reteaching or prompting recall of important ideas. *Motivation* refers to the need for PL to motivate teachers to take up what they learn and exert effort to change their practices accordingly. This can be achieved through *explicit goal setting*, evidence from *credible sources* to support suggested changes, and *reinforcement* of teaching practices. *Techniques* refers to the need for PL to help teachers learn how to implement a new teaching practice. Five mechanisms support this purpose including *practical social support* from colleagues*, modelling* of target teaching practices*, instruction* on how to perform a teaching method*, feedback, and rehearsal of* teaching practices outside the classroom setting. Finally, embedding practice refers to the need for PL to make a newly acquired teaching practice firmly part of the teachers' repertoire and their teaching routine. This can be achieved through specifying how and when changes should be implemented in the classroom, rehearsing a teaching practice in the real classroom setting, prompting desired practices in the classroom, and monitoring own practice.

3. Outcomes of professional learning

As the ultimate purpose of professional learning is to bring about positive student learning outcomes, a substantial body of research that evaluates the effects of professional learning has focused on whether various PL models produced desirable student learning outcomes. In their influential report on elements of effective professional learning, Darling-Hammond et al. (2017) identified 35 studies with rigorous research designs that have demonstrated positive effects of various PL programs on student academic performance in various disciplines (see, for example, Allen et al. 2011; Campbell & Malkus, 2011; Kutaka et al. 2017). Since then, research that probes into the positive link between teachers' participation in PL programs and student learning outcomes has grown exponentially (for recent research syntheses, see Brunsek et al. 2020; Didion et al. 2020). In addition to student academic achievement, other student-

related attributes have also been identified as outcome of PL programs. For example, Juuti et al. (2021) reported a teacher professional learning initiative in which teachers and researchers engaged in a co-design, co-implementation, and co-reflection cycle of a project-based learning approach to enhance student engagement. They found that students were 20% more engaged in the second year than in the first year as a result of this PL initiative. Similarly, Zhang and Yin (2017) found that teachers' participation in professional learning communities had a positive influence on student motivation and learning strategies. Robertson et al. (2020) also reported a positive link between teacher professional learning and student agentic learning experience.

In addition to unpacking the relationship between teacher professional learning and student outcomes, studies have also examined the mechanisms by which such professional learning experience exerted effects on student learning outcomes. In this regards, numerous studies have sought to examine whether professional learning brought about changes in teacher beliefs and practices and subsequently changes in student outcomes. Studies have found that participation in professional learning increased teacher agency (Brodie, 2019; Robertson et al. 2020), self-efficacy (Rutherford et al. 2017; Yang, 2019), collective self-efficacy (Loughland & Ryan, 2020; Voelkel & Chrispeels, 2017), well-being (Liang et al. 2020; Wolf & Peele, 2019), motivation (Jansen in de Wal et al. 2014; Power & Goodnough, 2018), and identity (Widodo & Allamnakhrah, 2020). Positive changes in teachers' teaching practices have also been found to result from their participation in professional learning. For example, Doğan and Yurtseven (2017) found that both school-based and reform-based professional learning activities positively predicted teachers' instructional quality such as classroom management strategies, supportive classroom climate, and cognitive activation. Loughland and Nguyen (2016) applied the instructional core framework including content, pedagogy, and student learning to teacher professional learning and found positive changes in both teachers' beliefs, pedagogy and student skill outcomes. Situated within the Advanced curriculum reform in sciences in the US context, Fischer et al. (2018) studied how professional learning translated into teachers' instructional practices and student learning outcomes, using a national dataset of 133336 students and 7434 teachers. They found that professional learning participation improved the quality of teachers' instructional practices, which in turn, increased student learning outcomes. However, not all professional learning initiatives produced desired outcomes for both teachers and students. (Shirrell et al. 2018), for example, reported that teachers' participation in formal professional development predicted changes in their instructional beliefs, but not their

practices, confirming the need for professional learning to be embedded in the teachers' routine classroom practices. Similarly, Jacob et al. (2017) designed a professional development program to help teachers improve mathematics content knowledge, understand how children learn, implement formative assessment, and develop effective instructional practices. They found little evidence of positive impact on teachers' mathematics knowledge, and no evidence of positive impact on teacher practices and student learning outcomes, owing to the lack of principal support and district support, and a lack of understanding of teachers' needs for professional development. These studies suggest that for professional learning initiatives to be successful, certain conditions or supporting mechanisms need to be met.

4. Conditions for professional learning

Teachers' participation in professional learning programs might not produce desired learning outcomes if different supporting mechanisms are not in place. Research has indicated that principals and middle-level leaders play key roles in supporting teachers to productively and effectively engage in professional learning. Principal support might be in the form of structural support – the involvement of teachers in curriculum design, planning, decision making, and supervising instruction, or the creation of teacher learning related rules and procedures (Marks & Printy 2003; Leithwood 2006, Walker, 2010); cultural support – the co-development of school visions and goals with teachers and the nurturing of individual and shared value and experience (Dimmock, 2016); and relational support – the provision of opportunities for teachers to establish and maintain positive relationships with colleagues (Knapp et al., 2010, Bryant et al., 2018). Different leadership styles have also been demonstrated to influence the effectiveness of teacher professional learning. Liu et al. (2016) reported that learning-centred leaders – those who foster a shared vision for learning in school, create supportive environment for both students and teachers, act as role models by sharing experience and expertise, find and allocate resources for teacher learning – helped increase teacher trust and agency, which in turn, produces positive professional learning experience for teachers in the school. Similarly, Liu & Hallinger (2018) found that principal instructional leadership, which refer to the creation of a common mission for both teachers and students, provision of coaching and instructional supervision, and the fostering of a positive school learning climate for teachers, exerted both direct and indirect effects on the quality of teacher professional learning. studies have also suggested that distributed leadership – the leadership style rooted in the assumption that leadership is the product of collective action of school members rather than the skills, ability, charisma, and cognition of a single individual leader – had positive effects on teacher

professional learning by buttressing teacher professional agency (Polatcan, 2021), and teacher trust and motivation (Bektaş et al., 2020).

In addition to principal leadership, time and infrastructures are also important conditions for effective teacher professional learning (DeLuca et al., 2015). Teachers need time to participate in meetings, peer observations, discussions, reflection, and practice of new learning, which necessitates release from regular classroom schedules. Educational infrastructures such as routines or instructional coaches can impact not only the amount of collaborative work but also the quality of such collaboration during professional learning (Shirrell et al., 2018). Other supportive conditions for teacher professional learning include collegial support and availability (Lohman 2006, Bubb & Earley 2009, Cordingley, 2015), guidance and supervision (Louis et al., 1996), and access to resources (Louis et al. 1996, Evans et al., 2006).

5. Professional learning communities

Among the various teacher professional learning models reported in the literature, teacher Professional Learning Communities (PLCs) have gained increasing attention from researchers, leaders, and policy makers due to their potential to promote teacher development, student achievement, and school improvement (Vangrieken et al., 2017; Zhang & Sun, 2018; Dogan & Adams 2018; Vescio et al., 2008). A PLC is defined as a community of educators "committed to working collaboratively in ongoing processes of collective enquiry to achieve better results for the students they serve". Professional learning communities operate under the assumption that "the key to improved learning for students is continuous, job-embedded learning for educators" (DuFour et al., 2008, p.14). The concept of PLC originates from two distinct theories, the organisational learning (Harris, 2014) and the communities of practice (Wenger, 1998), and was popularised by (DuFour et al., 1998) as an educational version of the learning organisation construct (Senge, 1990). The emphasis of PLC is on the building of a collaborative work culture for teachers amid the school reform movements driven by standards, accountability, and competency (Mertler, 2017). It is therefore, proposed as a more effective professional learning approach than the traditional one-off, drive-by models of professional development with a heavy emphasis on knowledge transmission and translation Mansfield and Thompson (2017).

Numerous attempts have been made to synthesise the growing body of research on PLCs, most of which converged on at least five key elements of effective PLCs, namely 1) shared vision and value – a collective focus on and commitment to student learning achievement, 2)

collective learning and inquiry – collective effort to analyse, plan, execute, and reflect on professional practices to improve student learning outcomes, 3) reprivatisation of practice – teacher engagement in peer observations, providing feedback, and interrogation of practice to enhance teaching quality, 4) shared responsibility – collective responsibility for student learning and school improvement, and 5) action orientation – teacher engagement in a hands-on approach to learning and a learning-by-doing mentality (Stoll et al., 2006; Louis et al., 1996; DuFour & Eaker, 1998; Hord, 1997). Other research syntheses focused on factors that facilitate or hinder the formation, development, and maintenance of PLCs (Stoll et al., 2006), impacts of PLCs on teachers' teaching practices and students' academic performance (Doğan & Adams, 2018; Vescio et al., 2008), and the different ways by which PLCs are formed (Vangrieken et al., 2017).

In the most recent systematic review of research on PLCs, Chiang et al. (2024) proposed a paradigmatic framework that enabled the categorisation of PLCs research into three strands: empirical-analytical, hermeneutic, and critical paradigms. Empirical-analytical PLCs research focuses on identifying key elements, attributes, and criteria of effective PLCs, developing and testing conceptual models that characterize effective PLCs, or describe the causal relationships among PLCs practices, teacher development, and student learning. Hermeneutic PLCs research places emphasis on gaining a rich understanding of the rationale for and processes by which knowledge is constructed and learning occurs through teacher collaboration and interactions within PLCs. Critical inquiry PLCs research shifts the focus from understanding the nature and make-up of PCLs to the critical analysis of the various social, economic, political, and contextual factors that shape the formation and development of PLCs. Research in this strand, therefore, seeks to expose the economic, political, and social realities and unearth the hidden tensions, hierarchies, and power inequalities in PLCs by challenging the taken-for-granted of or well-established beliefs about PLCs. Understanding research on PLCs from this paradigmatic perspective offers researchers a tool to interrogate taken-for-granted philosophical assumptions about PLCs, identify the dominant paradigms that shape PLCs discourse, and stimulate discussion on what makes PLCs robust in a specific context.

6. What are the missing pieces

The research literature reviewed above provides us with an overview of the current understanding of teacher professional learning including the range of PL models reported, what make those PL models effective, what are the enablers and hindrance for the formation,

development, and maintenance of those models, what are the outcomes of those models, and how to evaluate the impacts of those models on teacher learning and student achievement. Upon reflection on this theoretical overview coupled with our multi-year experience as provider of professional learning in response to school reforms and increasing demands on teachers' teaching quality, we propose that a contextualized, adaptive, and well-functioning model of teacher professional learning needs to consider three key elements: a sustained, situated, and job-embedded mechanism for professional learning, teacher collaboration, and the role of data in the decision making process. We elaborate on these elements in the sections that follow.

Research on professional learning has indicated that traditional professional development models characterized as detached, one-off, drive-by workshops delivered within a specific timeframe and focused on the transmission of knowledge from an expert to novice teachers with the hope that translation into practice would eventually occur are unlikely to be effective. This is because researchers have employed simplistic conceptualisations of teacher professional learning that fail to consider the embeddedness of teacher learning within their daily teaching practices and working conditions (Mansfield & Thompson, 2017). For professional learning programs to produce expected outcomes, it is suggested that they be situated within the authentic world of everyday classroom where teachers perform "concrete tasks of teaching, assessment, observation, and reflection that illuminate the processes of learning and development' (Darling-Hammond & McLaughlin, 2011, p. 82). This situated view of teacher professional learning stems from a complex system thinking perspective which assumes that there are multiple dynamics at work in social behaviour and they interact in ways that create a knock-on effect such that decisions made at one point might produce multiple causal pathways affecting the whole system (Clarke & Collin, 2007; Collin & Clarke, 2008). Underplaying the complexity of teacher learning leads to a focus on the micro context (e.g., individual teachers and individual activities) at the expense of excluding meso (e.g., classroom, institution) and macro (e.g., school district/system) systems (Bore & Wright, 2009). Therefore, teacher learning must be conceptualised as a multilayered phenomenon embedded within the activities of the entities (e.g., individual teachers), collectives (e.g., grade/subjects levels), and subsystems (e.g., schools within school systems). To support teacher professional learning requires a rich understanding of what "local knowledge, problems, routines, and aspirations shape and are shaped by individual practices and beliefs. How are these then framed by the other systems involved?" Opfer and Pedder (2011, p.379). Teacher PLCs, therefore, become a

salient teacher professional learning approach as they underscore the importance of the situated and embedded nature of teacher learning and incorporate elements of a community of practice where teachers collaborate with one another to improve their teaching quality and student learning experience. Research evidence from studies that either took an empirical-analytical paradigm (see, for example, Gümüş & Bellibaş, 2021; Posnanski, 2017) or a hermeneutic paradigm (see, for example, Chen, 2022; Chou, 2011) has demonstrated the effectiveness of conceptualising and operationalising teacher professional learning as a component within an interconnected complex system.

While sustained duration and situated learning are essential requirements for effective professional learning, they are not sufficient. PL needs to have content or a focus into which teachers collaborate to inquire. A clearly articulated problem of practice forms the focus around which teachers collaborate to problem solve, to acquire new knowledge and skills, and to orchestrate instructional practices in ways that benefit their student learning. A problem of practice might be identified by a skilful teacher who has experience teaching a content area to a specific group of students over years, and thus understands what difficulties or needs these students have through their intuition as a teacher. Mertler (2017) refers to this intuition or "gut instinct" as the art of teaching. However, in this age of accountability, the art of teaching is not enough, but must be accompanied by the science of teaching – the use of hard evidence or data to inform instructional decisions. Brodie (2013) distinguished between evidence-informed and data-informed practices. The former refers to practices that place emphasis on research-based evidence claiming that only research evidence is valid enough to inform teacher professional learning. The latter refers to professional learning that starts with teachers' interpretation of data and their understanding of their own students to inform what they need to learn and how to cater to their student needs. The former is, therefore, usually criticised for its ignorance of the local school and classroom-level data and teachers' knowledge of their own students as well as the difficulties that teachers confront in their search for and understanding of research-based materials. (Schildkamp et al., 2019) made a distinction between data-informed instructional decision making and data-driven instructional decision making. Whereas the former focuses on the use of data to inform instructional practices that contribute to achievements and learning in schools, the latter carries a connotation of accountability imposed upon the use of data as a measure to address students' deficit rather than promote their learning and to increase students' standardised scores on tests rather than develop all-round individuals, thereby promoting cheating behaviours on tests and a focus on teaching to the test (Booher-

Jennings 2005; Hargreaves et al., 2018). Data use, therefore, should not be the driving force behind PL, but the focal point around which PL is structured. Research that supports the use of data to improve teachers' teaching practices and student learning is abundant (Lachat & Smith, 2005; Schildkamp & Kuiper, 2010; Wayman & Stringfield, 2006; Wohlstetter et al., 2008), but those that make connections between data use, teacher practices and knowledge, and student achievement are limited, prompting further inquiry into data-informed instructional decisions in teacher learning communities.

Finally, teacher collaboration is the cornerstone of teacher professional learning. DuFour and DuFour (2009) define collaboration as "a systematic process in which teachers work together, interdependently, to analyse and impact professional practice in order to improve results for their students, their team, and their school" (p.16). New knowledge and practices cannot be produced as a result of an individual teacher effort but must be a collaborative endeavour where all teachers are hold mutually accountable for achieving the common goals – to improve student learning and achievement. Extensive research evidence has suggested that teachers working in collaborative cultures produce higher results in student academic performance than those working in individualism cultures and that social capital engendered by collaboration contributes to human capital with respect to increasing student achievements (Bryk & Schneider, 2002; Day, Sammons, Stobart, Kington, & Gu, 2007; Leana, 2011; Hargreaves, 2019). As concluded by the OECD through its TALIS survey, a collaborative culture in school represented "one of the strongest associations with teacher self-efficacy and job satisfaction". Teacher collaboration is premised on at least two key elements: collegial support and openness. The former refers to "teachers' involvement with the peers on any levels, be it intellectual, moral, political, social/emotional" (Jarzabkowski, 2002). Collegiality entails "respect, trust, norms of critical inquiry and improvement, and positive, caring relationships" (Hipp & Huffman, 2007). As stated by Bryk et al. (1999, p. 767), "when teachers trust and respect each other, a powerful social resource is available for supporting the collaboration, reflective dialogue, and derivatisation characteristics of a professional community". Openness is crucial in the derivatisation of practice, discussion of feedback, and reflection as these practices might expose teachers to their student deficits in performance, and hence their own incapabilities (Mertler, 2017). Without the brutal honesty with and critical reflection on things teachers do or fail to do well, a culture of collaboration within teams might be undermined.

7. The data-informed professional learning cycle

Based on the three key mechanisms identified above, we propose the model of data-informed professional learning cycle that provides a blueprint for the conceptualisation and implementation of contextualised professional learning in a given context. This model is operated on the basis of job-embedded professional learning communities where teachers work in teaching teams (e.g., year levels or subject levels) under the leadership a middle-leader (e.g., middle leaders). Team members regularly meet to review and discuss school performance data, collaboratively develop strategies for dealing with data trends, engage in reading research literature to plan professional learning strategies for the team, and implement instructional knowledge and skills acquired in their own classroom within an observation-feedback-reflection regime. With the purpose of empowering teachers to make positive decisions that lead to tangible improvements in their instructional methods and consistent growth in student learning outcomes, the model directs team members to work collaboratively on a problem of practice within a cyclical process. Each cycle of practice starts with members' analysis of school performance data and ends with the collection of student and their own performance data that feed into the next cycle. Therefore, this cyclical model features three core components: data-informed instructional decision making, co-planning, and co-implementation.

Data-informed instructional decision making

As discussed in the previous section, data constitute the focal point around which professional learning communities operate. The traditional approach to data utilisation is characterised as having a narrow and limited view of what consitutes data, primarily focusing on the use of standardised test scores to shape instructional approaches and practices. This restricted view of data has been criticised for its ignorance of the other critical indicators of students' educational development and the local context in which student learning occurs. Student learning is a complex process and standardised test scores is just one of the multiple sources of evidence that can be used to shed light on such individual learning processes (Mertler, 2017). Therefore, data in this project can be understood as the systematic collection and organization of any information that represents certain aspects of the school (Schildkamp et al., 2019). We argue that data can be collected, analysed, and interpreted at three levels of the school system to inform instructional decision making. At the macro level is the type of data that indicate the extent to which the school and its staff are optimised for innovation and reform. This involves the assessment of alignment – the synchrony of people with the goals, clientele, and brand of the organisation, capability – the existing skill, knowledge, information, and resources sufficient to meet the organisation's goals, and engagement – staff satisfaction, commitment, and willingness to take action for the benefit of the organisation. Taken together, the three

components of alignment, capability and engagement form an indication of how a school is traveling and how much it is ready for taking up changes and innovation initiatives such as new teacher learning communities for supporting student learning. At the meso level, data concerns the teachers themselves. This data not only demonstrates the quality of teaching, their pedagogical content knowledge, or how well they understand their student learning. Aspects beyond knowledge such as teachers' beliefs, motivation and self-regulation also play an important role in what teachers do in the classroom and how they deliver the outcomes expected. Kunter et al. (2013) proposed the model of teacher professional competence which is composed of four components: knowledge, beliefs, motivation, and self-regulation. As such, beside pedagogical content knowledge and knowledge of students, teacher beliefs – "implicit or explicit conceptions about school- or learning-related matters that influence their perceptions of the environment and their behaviors", motivational orientations – e.g., teacher self-efficacy, intrinsic value, and self-regulation – their ability to regulate their engagement to cope with increasing demands, together constitute a teacher's professional competence allowing them to obtain mastery of the teaching situations they find themselves in. Therefore, meso-level data need to attend to these components to understand how teachers are performing in their profession and what needs to be provided to support their teaching. Finally, micro-level data concentrates on the student themselves, how they learn, and what influences their learning. In addition to standardised scores on tests, student data should entail a wide range of performance indicators including, but not limited to, their well-being, critical thinking, creativity, behaviors, errors, engagment, and resilience. These indicators might not only come from their self-perceptions and focus groups but also from teachers' classroom observations and classroom assessment. Taken together, macro-, meso-, and micro-level data provide a rich characterisation of how school is performing as a whole, what are teachers and students' needs, and how to approach the professional learning communities for the benefit of all those involved.

Co-planning

In the co-planning stage, teachers work in teams across year- and subject-levels to collaboratively plan an appropriate approach for the PLCs. This planning step is a crucial phase where teachers analyse data across school levels and seek insights from diverse sources to develop their action plan. They examine successful practices, embrace evidence-based decision-making, and tailor their strategies to align with improvement goals. This phase emphasises thoughtful analysis, collaboration, and targeted action plans to drive meaningful change in teaching practice. Teachers carefully analyse their observations, including reflections on their teaching performance, previous classroom observations, and feedback received. They

seek insights from researchers, academic literature and colleagues, gaining a broader perspective on effective strategies. By integrating observations, diverse insights, and evidence-based research, teachers formulate a targeted action plan that outlines specific strategies, timelines, and resources. Collaboration plays a significant role, fostering a culture of continuous improvement and facilitating the exchange of innovative teaching practices. There are at least two supporting mechanisms required for this stage to function effectively. First, principal leadership is important in facilitating collaboration among teachers. By engaging teachers in the creation of and commitment to a shared value and goal, actioning the principles of distributed leadership through providing support, directly involving in the PLCs, and maintaining a flat hierarchy of power in communication, and creating a school culture in which openess is appreciated, mistakes are tolerated, and mutual understanding is encouraged, school leaders will be able to provide the conditions needed for productive collaborative works during PLCs. Second,

Co-implementation

In the co-implementation phase, teachers take turn to implement their action plans and actively apply the identified strategies in the classroom. They closely monitor student responses, engagement, and learning outcomes using various data collection methods, such as observations, assessments, surveys, and interviews. This data helps teachers assess the effectiveness of their strategies, determine if they are achieving the desired outcomes, and identify areas for improvement or adjustment. Teachers adopt a reflective stance, making real-time adjustments, seeking support if necessary, and continuously evaluating the ongoing effectiveness of their strategies, recognising that professional development is a learning process involving both successes and challenges. The duration of the action phase varies depending on the strategies being conducted, with some teachers implementing plans over a few weeks for focused investigations and others opting for an entire academic year to examine long-term effects and contextual factors. The data collected during this phase serves multiple purposes. It allows teachers to assess the impact of their strategies, understand the dynamics of their classrooms, and make informed decisions about refining their approaches to align with improvement goals. By embracing a growth mindset and learning from their experiences, teachers actively engage in professional development to enhance their practice.

Co-implementation is operationalissed in an observation-feedback-reflection regime. While a team member applies the co-developed plans in their classroom, others engage in peer observations, using checklists based on the professional competence framework to assess the implementation of the plan, what has been implemented well and what needs to be attended to.

These checklists provide information for group discussions and reflections where all team members come together to analyse performance and review the plans and discuss startegies for further improvement. During this stage where depritavisation of practice is the priority, teacher openess and a non-judgmental attitude is the most important element, facilitating the critical analysis and reflections of the self and others to achieve the common goals. The data collected during this stage form the focal point for the new cycle of PL.

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