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Teacher perceptions of effective professional development: insights for design

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ABSTRACT

A considerable number of empirical studies have led researchers to identify key characteristics that indicate effective professional development (PD). However, few studies have attended to teacher perceptions of PD characteristics across international contexts. This article reported on an exploratory study utilising latent class analysis (LCA) to identify similarities and distinctions in teacher perceptions regarding commonly agreed-upon characteristics of effective PD. Data used in this analysis were from the Teaching and Learning International Survey (TALIS) 2018, which consisted of 113,667 lower secondary (e.g., grade 7 through 9) teachers from 45 education systems. The LCA identified four classes of teachers who shared similarities in their perceptions. The researchers labelled the four categories as Low-Perception-Space/Time Rater (37.66%), High-Perception Rater (31.35%), Mixed-Perception Rater (15.55%), and Low-Perception Rater (15.44%). Results showed that a significant discrepancy existed in teacher perceptions of PD programmes that were school-embedded and extended. Additionally, cross-nation analyses revealed an evident difference in the distribution of class membership across education systems. Considering these findings, we provide implications for future research investigating how to design PD that supports personalised learning experiences.

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Professional development; latent class analysis; teacher perception; TALIS

Introduction

A global focus on providing teachers with high-quality professional development (PD) opportunities emerged two decades ago (Akiba 2017). This focus has become increasingly apparent given that global education systems are facing an unprecedented challenge and, correspondingly, a growing need for supporting all students in rapidly changing learning environments (UNESCO 2020). The development of the fourth United Nations Sustainable Development Goal has recently called for international education systems to ensure inclusive and equitable quality education and increase access to lifelong learning for all (United Nations 2015, Boeren 2019). UNESCO specified

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that teacher participation in effective PD activities as one indicator for achieving the goal (OECD 2019a).

A substantial body of research on PD has theorised and examined the design, implementation, and evaluation of PD programmes for supporting teachers' learning experiences and growth (Boylan et al. 2017). Drawing upon a literature review, Kennedy (2016) found that PD programmes investigated in educational research vastly differed in type, content, design, or implementation strategies. This significant variation makes it challenging to assess whether PD programmes led to improved teacher learning experiences and instructional practices. While varying theories and approaches to understanding how teachers learn exist across international contexts, PD is commonly viewed as complex and diverse to teachers (Day and Gu 2007, Darling-Hammond and Richardson 2009, Hill *et al.* 2013, Webster-Wright 2017).

To better capture the complexity of PD, researchers posited that it was the critical characteristics of PD that make it practical for improving teachers' instructional practices and ultimately for improving student learning rather than on the type of PD (e.g., Penuel *et al.* 2007, Desimone 2009). A considerable amount of empirical research has led researchers to identify key characteristics that indicate effective PD (Garet *et al.* 2001, Blank and de Las Alas 2009, Webster-Wright 2017). These features include but are not limited to content focus, coherent structure, extended time, active learning, collaboration among colleagues, and job-embedded practice (e.g., Garet *et al.* 2001, Borko 2004, Desimone 2009, Darling-Hammond *et al.* 2017).

Previous research has investigated a variety of discrete features of effective PD; however, there is a lack of sufficient evidence revealing what combinations of these features led to the success of a specific PD programme (Hill *et al.* 2013). There are several potential reasons for such an insufficient evidence base. For example, in reviewing how PD was investigated across professions and contexts, Webster-Wright (2017) found that most studies evaluated content, participation, delivery, or outcomes of specific programmes; few have attended to teachers' learning experiences as successful indicators of PD. Moreover, measuring a myriad of characteristics of different PD programmes under varying contexts has proven to be a challenge for causal studies (Borko 2004, Desimone 2009).

One way to investigate PD is to examine teachers' perceptions of the PD activities in which they have participated. Teachers have first-hand learning experiences, such as participating in PD activities and interacting with colleagues, within a PD programme. Therefore, understanding teacher perceptions of PD will provide insight into more effective designs of PD programmes that meet their needs. Additionally, given considerable quantities of money, resources, time, and effort invested in any form of PD, it is critical for stakeholders across international contexts to better understand how to support teachers' needs for PD at the initial stage of programme development (Hill *et al.* 2013). That said, the core characteristics of effective PD investigated in previous research need further investigation to determine whether they still hold within the increasingly changing education systems worldwide.

To date, few studies have examined cross-national similarities and differences in teachers' perceptions of PD in which they have participated. Therefore, this study aimed to examine teachers' perceptions of PD activity characteristics that had the greatest positive impact on teaching across international contexts using data collected from the 2018 Teaching and Learning International Survey (TALIS). TALIS 2018 is an extensive cross-sectional survey on school leaders' and teachers' working conditions and learning environments. Initiated in 2008 by the Organization for Economic Cooperation and Development (OECD), they distribute the survey in five-year cycles. Forty-eight countries or education systems participated in the most recent cycle in 2018.

The TALIS 2018 Glossary defines PD as activities 'designed to develop an individual's skills, knowledge and expertise as a teacher (or more generally, a professional). Unless otherwise stated in a specific question, these activities are formal and could refer to different activities such as courses and workshops, but also to formalised teacher collaboration and participation in professional networks' (OECD 2019b, p. 9). To better understand teacher perceptions, participants were asked

to select the pertinent characteristics of PD that positively impacted their instructional practices from 12 items. Previous research on effective PD characteristics, such as whether the PD was built on teachers' prior knowledge, had a coherent structure, focused on content, provided collaborative learning, and was extended and sustained (for reviews, see Yoon *et al.* 2007, Desimone 2009, Darling-Hammond *et al.* 2017), informed the development of these items. Therefore, TALIS provided an ideal data source to explore teacher perceptions of PD, which may inform future research and policy direction in the global context. Recognising PD's complexity and the importance of teachers' perceived learning experience within a PD programme, we drew on Clarke and Hollingsworth (2002) Interconnected Model of Professional Growth as our conceptual framework.

Conceptual framework: an interconnected model of professional growth

Clarke and Hollingsworth (2002) PD model is applied to explain the interconnected, non-linear structure of four domains through the mediating processes of reflection and enactment that interact to promote professional growth. These include the personal domain (teacher knowledge, beliefs, and attitudes), the external domain (sources of information, stimulus, or support), the domain of practice (professional experimentation), and the domain of consequence (salient outcomes). Interconnectedness among the four domains occurs through the mediating processes of enacting and reflecting on instructional practices; growth in one domain links to change in another non-linear way.

For example, consider the context wherein teachers improve their capacity to vary their practice to meet students' diverse learning needs. Ideally, PD programmes are designed to provide teachers with information and stimuli (the external domain), such as new instructional strategies and the value of applying these strategies, to support all students. Teachers enact new instructional strategies as experimentation (the domain of practice). The experimentation may yield salient outcomes of student learning (the domain of consequence), encouraging teachers to persist with the investigation and evoke future reflection on the value of the enacted strategies (the personal domain). Potential changes in knowledge, beliefs, and practice would follow accordingly.

The reflection and enactment processes are situated with individual teachers' professional context and a learning community to share experiences. Interpretation of salient outcomes lies in individual teachers' value system, given they consider different things salient. Clarke and Hollingsworth (2002) highlighted that change in belief or practice can occur in any domain, and how and when change occurs varies across teachers and contexts. Thus, the model recognises the idiosyncrasy and individuality of teachers' learning experiences within a PD programme through multiple pathways between the domains (Boylan et al. 2017, Clarke and Hollingsworth 2002, Desimone 2009). In line with this perspective, researchers have posited that providing flexible learning pathways is an effective practice for supporting teachers' learning experiences within PD (e.g., Webster-Wright 2017).

A person-centred approach to investigating teacher perceptions of PD

The Interconnected Model of Professional Growth suggests that PD programmes' design should be more flexible and learner-centred to meet individual teachers' learning, professional growth, and other context-related needs (Clarke and Hollingsworth 2002). Understanding the interplay between teacher belief and practice will provide insight into better designs of PD based on individual teachers' needs. Teachers' perceptions of PD may drive more experimentation with new strategies and tools (Clarke and Hollingsworth 2002).

As noted above, a large amount of prior research on PD has focused on specific effective characteristics, revealing essential knowledge about how they related to or predicted teacher and student learning outcomes as measures for successful PD (Garet *et al.* 2001, Desimone 2009). However, this characteristic-focused approach cannot capture a holistic picture of teacher

perceptions of PD characteristics. In other words, this approach is limited in identifying combinations or interplays of PD characteristics that help distinguish profiles of teachers who may need varying support for professional growth. This study utilised latent class analysis (LCA) to investigate individual teachers' perceptions of effective PD characteristics. LCA is a person-centred approach to clustering persons who possess similar characteristics or shared commonalities in their item responses (Halpin and Kieffer 2015, Collie *et al.* 2020).

Purpose of the study

The present study aimed to examine teacher perceptions of PD programmes' pertinent characteristics across international contexts using the TALIS 2018 international data. Guided by the Interconnected Model of Professional Growth, we conceptualised teacher perceptions of a PD programme as a potential driver for change in practice. Specifically, this study aimed to identify latent classes of teachers whose perceptions of the pertinent characteristics shared similar patterns using LCA. These analyses could provide information on new possibilities for facilitating research investigating how to design PD that supports improved learning experiences and growth.

Method

Data source and sample

Data used in this study were collected from the TALIS 2018, which used a two-stage probability sampling design to recruit participants (OECD 2019c). Approximately 200 lower secondary (e.g., grade 7 through 9) schools with a probability proportional to size from the stratified sampling frame per education system were selected first; 20 teachers within each school were selected in the second-stage random sampling. TALIS 2018 developers computed survey weights to consider different sampling rates among strata and different response rates across schools, allowing for generating estimates representative of teacher population at the national level (see details about weighting procedures in OECD 2019c).

To ensure that the samples are not biased by non-response, TALIS 2018 required a minimum overall participation rate of 75% of teachers for each participating education system with a minimum response rate of 75% of sampled schools and each included school attaining a minimum response rate of 50%. Australia did not meet the minimum participation requirements. Hungarian teachers' responses to effective PD related items were all coded as 'Not administered' in the original dataset. Also, Iceland withdrew all data from the international database. Thus, the analysis did not include these countries. The final sample for this study consists of 113,667 lower secondary teachers from 45 participating education systems.

Measure

Teacher perception of effective features of PD

To examine teachers' perceptions of the characteristics of effective PD, we used twelve items from TALIS 2018 (see Table 1). These items identify the features of a PD activity that had a perceived positive impact on instructional practices from the teacher's perspective. TALIS 2018 developers classified these characteristics into four dimensions, which are 'content focus,' 'active learning and collaboration,' 'sustained length,' and 'school-embedded training' (OECD 2019a). The first group of characteristics of effective PD programmes includes building on teachers' prior knowledge (Item A), adapting to personal development needs (Item B), coherent structure (Item C), and content-focused (Item D). The second group of items measure perceptions of engagement in active learning (Item E) and collaborative learning (Item F), application of new ideas and knowledge (Item G), and focus on innovation (Item I). Within 'sustained length,' there are two PD characteristics embedded,

Table 1. Descriptive statistics for items regarding characteristics of professional development.

TALIS Items on Effective Professional Development	Mean	Standard Deviation	Response Proportion (Yes: No)
A. It built on my prior knowledge.	1.09	0.28	91%: 9%
B. It adapted to my personal development needs.	1.18	0.39	82%: 18%
C. It had a coherent structure.	1.22	0.41	78%: 22%
D. It appropriately focused on content needed to teach my subjects.	1.24	0.43	76%: 24%
E. It provided opportunities for active learning.	1.18	0.38	82%: 18%
F. It provided opportunities for collaborative learning.	1.22	0.41	78%: 22%
G. It provided opportunities to practise/apply new ideas and knowledge in my own classroom.	1.12	0.32	88%: 12%
H. It provided follow-up activities.	1.41	0.49	59%: 41%
I. It took place at my school.	1.48	0.50	52%: 48%
J. It involved most colleagues from my school.	1.54	0.50	46%: 54%
K. It took place over an extended period of time.	1.56	0.50	44%: 60%
L. It focused on innovation in my teaching.	1.29	0.46	71%: 29%

Note. Items were scored as 1 for 'Yes' and 2 for 'No.' These items were rated when teachers were asked: 'Thinking of the professional development activity that had the greatest positive impact on your teaching during the last 12 months, did it have any of the following characteristics?'

which are providing follow-up activities (Item H) and taking place over an extended period (Item K). Lastly, PD took place at the teacher's school (Item I) and involved most colleagues from the teacher's school (Item J). Teachers' rating on each item was dichotomous response options, with 1 indicating 'Yes' and 2 indicating 'No.'

Data analysis

We employed LCA to identify patterns of teacher perceptions of widely shared characteristics of effective PD. LCA is an individual-centred approach to clustering persons who possess similar characteristics or shared commonalities in their item scores (Halpin and Kieffer 2015). Specifically, we assigned each teacher (i.e., observation) as a member of one, and only one, of an unobserved (i.e., latent) class contingent on their response patterns of the 12 items on effective PD. This means that an individual teacher was assigned to a class according to their highest probability of being in a given class (Clark and Muthén 2009). Rather than specifying the number of clusters, this procedure allowed the appropriate number of clusters, which are also called profiles, to emerge from the data (Huberty *et al.* 2005).

We used two indices to determine the best fitting model and the final number of latent classes, including the minimisation of the Bayesian Information Criteria (BIC) and the Akaike Information Criterion (AIC; Akogul and Erisoglu 2016). Alongside fit indices, we used parsimony, practical value, and/or theoretical interpretability to determine the final model (Keller *et al.* 2007). That said, we considered whether emergent clusters produced meaningful groups given the large sample size of the international database. Across all items, an average of 25% of the data was missing. Missing data were dealt with utilising the listwise technique. All data were analysed within R version 3.4.1 using the BayesLCA package (White and Murphy 2014).

Results

Distribution of item response

(Table 1) shows descriptive statistics for the twelve items on PD characteristics. The rate of missingness is 25% across all items. Reliability was assessed with Cronbach's α and was acceptable for the sample ($\alpha = 0.742$). A majority of teachers (> 50%) rated 'Yes' for Items A through H and L, indicating their endorsement of the positive impact of PD having these measured characteristics on instructional practices. Items I, J, and K were rated as 'No' by more than half of the teachers. To

a large extent, these results are consistent with the OECD's technical report (2019a) on the percentages of teachers who held different views on the characteristics nested within the four categories mentioned above. In the present study, most teachers viewed content-focused characteristics as impactful: built on prior knowledge (91%), adapted to personal development needs (82%), coherent structure (78%), and content-focused (76%). On average, a majority of teachers viewed the characteristics of 'active and collaborative learning' as impactful: application of new idea and knowledge (88%), opportunities for active learning (82%) and collaborative learning (78%), and focus on innovation in teaching (71%).

By comparison, a smaller percentage of teachers reported sustained length characteristics as an effective element of PD activities: providing follow-up activities (59%) and taking over an extended period (44%). Moreover, fewer teachers rated school-embedded PD characteristics as impactful: taking place at the school (52%) and involving most colleagues from the school (46%). It is important to emphasise that we did not initiate any effort in building latent constructs of PD characteristics based on the OECD's categorisation (2019a). This study focused on using the person-centred approach to investigating patterns of teachers' perceptions towards distinct PD characteristics. However, we believe that these descriptive statistics on the overall teacher responses to individual items framed within the OECD's four dimensions of PD characteristics indicated potential patterns triangulated with results from the cluster analysis of individual teachers' perceptions.

To examine cross-national differences, we calculated the distribution of teachers' responses to each item for the United States, Shanghai (China), and Finland samples (see Figure 1). We selected these countries as examples because of the notable differences in their education systems, such as education policy and practice related to PD. Despite differences in the percentages of teachers who participated in the TALIS 2018, these countries showed a certain extent of similarity in teachers' item response, with Items A through G and I (reflecting content-focused, active, and collaborative learning) having a higher endorsement rate. Items H through K (reflecting sustained length and school embeddedness) had an overall lower endorsement rate. Compared to teachers in Shanghai (China) and the United States, a larger proportion of Finnish teachers perceived PD characteristics measured by Items H through L as having no positive impact on their instructional practices.

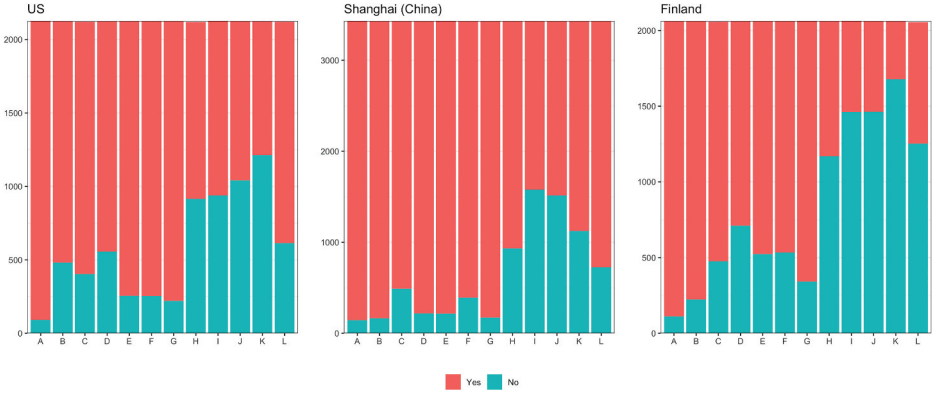

Figure 1. Comparison of teacher perceptions regarding characteristics of effective PD across the United States, Shanghai (China), and Finland. *Note*. This figure illustrates teacher perceptions regarding characteristics of effective professional development across the United States, Shanghai (China), and Finland. Red and green bars represent the numbers of teachers who rated 'Yes' and 'No' to items on PD characteristics, respectively.

Table 2. Fit statistics for each solution and classification probability for the final solution.

Solution	AIC	BIC	Average Classification Probability
Two-class	1,350,654	1,350,895	–
Three-class	1,310,248	1,310,615	–
Four-class	1,292,839	1,293,331	0.874
Five-class	1,287,422	1,288,039	–

Note. AIC = Akaike Information Criteria. CAIC = Consistent Akaike Information Criteria. BIC = Bayesian Information Criteria

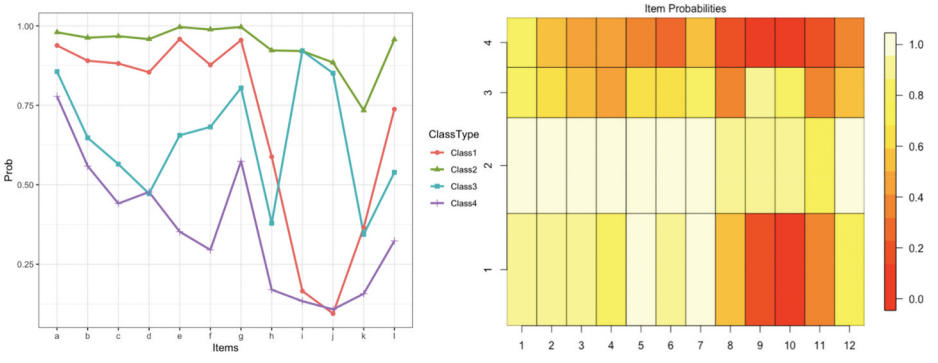

Figure 2. Distributional similarity and distinction of four classes of teachers. *Note*. This figure illustrates distributional similarities and distinctions of the four-class solution in the form of plot on the left panel and heatmap on the right panel. Class 1 is labelled as *Low-Perception-Space/Time Rater*; Class 2 as *High-Perception Rater*; Class 3 as *Mixed-Perception Rater*; and Class 4 as *Low-Perception Rater*. Y-axis of the plot indicates the probability of teachers rating 'Yes' to PD characteristics-related Items through A to L. Numbers on the Y-axis of the heat map represent the four classes of teachers.

Latent classes of teachers based on perceptions of PD characteristics

We estimated a range of solutions, including one through five classes, to profile teachers sharing similar perceptions of PD characteristics. The fit statistics AIC and BIC decreased as additional classes were added, which failed to pinpoint an optimal solution (see Table 2). However, a relatively smaller discrepancy between four- and five-class solutions prompted us to select the four-class as an optimal solution by considering its parsimony and practical value. Specifically, when we compared the two solutions, the added class did not appear to contribute additional information to the solution, merely resulting in another layer of complexity of interpreting emergent clusters. Moreover, the four-class solution showed similar patterns in item probabilities between Class 1 and 2 and between Class 3 and 4, respectively (see Figure 2). We retained the four-class solution as the final model without diminishing the interpretability of clusters. The average classification probability of each class in the final solution is 0.874.

(Figure 2) shows distributional similarities and distinctions of the four-class solution in the form of a plot on the left panel and a heatmap on the right panel. It indicates that not all of the four classes are differentiated on all items. Specifically, Class 1 included 37.66% of the sample, within which teachers reported a high level of perceived PD effectiveness except for a low probability of endorsing (i.e., probability < 0.5) Item I (i.e., *school-based*), Item J (i.e., *involving colleagues at school*), and K (i.e., *extended period of time*). Given these three items measure teacher perceptions of PD activities bound by space and time, we labelled Class 1 as *Low-Perception-Space/Time Rater*. Class 2 included 31.35% of the sample, and the probability of teachers rating 'Yes' to 11 items was high (i.e., probability > 0.75), indicating an average high level of endorsement for these PD characteristics, and labelled as *High-Perception Rater*. Class 3 included 15.55% of the sample, within which four items have a high probability of endorsement (e.g., .50 < probability < .75), four items have a medium probability of endorsement (e.g., .50 < probability < .75), and three items have a low

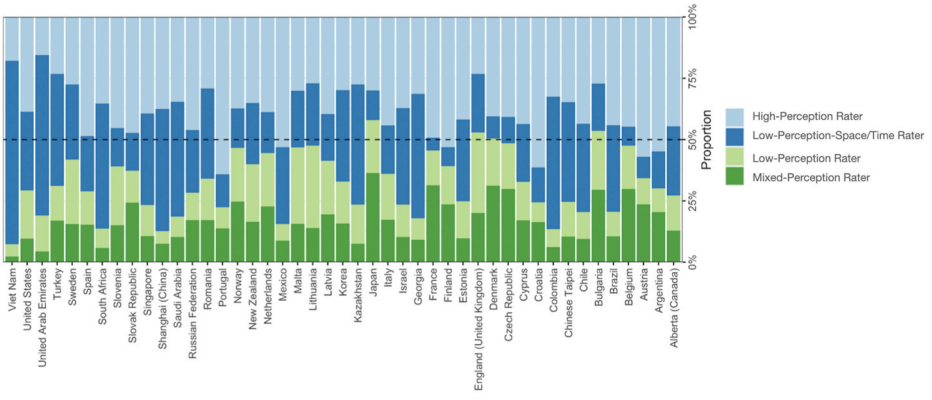

Figure 3. Class membership distribution across international education systems. *Note*. This figure illustrates the distribution of class membership across the TALIS 2018 participating education systems.

probability of endorsement (e.g., probability < 0.50). Additionally, the probability of teachers in this class rating 'Yes' to Items I and J was higher than that of the teachers in classes 1 and 4. Class 3 was thus labelled as *Mixed-Perception Rater*. Class 4 included 15.44% of the sample and was labelled as *Low-Perception Rater* in that a majority of items have a low probability of endorsement (probability < 0.5). Additionally, the probability of teachers in this class rating 'Yes' to almost all items was lower than that of the teachers in other classes.

Within Class 1, 2, or 4, teachers were more likely to endorse the effectiveness of PD characteristics as measured by Items A through G than those assessed by Items H through L. Similarly, the probability of teachers in Class 3 endorsing Items A through G was also high. Still, the endorsement probability of Items I and J was higher than that of other items. In addition to within-cluster comparison, (Figure 2) also illustrates that the least amount of discrepancy existed in the probabilities of teachers rating PD activities as effective if PD was built on prior knowledge (Item A), adapted to their personal development needs (Item B), and provided opportunities to apply new ideas and knowledge (Item G). We found large variations in the likelihood of teachers endorsing PD characteristics in terms of providing follow-up activities (Item H), taking place at school (Item I), involving colleagues at school (Item J), and an extended period of time (Item K). These results align with the descriptive statistics on the overall distribution based on their responses to each item.

Class membership distributions across education systems

(Figure 3) depicts distributions of class membership across education systems. It shows that teachers in education systems such as Vietnam, South Africa, Shanghai (China), Mexico, Georgia, and Colombia had a high probability of belonging to Class 1 or 2, indicating higher-level teacher perceptions of varying PD characteristics being effective. By comparison, teachers in countries such as Japan, France, United Kingdom, Czech Republic, and Belgium had a higher probability of being in Class 3 or 4, indicating a lower level of teachers' perceived effectiveness of PD opportunities. Moreover, countries such as Portugal, Mexico, France, Finland, Croatia, Austria, and Argentina have a large percentage (> 50%) of teachers who corresponded to Class 1 or 4, indicating a low endorsement rate for Items I and J within those contexts.

Discussion

In this study, we utilised LCA as a person-centred approach to identifying classes of teachers contingent on their perception of PD characteristics that had a positive impact on instructional

practices across 45 countries or education systems. Using data on teachers' perception of effective PD collected from TALIS 2018, we identified four classes of teachers: *Low-Perception-Space/Time Rater* (37.66%), *High-Perception Rater* (31.35%), *Mixed-Perception Rater* (15.55%), and *Low-Perception Rater* (15.44%). These classes profiled the extent to which teachers commonly endorsed characteristics of effective PD.

Consistent with findings from previous research on characteristics of effective PD, this study pointed to the significance of PD being content-focused, adapting to personal needs, providing opportunities for applying new knowledge in the classroom, and enhancing active learning. These characteristics were rated as impactful by most teachers in the sample (> 80%). However, there was a stark discrepancy in teacher perceptions of the PD activities that took place and involved most school colleagues. While less than half of the teachers who corresponded to class 2 (31.35%) or class 3 (15.55%) tended to rate school-embedded PD as impactful (probability > 0.80), the rest of the teachers belonging to class 1 (37.66%) or class 4 (15.44%) had a low probability of endorsement for these two items (probability < 0.20). A relatively lower discrepancy was found in teacher's perceptions towards PD characteristics pertaining to sustained length. The results showed most teachers (i.e., Class 1, 3, or 4) tended to regard providing follow-up activities and an extended period as ineffective in improving instructional practices. Taken together, the probability of affirming the effectiveness of school-embedded and sustained PD for teachers corresponding to Class 1 or 4 was low.

In addition, cross-nation analyses revealed an evident difference in the distribution of class membership. These findings were not surprising in the sense that varying policies and practices of PD may contribute to these differences across education systems. This study's findings provide insight into investigating combinations of PD characteristics that support individual teachers' learning experiences across the international context.

It is important to note that it was not our intention to simplify teachers' perceptions of effective PD characteristics in a global context using LCA. Instead, the present study's consistencies and discrepancies provide important implications for policy and research on PD across education systems. In this regard, our research started with acknowledging the complexity of PD and highlighted the salience of designing PD that supports individual teachers' needs. In the following sections, we discussed emergent issues and implications for future PD research and policy.

A novel understanding of collaboration within community

As noted above, approximately half of teachers worldwide perceived school-embedded learning communities bound by physical space (i.e., PD taking place at school and involving colleagues from their schools) or time (i.e., extended period of time) as ineffective. Specifically, *Low-Perception-Space/Time Rate* and *Low-Perception Rater* reported less favourable PD features bound by physical school environments and time compared to those in the other classes. One potential explanation for the low endorsement of these two types of PD features is that if school-embedded PD failed to impact instructional practice, it was unlikely that teachers would regard follow-up activities or extended training as necessary or effective. Unfortunately, we were unable to further explore the explanation due to the nature of TALIS data.

Early research has documented the importance of situating PD within a school community (e.g., Hord 1997, Stoll *et al.* 2006). Hord (1997) suggested that an influential professional learning community has supportive and shared leadership, shared values and vision, collective learning and application, supportive conditions, and shared personal practice. In particular, some research indicated that school location and physical work environment served as an influencer for sustaining a professional learning community (e.g., Higham *et al.* 2004). Teachers' sense of school-based professional community increased their work efficacy, which led to greater collective responsibility for student learning (e.g., Louis *et al.* 1996). More recent international research has also found that strong professional site-based professional learning communities enhanced teacher collaboration

and improved instruction in the classroom (e.g., Lee *et al.* 2011, Ning *et al.* 2015, Lipscombe *et al.* 2019).

Our study shows that a large percentage of teachers did not find school-embedded PD to be effective; however, they did endorse the positive impact of collaborative learning on their instructional practices. This finding suggests the importance of providing PD opportunities that break physical boundaries yet facilitate collaborative learning for teachers, especially those who identify as *Low-Perception-Space/Time Rater* or *Low-Perception Rater*. The unprecedented disruptions caused by COVID-19 to global education systems have expedited a need for breaking the space or time boundary for effective PD. School closures across the globe have sparked the conversation about how to invest effort, time, and other resources in PD that would yield better outcomes (Alexandrou 2020). When it comes to collaborative learning, what remains important is to create an effective learning community that fosters collective decision-making, shared purpose, and cohesive organisation practices. As we have witnessed throughout the pandemic, an effective community can take on many forms, such as online professional learning communities to support teachers' individual needs.

Design implications for personalised professional development

Findings from this study revealed that most teachers (82%) across the globe considered PD programmes that met their personal development needs as effective. What is more interesting is that a significant discrepancy existed in teacher perceptions towards varying PD characteristics. This discrepancy is especially evident for teachers labelled as *Mixed-Perception Rater*, for whom the probability of endorsing PD characteristics as effective varied significantly. In line with Clarke and Hollingsworth (2002) interconnected model for PD, this discrepancy illustrates the complexity of supporting individual teachers' learning experience. The complexity, in turn, indicates that effective PD should be designed to meet teachers' personalised learning and professional growth needs. Accumulated research has supported and substantiated the notion that learning experience is diverse and personalised to the learner; thus, it is critical to provide flexible pathways for learning across all areas of education, including PD (Webster-Wright 2017).

Our findings offered empirical evidence for a need to elevate traditional site-based PD and improve teachers' personalised learning experiences (Hunt et al. 2019, Hunt et al. 2020). In recent years, personalised PD has increasingly been positioned as a transformative approach towards teacher-centred PD, which is otherwise insufficiently supported by traditional PD programmes (Sprott 2019). For example, researchers have argued that most PD programmes applied in the U.S. schools rely on approaches such as a one-shot workshop or 'sit and get' model (Darling-Hammond and Richardson 2009). These PD models focus on training teachers in techniques that are not typically related to their specific contexts nor address individual professional needs (Reimers and Chung 2016, Darling-Hammond *et al.* 2019). As adult learners, teachers vary in meaning-making processes and need personalised PD that helps build knowledge and skills required for improving student learning (Sprott 2019). This especially holds when education systems worldwide face challenges of preparing both teachers and students in rapidly changing learning environments.

To advance PD reform, multiple countries such as the United States, New Zealand, Germany have already put forth education policies and/or guidance on promoting personalised PD (Kato *et al.* 2020, Authors 2020). For example, Kato *et al.* (2020) reported an emergence of micro-credentials and digital badges as alternative credentials across many countries. These novel forms of PD, often supported through digital platforms, are reported to have the potential to improve teachers' autonomy over what knowledge and skills to improve as well as how and when to engage in learning. Research investigating personalised PD programmes from different perspectives has also emerged (e.g., Gamrat *et al.* 2014, Hall and Trespalacios 2019, Yurtseven Avci *et al.* 2019). For example, Gamrat and colleagues (2014) examined how personalisation through a digital badging system could enhance online PD. The researchers suggested that digital badges (i.e., representations

of the learner completing learning activity) could capture teachers' unique learning experiences and support professionals' decision making within their PD activities.

Our findings suggest that personalisation is by no means to deprive individual teachers of situated learning experiences within PD programmes. Instead, studies examining individual teachers' learning experiences and instructional practices enhanced by collaboration will provide valuable insights into the design of personalised PD. One emergent avenue of research is to explore the use of technology in personalised PD while expanding collaborative learning among teachers from around the country and globe. For example, Yurtseven Avci *et al.* (2019) proposed a flipped model of personalised PD by combining a virtual system and face-to-face sessions for technology integration in schools. The researchers suggested that this model allows for flexible scheduling and collaboration with colleagues and other professionals to support teachers' needs, reflection, and learning. However, research on personalised PD is still in its infancy. There is a need to investigate how to design personalised PD that better facilitates individual teachers' learning experiences and whether this form of PD would improve instructional practice.

We were aware that classifying teachers contingent upon their perceptions reduced teachers' individualities; however, we consider these findings as initial considerations for designing more sophisticated, interactive, and personalised learning experiences. The results illustrated the potential of LCA in facilitating the design of PD that is personalised to individual teachers across national contexts. For example, differentiating the perceived effectiveness of PD characteristics offers a rigorous quantitative basis for supporting better designs of PD programmes. Based on a teacher's class membership, it is possible to identify what PD designs or combinations of these designs would have the most potential to support the teachers' learning experiences, thereby transforming instructional practices and improving student learning experiences.

Limitations and future directions

This study has several limitations worth noting. First, most of the participating countries in TALIS 2018 are mid- to high-income countries. Therefore, we have no intention to claim the sample is globally representative even though this cross-national analysis has global implications. We are also aware that there was approximately 25% of missing data across the items regarding effective PD, which undermined the generalisability of the findings as nationally representative to each participating country or education system. Additionally, education systems vary across nations (Roth *et al.* 2006), and so do education policies that inform research efforts and future directions for teacher development and reform. Even within an education system, such as the United States, where PD is situated within a governance structure involving stakeholders at multiple levels (e.g., federal, state, district), there exists a large amount of diversity in PD design and implementation (Akiba 2017). However, exploring PD using an international database such as TALIS contributed to advancing our knowledge on cross-national similarities and differences in teachers' perceptions towards effective PD characteristics. Combined with small-scale regional studies, findings from this study could inform PD designs that have potential to improve individual teachers' practices across instructional and cultural contexts.

Secondly, the present study merely measured teachers' self-reported perceptions of commonly agreed-upon characteristics of effective PD. Several previous studies have shown that there were discrepancies between teachers' self-reports and direct assessments of PD outcomes (Lawless *et al.* 2007, Copur-Gencturk and Thacker 2020). As Lawless and colleagues (2007) pointed out, the focus of using self-reports to measure the effect of PD was more on teachers' competency within a particular domain than on changes in their knowledge or skills. Regardless of this limitation, the purpose of our study was to provide a better understanding of teacher belief or perception as a means of examining their learning experiences. According to the Interconnected Model of Professional Growth (Clarke and Hollingsworth 2002), teacher belief would influence instructional practices. Teacher feedback about whether specific characteristics positively impact instructional

practices could provide information that signals the potential success of a specific PD programme (Hill *et al.* 2013). Thus, more research is needed to understand how PD developers and researchers determine more meaningful PD designs for individual teachers drawing upon multiple data sources such as teacher feedback, professional growth needs, and student learning needs.

Lastly, the large-scale TALIS data provided limited information on the specificity and clarity regarding commonly agreed-upon characteristics of effective PD. Researchers have argued that investigations on the specificity of PD features such as content, implementation strategies, and measures used to determine PD effects would advance our understanding of what PD works under which contexts (Copur-Gencturk *et al.* 2019). We were also aware that different PD programmes targeted different aspects of teachers' knowledge of teaching practice in specific content areas or general pedagogical strategies. The TALIS data used in our analysis did not offer the level of granularity that allowed us to analyse specific characteristics of PD programmes across international contexts. This limitation suggests that future research, especially smaller-scale studies, which investigates the specificity of PD characteristics, will provide a more nuanced understanding of teachers' learning experiences within or between specific PD programmes. We also recommend that future research incorporates other information such as teachers' background characteristics into analysis to inform better understandings of how to design PD that supports teachers with diverse characteristics and ongoing learning needs.

Conclusion

This study investigated teachers' perceptions of the characteristics of PD activity that had the most significant positive impact on their teaching across global education systems. Using cluster analysis, we identified four classes of teachers with distinct perceptions of PD characteristics. Multiple identified similarities in teacher perceptions (e.g., high-level perceptions towards content-focused and active learning experience) were consistent with previous research on effective PD characteristics. However, this study revealed more interesting findings regarding lower-level or mixed-level perceptions of PD characteristics proven to be effective in previous research. In particular, findings regarding the discrepancy in teachers' perceptions of whether PD activities took place at school and involved colleagues from school were valuable in guiding future practice and research regarding innovative PD designs. These findings opened opportunities for future research investigating whether PD programmes that reduce physical boundaries and provide authentic learning experiences could have more potential to support teacher skill acquisition.

Additionally, our study also highlighted the merits of person-centred research on PD and provided implications for situating PD designs in a nuanced understanding of teachers' personalised learning experiences. To conclude, this study contributed evidence on teacher perceptions of PD characteristics. Based on the evidence, we offered implications for future research on designing and investigating personalised PD across international contexts.

Disclosure statement

No potential conflict of interest was reported by the authors.

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