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ORIGINAL ARTICLE

BERJ BERA

Does education policy affect teachers' learning needs? An international comparison of trends in teachers' continuing professional learning needs in secondary schools in Australia, England, Japan and the Netherlands

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Abstract

Education policy changes are believed to influence teachers' continuing professional learning (CPL) needs, but there is limited empirical evidence to support these claims. This lack of deep understanding has significant practical implications. This study used a new circular conceptual framework to analyse teachers' CPL needs. Leveraging public administration theory, the study distinguished four countries' governance styles and the predicted impact of these on teachers' perceptions of professionalism. By conducting secondary analyses of TALIS ICSEI-2 data from Australia, England, Japan and the Netherlands (2013–2018), we investigate whether the results align with theoretical predictions. Our analysis revealed three key trends in teachers' CPL needs that support these predictions: (1) CPL needs in Australia and England diverged between 2013 and 2018, coinciding with an emerging difference in governance style that manifests itself in divergent governance of curriculum revisions and teacher education policies; (2) Japanese teachers perceive knowledge about the curriculum as more central to CPL in 2018 than they did in 2013, coinciding with successive curriculum

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revisions and (3) the Netherlands exhibited no trends or changes; coinciding with reports describing Dutch Educational policy as ad hoc and unpredictable. These findings highlight key trends in teachers' CPL needs, in contrast with the TALIS 2018 report's conclusion that there are no substantial trends. We concluded that this circular model offers a valuable tool for improving our understanding of how education policy affects teachers' CPL needs.

KEYWORDS
educational policy, professionalism, teacher development, teacher learning

Key insights

What is the main issue that this paper addresses?

This paper explores how policy developments relate to teachers' needs for continuous professional learning (CPL) in Australia, England, Japan, and the Netherlands. Using circular statistical models, it investigates whether these methods can deepen our understanding of these associations, which are argued to have important practical implications.

What are the main insights that the paper provides?

Using the circular method, the study reveals new trends in teachers' needs for CPL—insights missed by previous linear analyses of the same TALIS data. It reviews important policy developments in the four studied countries and discusses how the identified trends are linked to policy developments in the four countries.

Educational policies have been substantially adapted and revised in various countries over the past two decades (Organisation for Economic Co-operation and Development Staff [OECD], 2018a). Often policy adaptations prompt needs for adjustments in teacher attitudes or behaviours because of their (desired) effects on educational practice. Examples include responses to the perceived changes to the (future) labour market, prompting needs among teachers to learn to teach students' 21st abilities (OECD, 2020) and educational policies emphasising the importance of effective integration of immigrants and students' preparation for a globalised world, prompting the need among teachers to improve skills in multicultural and multilingual teaching (Australian Institute for Teaching and School Leadership [AITSL], 2022; Lee & Oxelson, 2006; Romijn et al., 2021). Based on such developments, international policy reviews predict increases in teachers' needs for continuing professional learning (CPL), especially in areas subject to educational policy revisions (Boeskens et al., 2020; OECD, 2019a, 2019b).

Contrary to Boeskens et al. and the OECD, Sachs (2016) and Mayer and Mills (2021) predict that disproportionate teacher accountability policies decreased teachers' CPL needs.

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Teacher accountability has increased in many Western countries (Hwa, 2023). Example policy measures are the explication of standards for teaching in Australia and England (Call, 2018). These accountability measures signal that educational effectiveness benefits from teacher adherence to standards. (Sachs, 2016) and (Mayer & Mills, 2021) share concerns of accountability measures shaping managerial views of professional learning. Instead of communicating confidence in teachers by expecting them to respond professionally to the need for change prompted by new policies, changes are required, prescribed and imposed through top-down accountability systems.

Studies, thus, predict varying associations between developments in educational policy and teachers' CPL needs. However, empirical assessment of this impact has proven to be challenging (Viennet & Pont, 2017). For instance, the Teaching and Learning International Study (TALIS) – the only large-scale, randomly sampled international comparative trend study on teachers' CPL (needs) – revealed that in 2018 'the highest share of teachers was concentrated on the same needs in the 2013 cycle of TALIS' (OECD, 2019b). Hence, despite numerous educational policy revisions (OECD, 2015), teachers' learning needs did not substantially change between 2013 and 2018. The lack of significant associations has led to alternative explanations, such as potential resistance to policy changes among teachers and/or the limited effectiveness of current CPL activities (e.g., Schleicher, 2016). However, these hypotheses are inherently complex and difficult to evaluate.

This limited understanding carries significant practical implications. Ineffective policy revisions, despite substantial public investment, have often failed to deliver meaningful improvements in education. These repeated shortcomings risk eroding public trust in policymakers and the education system as a whole (Viennet & Pont, 2017). Moreover, policymakers are held accountable to achieve results by the public, even if there is no clear scientific basis to guide their decision-making (OECD, 2017). Lack of insights into policy effectiveness might lead to ineffective or even counterproductive policy, further reinforcing the problem (Viennet & Pont, 2017).

The present study explores novel alternative methods to study teachers' CPL needs trends and associates these with policy developments in four countries: Australia, England, Japan and the Netherlands. Specific attention is given to the triadic relation between instrumental operationalisation, statistical representation and theoretical conceptualisation. Operationalisations of CPL needs simultaneously inquire two dimensions of teachers' CPL needs, namely the level of need (e.g., how high is my need to learn), and what area do I want to learn about (e.g., I want to improve: my assessment skills; my expertise in subject matter knowledge; or my skill in maintaining relationships with parents). This operationalisation nicely aligns with standard conceptualisations, namely that the concept CPL needs spans what teachers want to learn about and how much they want to learn about it (Louws, van Veen, et al., 2017; Opfer & Pedder, 2011). However, interpretation of item responses is usually mediated by statistical models grounded in hypotheses that do convalesce both the items operationalised dimensions. To illustrate, the much-used technique factor analysis (Chin et al., 2022; Louws, Meirink, et al., 2017; OECD, 2019a), maximises information about teachers' level of need by reducing information about preferred areas for CPL. Hence, the factor-analytic statistical representations permit the study of one conceptual interest by reducing information about the other. Moreover, when areas do not fit any factor, it is not uncommon to exclude them. Indeed, published factor solutions were derived using selections of the operationalised areas (e.g., OECD, 2019a) or, when authors attempted to include all originally operationalised areas, they felt that they had to remove misfitting areas (e.g., Louws, Meirink, et al., 2017). Exclusion of areas will result in statistical representations that are narrower than the original conceptualisation and operationalisation intended. Another concern with the use of factor analysis is that the technique has not proven to yield internationally invariant comparable metrics. Configural invariance can be achieved when

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selecting narrow item sets but then still model outcomes have low fit to the observed data in various countries, including the Netherlands and England that are subject of this study (OECD, 2014; OECD, 2019a). Sumarised, the further study and learning about professional learning needs will benefit from research taking a novel statistical approach that can provide information related to both our conceptual interests; what teachers want to learn and how much they need it, that can inform about teachers' learning needs while including all surveyed areas for professional learning, and which outcomes can be internationally compared.

Previously we found circular models to have superior model fit, can include all areas for CPL, and can yield cross-country comparable results (van der Lans et al., 2024). The circular method also enabled simultaneous study of our conceptual interests. In order to (1) examine the utility of the circular representation for international comparison of trends in teachers' CPL needs, (2) further our understanding of country-specific differences in educational policy developments in the domain of teacher learning and (3) investigate how differences in educational policies associate with trends in teachers' CPL needs, we asked: How do trends in teachers' CPL needs reflect country-specific policy developments between 2013 and 2018?

THEORETICAL BACKGROUND

This study applies the term CPL (rather than teachers' professional development) to emphasise that professional learning is an ongoing process. Viewing CPL as ongoing is consistent with beliefs in teachers to autonomously engage in CPL when prompted by policy revisions. CPL comprises formal and informal learning activities that aim to develop, broaden or update the skills, knowledge or expertise of in-service teachers (Boeskens et al., 2020). Learning activities can thus be studied along two dimensions: area and pedagogical-didactical mode. Areas of CPL refer to the many domains of skills, knowledge or expertise required for sustainable high performance in classroom teaching (e.g., knowledge of the curriculum, classroom management skills). The pedagogical-didactical mode[1] (e.g., external courses, professional learning communities) describes the CPL activity designs, i.e. how teachers learn about an area.

Circular conceptualisation of areas in need for CPL

Contemporary applied conceptualisation of teachers' CPL needs relies on various linear statistical models, mostly factor analysis (Louws, Meirink, et al., 2017; OECD, 2019b). As argued, linear models do not meet all conceptual interests and typically result in empirical factors narrower than the original operationalisations. The key claim here is that circular models are superior in identifying areas needing CPL. In contrast, linear models are better at identifying teachers' level of need to learn about that area. The ideal, therefore, is a combined circular-linear model. To further the field towards this goal, an adapted version of Guttman's (1954) circumplex was developed and fitted to data on teachers' CPL needs (van der Lans et al., 2024) by extending the original circumplex with a linear component. Among competing models, it was found to have the best fit for data on teachers' CPL needs (van der Lans et al., 2024).

An analogy of sailing is used to explain the model (see Figure 1). While the circular part of the model informs us about what direction is sailed, the linear part informs us about how far the crew (wants to) sail(s) in that direction. The left and right panels present two visual representations of the circular model for CPL needs, with both showing results for one hypothetical teacher. The coloured dots represent areas for CPL. In our analogy, they are the

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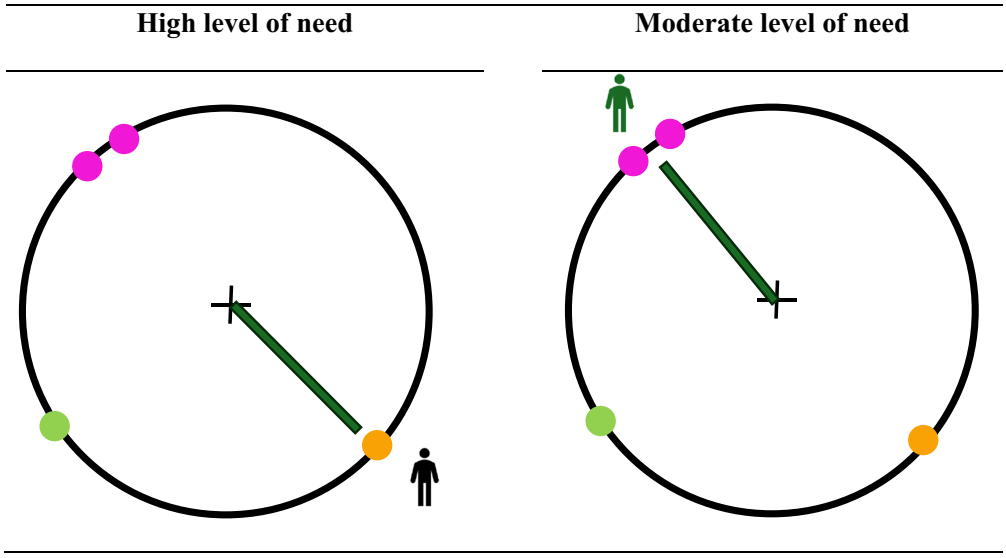

FIGURE 1 Two hypothetical circular representations of teachers' CPL needs. The left panel represents one teacher with a high level of need for CPL one the orange area; The right panel represents one teacher with moderate level of need on the pink areas. Because the proportional number of teachers is equal, the Windrose bars are of equal length. [Colour figure can be viewed at wileyonlinelibrary.com]

islands where we may need to sail towards. For this hypothetical example, the orange dot represents the CPL area 'student assessment practices,' the green dot represents 'pedagogical skill in teaching my subject,' and the pink dots represent the areas 'teaching students with special needs' and 'approaches to individualised learning.' Colour use reflects which areas are believed to refer to a common set of skills, knowledge or expertise based on theory and prior factor analytic evidence. Previous evidence had clustered the pink areas within the factor of 'needs for professional development for teaching for diversity' (OECD, 2019a). The black and grey icons are positioned near the area where the teacher has the highest need. This can be considered the teachers' preferred 'direction' for learning. Directions can also be visualised by bars that facilitate simultaneous plotting of many teachers. This type of circular bar plot is called a Windrose, and its interpretation is similar to histograms (Pewsey et al., 2013). The longer the bar, the larger the proportional number of teachers in that direction. The column headers discriminate the level of need. For example, the left panel represents a high level of need, meaning that bars in that plot refer to all teachers whose answers indicate relatively high CPL needs.

Occasionally, teachers conjoin CPL needs (i.e., assess multiple areas as being in the highest need). Conjoined needs impact on model results in two ways. First, when teachers typically conjoin two areas, there is a higher than average positive correlation, and the model will locate these two areas nearer to each other than to other areas (see pink dots; Figure 1). Second, when teachers' highest need for CPL spans two or three areas, the model assigns teachers one conjoined direction. Conjoined directions no longer point to one specific area (see the grey icon as an example of the hypothetical teacher with a conjoined direction towards the two pink areas; Figure 1).

Based on the variation in area location between countries found in our previous TALIS circular model study (van der Lans et al., 2024), we predicted area locations for CPL to vary per country in the current study. For example, the orange area of 'student assessment practices' located in 'The South-East' may be located in 'The South-West' in another country. This prediction concurs with prior factor analytic evidence suggesting no invariance, meaning

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that while areas may cluster in the same direction in some countries, the same clustering is not found in all countries (OECD, 2014, 2019a). Yet, in contrast to factor analysis, the exact item parameter has no effect on measurement invariance in circular models. To explain, the challenge of invariance with factor analysis is due to its linear dimension having no fixed origin and ending. Invariance depends then on the identification of one identical origin and ending, typically defined by item (or sample) parameters. Circular lines have a fixed origin and ending. Therefore, the challenge of invariance concerns mainly the scaling, i.e. does the distance between two items reflect the same association strength.

Conceptualising differences in educational policy

Comparison of policy developments between countries is complex due to the many individual policy revisions (OECD, 2015), the number of years it takes before policy effects become tangible, and since key events happening in two or more countries rarely occur in an identical manner (Viennet & Pont, 2017). We use the model in Figure 2 to describe differences in governance in Austalia, England, Japan and the Netherlands. The model in Figure 2 is based on prior work by (Sachs, 2016) and (van der Steen et al., 2019). It visualises two orthogonal dimensions: centralisation and steering-orientation. The centralisation dimension distinguishes between more hierarchically organised governance and more horizontally organised governance. We view hierarchically organised governance as an organisation that tends to centre decision power around one or some few parties involved. Horizontally organised governance tends to diversify decision power over many different parties involved. The steering-orientation dimension distinguishes between product-oriented governance and process-oriented governance. In product-oriented governance, teachers are incited to maximise effectiveness. Professionalism is evidenced by the 'product delivered' (Sachs, 2016). This product can take different forms but commonly used products are the class-average achievement test results and teachers' observed pedagogical-didactical expertise. In process-oriented governance, teachers are incited to maximise personal development (Sachs, 2016). Here, professionalism is considered as evidenced by the 'process' of teaching. Again this process can take different forms. Sachs (2016) presents teachers in this orientation as being role models that have an attitude enabling them to fully develop the whole child, thus cognitively, emotionally and morally. We propose a less specific broader conceptualisation and view process-oriented

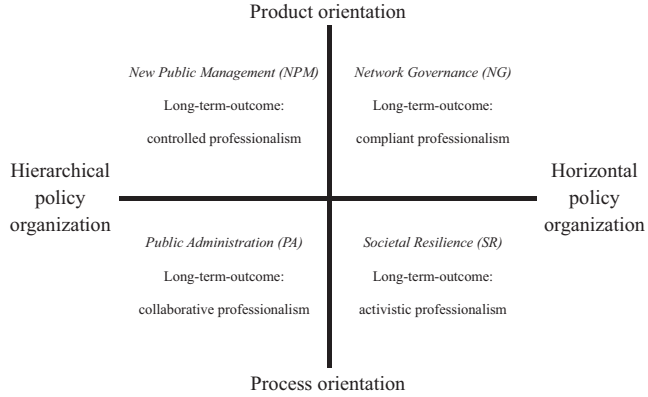

FIGURE 2 The applied model to distinguish between four governance styles. Horizontal axis reflects differences in centralisation; vertical axis reflects different orientations.

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governance as inciting teacher attitudes that convey interest, enthusiasm and eagerness among students to learn and develop themselves. Using the two orthogonal dimensions, four governance styles are distinguishable ((van der Steen et al., 2019), van der Steen et al., 2019): New Public Management (NPM), Network Governance (NG), (traditional) Public Administration (PA) and Societal Resilience (SR).

Sachs (2016) claims that robust and coherent applications of governance styles can shape teachers' perceptions of professionalism as controlled, compliant, collaborative and activistic perceptions. We added these hypothesized durable effects of governance styles to Figure 2 in non-italics. Controlled professionalism results from governance attempts to control teachers' performance by legislation articulating standards of compliance. This environment shapes perceptions of teachers as technicians and teaching as protocolised. Compliant professionalism evolves when networks of non-governmental organisations – together act as teacher representatives – formulate a change agenda to improve student achievement and complemented by standard evaluative protocols and procedures through which professionals can evaluate their contribution to student achievement (Sachs, 2016). This environment shapes teachers' perceptions of autonomous craftsmen, who define the norms and standards of being called 'professional teachers.' Collaborative professionalism results from governance that provides incentives to develop teachers' pedagogical-didactical skills as well as their personality, attitude and research skills (Sachs, 2016). This environment shapes perceptions that there are more ways to be a 'good' teacher and that teachers can learn from each other's strengths through collaboration. Activist professionalism unfolds when teachers organise themselves (specify their own procedures and frameworks) to drive professional renewal, transform existing practice and create new professional knowledge (Sachs, 2016). This environment shapes perceptions of teachers as self-evaluative, reflective and research-minded professionals who collaboratively engage in CPL for personal and professional growth. The present study employs the model to examine educational policy developments in four countries: Australia, England, Japan and the Netherlands.

An application of the model

This section presents a review of the most important policy developments in Australia, England, Japan and the Netherlands in the last two decades and relates these to the model in Figure 2. These countries have been well-studied, allowing us to relate the circular model outcomes with national policies. The authors' expertise in studying these countries further benefits this aim. The section will review Australia and England together as these countries are claimed to have similar cultural and policy profiles (Campbell & Stephenson, 2019). Japan and the Netherlands are thereafter presented apart.

Australia and England

Australia and England have occasionally been described as 'borrowers' of each other's policies (Campbell & Stephenson, 2019; Mayer & Mills, 2021). Australia and England both introduced new curriculum and assessment standards between 2008 and 2011 (DfE, 2011; AITSL, 2024). Also, both countries implemented teaching standards (Call, 2018) articulating skills and behaviours that exemplify high quality teaching. Both countries also have been framed as preoccupied with accountability as a mechanism to enforce compliance and uniformize schooling (Freedman, 2023; Mutton et al., 2017; Sachs, 2016). However, despite their similarity in policy intentions, their policy implementation differed. The Australian federal system, for example, does not allow for centralised implementation

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of policy while the English system does. To implement educational policies Australia established the ACARA (Australian Curriculum, Assessment and Reporting Authority [ACARA], 2023), a semi-governmental organisation financed by and accountable to the federal government and the State and Territory governments. While ACARA can be viewed as a centralisation of educational policy, Savage (2016) claims it is better viewed as an attempt to organise governmental networks of cooperative governance. England, instead, disbanded semi-independent non-governmental institutions which had functions similar to ACARA (Ellis et al., 2021) to give the Departement of Education (DfE) greater leverage to control policy implementation. Another second example of difference in governance styles is Englands commitment to stimulate the development of alternative routes to teacher certification (Mayer & Mills, 2021). England established many alternative routes to teacher certification between 2010 and 2020. To promote these routes, English policymakers occasionally presented 'learning to teach' as involving no more than the mastering of didactical routines and procedures (Mayer & Mills, 2021; Menter et al., 2019). Moreover, learning-by-doing was assumed to be superior to university-based teacher education, with its accent on theory (Mayer & Mills, 2021). These statements prompt perceptions of controlled professionalism which, according to Sachs (2016), is the result of robust and coherent governance according to the principles of NPM. Australia, instead, kept university-based teacher education as the main route to teacher certification and its policymakers did not prompt perceptions of controlled professionalism alike their English colleagues. Another third example concerns the role assigned to school inspections. NPM goverance tends to make schools and teachers accountable for achieving thressholds and standards, but this only works if noncompliance has (severe) consequences (Hwa, 2023). In England, the Ofsted inspectorate has increased its ability to leverage schools' accountability policies ever since its establishment in 1992 (Freedman, 2023). Espcially the 2006 Education and Inspections Act, which assigned Ofsted the power to make schools 'eligible for intervention', substantially expanded Ofsteds ability to change English education and eforce compliance with standards. Australia never organised a national inspectorate. School inspection falls under the authority of the States and Territories (Cunningham, 2019) and inspection criteria often are a mix of product-oriented evidence; e.g., student success rates and process-oriented evidence; e.g., teacher attendance to specific courses; proportion of certified teachers.

In sum, Australia and England tend to 'borrow' policy intentions and organise policy revisions accordingly. Yet, English policies were more successful in centralising control and uniformly implementing educational policies in accord with principles of NPM whereas the Australian federal system seemed to be restrained in its possibilities for complete centralisation. As a result, Australia's governance of educational policy mixes NPM with aspects related to NG and PA. Effects of these different governance structures must have accumulated over the years and, because most educational reforms occurred in the 2008–2014 time frame, the 2013 TALIS administration is less affected by these differences in governance than the 2018 administration.

Japan

Japan's government typically uses curriculum revision to achieve its national policy aims (Yamanaka & Suzuki, 2020). In terms of the governance model, Japan's policies are hierarchically organised but tend to be more process-oriented than policies in Western countries. Japan's government typically applies a ten-year cycle in which revisions are introduced, implemented and evaluated. In this cycle, policy revisions are advised upon by a network of institutions, including the Council for the Implementation of Education Rebuilding, to help

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with policy implementation (OECD, 2018b). Japan combines this hierarchical organisation of educational policy with an institutionalised lesson study culture at both formal and informal levels (OECD, 2018c). Lesson study horizontally organises Japanese teachers' teaching at the same school to create and develop lesson series based on the national curriculum and decide about appropriate pedagogical approaches to teach subject content together at the school while regularly communicating it with other schools. We classify this as SR. Overall then, Japan's governance is most consistent with governance styles sharing a process-orientation (PA and SR).

Japan's policies have consistently pursued objectives to promote the shift from knowledge-transmission model of teaching to discussion and inquiry-based model of teaching since the 1980s (Yamanaka & Suzuki, 2020). Predictability and consistency helped teachers to prepare for coming revisions and ensured gradual smooth implementation. An exception is the introduction of Integrated Studies in the early 2000s with the relatively open-ended definition of what teachers should do for teaching the new subject area. Although its introduction was announced and fitted with longstanding policy objectives (Yamanaka & Suzuki, 2020), studies hint that Integrated Studies had a marked impact on teachers' perceptions, practices and routines (Bjork, 2009; Bjork & Tsuneyoshi, 2005). Integrated Studies had a cross-curricular project-based design and the goal to teach students 21st century abilities. All middle school teachers were supposed to teach Integrated Studies in addition to their core subject area (Bjork, 2009). To accommodate this, teaching time for core subjects was cut about 30%. Policies stressed that teachers plan Integrated Studies lessons and the lesson goals themselves as they collaborate with each other. Teachers were assumed to take coaching roles for student self-initiated projects. Many of these features of the new subject were new to Japanese teachers. The trivial support from the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in planning lesson goals, the weak links to the rest of the traditionally existent curriculum and the pedagogical approach led to challenges (Bjork, 2009; Bjork & Tsuneyoshi, 2005). The introduction of Integrated Study sparked fierce debate in society and exacerbated existing differences in pedagogical vision (Bjork & Tsuneyoshi, 2005). Debates eased after the 2012–2013 revisions which decreased time for Integrated Study.

The Netherlands

Existing policy reviews suggest that Dutch policies mostly steer education through NG (van der Steen et al., 2019). This governance style exercises high product-orientation by using peer pressure and benchmarks set by external non-governmental organisations (Browes & Altinyelken, 2021). However, Dutch teachers' perception of their government as rigid and distrusting evoked protest. Dutch teachers organised themselves within various associations to fight and oppose various policy changes – an activistic attitude that fits SR (van der Steen et al., 2019). Overall, Dutch governance was impacted by horizontal organisation more than policies in the other countries.

Evaluations of Dutch educational policy between 2010 and 2020 indicate that it was unpredictable and inconsistent (Rijksoverheid, 2022). To illustrate, during 2013–2018, Dutch policymakers signalled their desire for a mandatory teacher registration system. This sparked strong opposition from teachers and advisory bodies (van der Steen et al., 2019). The government implemented the system nonetheless but made registration voluntary. Few teachers registered, and the system was revoked just two years after its implementation. Another example of inconsistency is provided by the Dutch government's 2015 installation of 'Onderwijs2032' [education2032], a committee of experts that had the objective to propose curriculum revisions and adaptations expected to better prepare Dutch students

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for future jobs (Platform Onderwijs2032, 2016). Again, plans were met with teacher opposition, were reverted, and eventually relaunched under the name Curriculum.nu [curriculum. now]. Curriculum.nu included teachers' voices but had ambiguous objectives (Onderwijsraad, 2018), and the initially planned revisions were diluted.

METHODS

Study design and data selection

Secondary analyses of TALIS 2018 and 2013 data were performed. TALIS data is available for open access.[2,3] Country samples of secondary school teachers in Australia, England, Japan and the Netherlands were selected. Details on sampling procedures are reported in the OECD technical reports (OECD, 2014, 2019a). TALIS has a trend study design, meaning that it gathers repeated observations from the same population but does not use the same sample of teachers or schools. This permits inferences about trends at the population level. Two exclusion criteria further defined our sample. First, we selected experienced teachers (≥5 years teaching experience). Beginning teachers were excluded because they can be enrolled in induction programs and are known to have different needs for CPL (Schleicher, 2016). Second, we restricted the maximum years of teaching experience so the population in 2013 would still be identifiable in 2018. As a result, the samples included the teacher cohort that started teaching between 1983 and 2008.[4] Because teachers started teaching during the same decades, they experienced the same policy reforms.

Instruments

TALIS operationalises teachers' CPL needs using the question: 'For each of the areas listed below, please indicate the extent to which you currently need professional learning activities,' after which a structured list of 14 areas followed (items *A* through *N*). Items *A* through *K* were administered in TALIS 2013 and TALIS 2018. Every item had four response categories: no need at present (0), low level of need (1), moderate level of need (2) and high level of need (3).[5] For an overview of item wording and descriptives statistiscs, see Data S1.[6]

Model fit

Configural and metric invariant analogues of the adapted circumplex model were estimated. The configural analogue posed no constraints on item locations, item communalities and on minimum score correlation (MSC). The metric invariant analogue constrained the MSC to $r = 0$. The Data S1 compares model fit coefficients for the configural analogue of the adapted circumplex model with the fit coefficients of configural invariant CFA's reported by TALIS (OECD, 2014, 2019a, 2019b) and two alternative linear measurement models: Generalised Partial Credit model (GPCM; Muraki, 1992) and Generalised Graded Unfolding Model (GGUM; Roberts et al., 1996).

This study reports on results of the metric invariant analogue of the adapted circumplex model. Model fit coefficients for this analogue of the model are presented in the Data S1 alongside those of the configural analogue, but since metric invariance imposes constraints stricter than those imposed by the GPCM, GGUM and CFA models, fit coefficients of the metric invariant analogue should not be compared directly.

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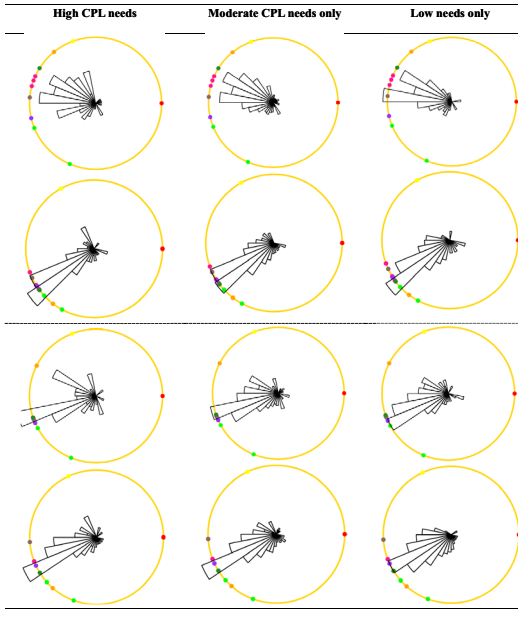
Analyses

Trends in area locations ($\angle_i$) and teacher positions ($\angle_p$) were examined at the population level. Trends in $\angle_p$ largely coincide with trends in mean Likert scale scores. Analyses found few changes in the mean Likert scale scores (OECD, 2019b). Therefore, we did not expect to find substantial trends in $\angle_p$. Trends in $\angle_i$ signal that teachers more often want to learn about some conjoined group of areas for CPL. Changes in $\angle_i$ were tested using the item Confidence Intervals (CIs). CIs were corrected for chance inflation using Bonferroni correction (i.e., CI = 100 − (5/11) = 99.54%).

The adaptation of the circumplex model concerns an extra step prior to the standard estimation though Browne's (1992) CIRCUM programme. The extra step transformed Likert scores into item step scores according to the Adjacent Category Approach (Penfield, 2014). Correlations were estimated for every item step apart, after which correlation results were pooled using Fisher's Z transformation procedure. Details can be found in the Data S1. The output of CIRCUM was further analysed in R and Rstudio with visualisations constructed using latex packages. Software versions and software packages are reported in the Data S1.

RESULTS

Figure 3 shows the circular distributions of $\angle_i$ and $\angle_p$ for Australia (top panel) and England (bottom panel) in 2018 (top row) and 2013 (bottom row). Figure 4 similarly shows the distributions of $\angle_i$ and $\angle_p$ for Japan (top panel) and the Netherlands (bottom panel) in 2018 (top row) and 2013 (bottom row). Coloured dots on the circumference represent the distribution of $\angle_i$. Tables printed alongside the figures provide item locations in the columns 2013 ($\angle_i$)' and '2018 ($\angle_i$)' and link these to the 11 inquired trend areas. The bars originating in the centre and pointing towards locations on the circumference (called a Windrose) provide



	Areas	2013 ($\angle_i$)	2018 ($\angle_i$)
A	Knowledge and understanding of my subject field(s)	0°	0°
B	Pedagogical competencies in teaching my subject field(s)	118°	113°
F	Student behaviour and classroom management	137°	158°
G	School management and administration	147°	167°
J	Teaching in a multicultural or multilingual setting	155°	185°
I	Teaching students with special needs	160°	195°
H	Approaches to individualised learning	148°	200°
K	Teaching cross-curricular skills (e.g. creativity, critical thinking, problem solving)	144°	204°
E	ICT (information and communication technology) skills for teaching	143°	212°
D	Student assessment practices	127°	231°
C	Knowledge of the curriculum	241°	250°

	Areas	2013 ($\angle_i$)	2018 ($\angle_i$)
A	Knowledge and understanding of my subject field(s)	0°	0°
B	Pedagogical competencies in teaching my subject field(s)	110°	112°
F	Student behaviour and classroom management	138°	151°
G	School management and administration	155°	156°
J	Teaching in a multicultural or multilingual setting	176°	159°
K	Teaching cross-curricular skills (e.g. creativity, critical thinking, problem solving)	159°	160°
H	Approaches to individualised learning	148°	160°
E	ICT (information and communication technology) skills for teaching	155°	161°
I	Teaching students with special needs	148°	161°
D	Student assessment practices	131°	207°
C	Knowledge of the curriculum	245°	249°

FIGURE 3 Longitudinal trends in Australian (top panel) and English (bottom panel) teachers' positions in 2018 (top) and 2013 (bottom). In the Windrose, the length of bars is relative to the number of data points in the plot. Bar length can not be compared between visualisations. [Colour figure can be viewed at wileyonlinelibrary.com]

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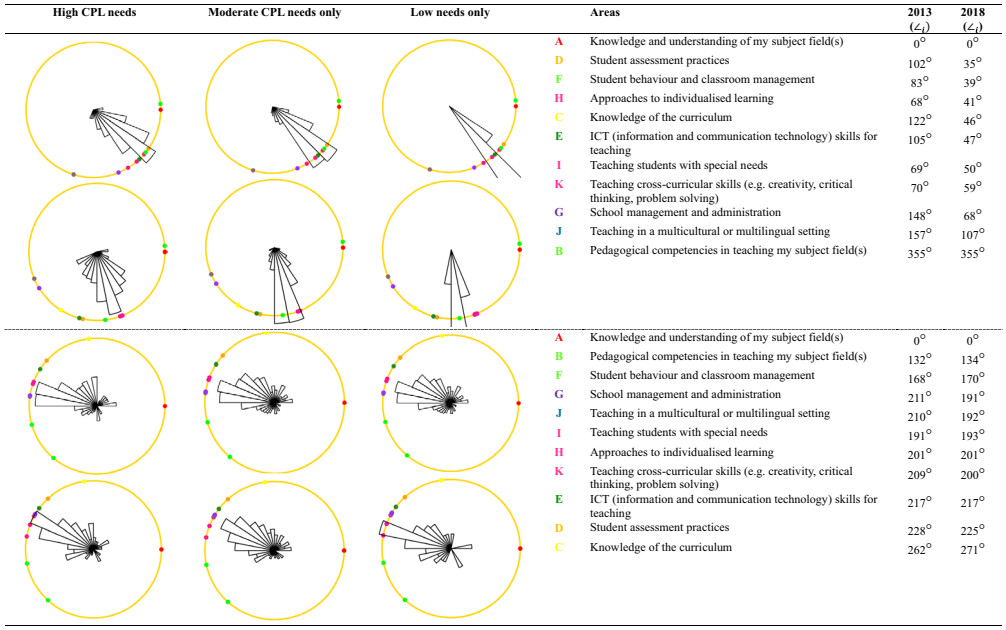

FIGURE 4 Longitudinal trends in Japan (top panel) and Dutch (bottom panel) teachers' positions in 2018 (top) and 2013 (bottom). In the Windrose, the length of bars is relative to the number of data points in the plot. Bar length can not be compared between visualisations. [Colour figure can be viewed at wileyonlinelibrary.com]

information about the distribution of $\angle_p$. Longer bars point to locations where more teachers were positioned. This teacher position is a composite weighted estimate of the area(s) of teachers' highest CPL need. Every row in every panel aligns three plots ordered by group. The high needs plots show teachers with at least one area for which they felt a high CPL need; The moderate needs teachers with at least one area for which they felt a moderate need but none were high needs; The low needs teachers with at least one area for which they felt a low need but none were moderate or high needs. Based on the findings shown in both figures, the following sections highlight the three key trends observed in these countries.

Trend 1: Australian and English secondary teacher populations have overlapping distribution of $\angle_i$ in 2013, but overlap was less in 2018

English and Australian secondary education teachers have similar distributions of $\angle_i$ in 2013. In fact, $\angle_i$ is not significantly different between Australia and England (Table 1). In comparison to Japan and the Netherlands, both these countries have low proportions of teachers with high learning needs (Table 2).

In Australia, seven areas have significantly different $\angle_i$ in 2018 compared to 2013. In England, just two areas have significantly different $\angle_i$. Further examination of Table 1 can teach us that in 2018, the distributions in Australia and England are less similar. While in 2013, Australia and England had no differences in $\angle_i$, in 2018 five areas have different $\angle_i$ in Australia compared to England. In Australia, area locations are more dispersed in than in 2013, while in England, areas mostly remain cluttered in the right-down corner. These changes coincide with an slight increase in the proportion of Australian teachers with high CPL needs (28 to 31%) and a slight decrease for English teachers (22 to 20%).

The only common trend in Australia and England is observed with area D. The area D 'Student assessment practices' changes location in both these countries from around 130°

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TABLE 1 Trends for CPL areas A to K between 2013 and 2018 TALIS administrations.

	Australia		England		Japan		The Netherlands	
	99.5%CI 2013	99.5%CI 2018	99.5%CI 2013	99.5%CI 2018	99.5%CI 2013	99.5%CI 2018	99.5%CI 2013	99.5%CI 2018
A	—	—	—	—	—	—	—	—
B	109–127°	104°–122°	99–122	101°–124°	349–1°	349°–1°	120°–144°	118°–142°
C	231–251°	240°–260°	235–255	239°–259°	112–132°	36°–56°	237°–287°	238°–288°
D	121–133°	225°–237°	124–138	200°–214°	91–113°	24°–46°	213°–243°	207°–237°
E	131–155°	200°–224°	138–158	151°–171°	92–118°	34°–60°	198°–236°	194°–232°
F	130–144°	151°–165°	129–147	142°–160°	70–96°	26°–52°	152°–185°	148°–181°
G	136–159°	156°–179°	144–166	145°–168°	138–158°	58°–78°	186°–236°	164°–214°
H	139–157°	191°–209°	140–156	152°–168°	56–80°	29°–53°	185°–217°	183°–215°
I	144–177°	179°–212°	150–168	152°–170°	55–83°	36°–64°	176°–206°	174°–204°
J	142–168°	172°–198°	162–190	145°–173°	144–170°	94°–120°	192°–228°	170°–206°
K	135–153°	195°–213°	146–164	151°–169°	56–84°	45°–73°	194°–224°	186°–216°
MSC	$r=0.00$	$r=0.00$	$r=0.00$	$r=0.00$	$r=0.00$	$r=0.00$	$r=0.00$	$r=0.00$

Note: Confidence intervals were Bonferroni corrected for chance inflation; $p=0.05/11$. Grey shadowing indicates significant change in area location. Trends in MSC values are reported at the bottom.

in 2013 to locations between 200° and 240° in 2018. This change is the largest observed in both countries. Areas D location in 2013 hints that Australian and English teachers associated learning about assessment practices with learning about areas related to general pedagogical skills, classroom management and more advanced teaching methods. The location in 2018 hints that Australian and English teachers associated learning about assessment practices with learning about the area 'knowledge of the curriculum'. In 2013, the area's location is similar to how Japanese teachers locate it, in 2018, the area's location is similar how Dutch teachers locate it.

Trend 2: Japanese teachers perceive knowledge about the curriculum as more central to professional learning in 2018 than they did in 2013

Alike Australia, Japan shows seven changes in area locations between 2013 and 2018 (Table 1). This signals that Japanese teachers' ideas of combining areas for professional learning changed considerable. We pay specific attention to the change in location of the area 'Knowledge of the curriculum' (yellow). This area was located at 122° in 2013, which is outer the cluster of items at the bottom. In 2018, however, it changed location to 46°, which is in the centre of the cluster of areas. Areas located at the centre have elevated associations with both the areas located left and right to it, suggesting Japanese teachers in 2018 more often than in 2013 believed that learning 'Knowledge about the curriculum' is well combined with learning about most other areas. We can further observe that in 2013 most Japanese teachers' $\angle_p$ are postioned in the direction to the areas 'classroom management' (83°), and the pink areas 'Teaching cross-curricular skills' (70°), 'Teaching students with special needs' (69°) and 'Approaches to individualised learning' (68°). As the OECD (2019a) reports, most Japanese teachers express high needs for learning on areas 'Knowledge of Knowledge and understanding of my subject field(s)', and 'Pedagogical competencies in teaching my subject field(s)', hence, the pink areas plus classroom management were the ones that identified unique needs. In 2013, these four areas were the most central located in the distribution

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TABLE 2 Distributions of proportions (P) of teachers with high, moderate, or low CPL needs complemented by teachers' mean years of teaching experience.

		N (*P*)		$M_{(experience)}$ (SD)	
	Level of need	**2013**	**2018**	**2013**	**2018**
AUS	High need	327 (0.28)	410 (0.31)	16.3 (7.5)	21.0 (7.3)
	Moderate need only	658 (0.56)	752 (0.56)	16.6 (7.5)	20.5 (7.0)
	Low need only	186 (0.16)	171 (0.13)	15.8 (7.4)	22.2 (6.8)
ENG	High need	312 (0.22)	201 (0.20)	14.2 (6.4)	18.8 (5.9)
	Moderate need only	725 (0.52)	565 (0.57)	13.6 (6.3)	18.5 (6.0)
	Low need only	359 (0.26)	226 (0.23)	13.7 (6.4)	19.1 (6.7)
JPN	High need	1688 (0.77)	1421 (0.79)	18.1 (7.7)	22.2 (7.5)
	Moderate need only	479 (0.22)	364 (0.20)	20.1 (7.3)	24.9 (7.3)
	Low need only	13 (0.01)	16 (0.01)	16.8 (8.9)	25.1 (8.1)
NLD	High need	454 (0.42)	431 (0.48)	14.7 (6.8)	19.4 (6.6)
	Moderate need only	566 (0.52)	408 (0.46)	15.3 (7.3)	20.3 (6.9)
	Low need only	73 (0.07)	50 (0.06)	15.2 (6.9)	21.0 (7.7)

Note: Selected cohorts are: TALIS 2013 all teachers with 5–30 years of experience and TALIS 2018 all teachers with 10–35 years of experience. These were all experienced teachers that started teaching somewhere between 1983 and 2008. We expect mean differences of 5 years.

in 2013, hinting that learning needs on pink areas plus classroom management were most consistently conjoined with needs to learn about other areas. Compared to 2013, the 2018 distribution of areas is less dispersed and more cluttered. This cluttering in 2018 is, in contrast to England, not coinciding with a decrease in the proportion of Japanese teachers with high learning needs (Table 2).

Trend 3: The Netherlands; No significant changes but more teachers with high CPL needs

The areas that significantly changed locations ($p < 0.05$) between 2013 and 2018 are shaded in grey in Table 1: seven areas in Australia and Japan changed location, two in England and none in the Netherlands. By comparison the area locations in the Netherlands have wider CI's (Table 1). Where in the other countries, the 99.5% CI width rarely surpass the 30°, in the Netherlands all but one CI surpass the 30°. The wider intervals indicate that Dutch teachers have lower consensus on conjoining needs for areas of professional learning. Interval width does not change between 2013 and 2018 due to which it cannot be ruled out that the wider CI's are typical to Dutch teachers. Despite the possibly lower consensus signalled by the CI's and the absence of changes in area location, the proportion of teachers with high learning needs increases from 2013 to 2018 (Table 2).

DISCUSSION AND CONCLUSION

We asked: How do trends in teachers' CPL needs reflect country-specific policy developments between 2013 and 2018? Using the circular conceptualisation, we delineated various trends observed between 2013 and 2018 in Australia, England, Japan and the Netherlands. Key findings indicate that (1) Australian and English teachers had similar levels of CPL needs

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with highly similar distribution of areas for professional learning in 2013, but overlap was much lower in 2018 and the proportion of teachers with high learning needs increased in Australia, while it decreased in England; (2) Among Japanese teachers the area 'Knowledge of the curriculum' changed location and its new 2018 location suggest that Japanese teachers got to perceive it as more central to their professional learning; and (3) Among Dutch teachers, the areas for professional learning did not change location between 2013 and 2018 and they had least consensus on area locations.

We reiterate that (our adapted version of) the circumplex was again able to keep all areas in its statistical representation, this time with data from secondary education teachers. The model had superior fit to other psychometric models. Moreover, the trends delineated coincide with policy developments we described in theoretical background, which hints on the model's validity and utility. Together this further supports our claim that this adapted circumplex model can help researchers and policymakers to identify trends in teachers' CPL needs more comprehensively, using all available data and review trends in relation to educational policy developments than other models can. In what follows we will discuss associations between key trends and policy developments in the four countries.

Australia and England: Divergent trends in CPL needs

The results show that in Australia, the distribution of the areas for CPL is more dispersed in 2018 than in 2013, while in England, it remains cluttered, with most areas being located near to the area of classroom management in 2013 and in 2018. In parallel, the proportion of Australian secondary teachers with high levels of CPL need is larger in 2018 compared to the 2013 cohort, while in England it is smaller. In one prior study on primary education teachers, we also identified the combination of low proportions of teachers with high learning needs and a cluttered distribution of areas for CPL in Australia and England. We then attributed this combination to the effects of a standardised and collective organisation of CPL that inhibits teachers' autonomous reflection on their learning needs. The current study results suggests that this combination persists in English secondary education but not in Australia.

Literature on educational policy links Australia and England both to New Public Management (NPM) driven accountability policies (Menter et al., 2019). Yet, our own review of policies in both countries indicates this labelling may be incomplete. Australia has, at least since 2010, gradually diversified its governance, while England tended to uniformize it. Australian policymakers' decision to organise semi-independent non-governmental institutions to govern teachers' CPL (i.e., AITSL; Savage, 2016) is an example of this diversification as this policy fits Network Governance, not NPM. Australian policymakers' decision to keep with university-based teacher education as the main route to teacher certification is another example, as policies upkeeping certification awarded by semi-governmental representatives fits principles of Public Administration. English policies, on the contrary, further unified their governance according to NPM. To illustrate, English policies disbanded semi-independent non-governmental institutions (Ellis et al., 2021). Remarkably English policymakers argued that abolishment of these institutions assisted efforts for decentralisation of policies on teachers' CPL and delegate authority over teachers' CPL to the schools. However, they linked this authority with accountability (Freedman, 2023). Freedman gives some examples clarifying how the severe consequences of not meeting standards pressed English schools to follow protocolised schemes and standards. Alongside, English policymakers disreputed university-based teacher education and consistently presented 'learning to teach' as involving no more than the mastering of routines and procedures (Mayer & Mills, 2021; Menter et al., 2019). Policies encouraged commercialised institutions to develop other routes to obtain teacher certification, and, in contrast to other countries that implemented such

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alternative routes, English policymakers meant these to replace university-based teacher education, not to complement it (Mayer & Mills, 2021). The desire to exchange traditional university-based teacher education, with its multi-dimensional assessment of teacher knowledge, skills and expertise, for alternative routes fixated on the acquisition of directly observable, thus measurable, behaviours is another example of English policymakers' insistence to govern education according to principles of NPM.

Summarised, consistent with our predictions, the English fixation on collective (i.e. school-wide) and standardised organisation of CPL coincide with the cluttering of areas for CPL on the circumference and a (slight) decrease in the by comparison already low proportion of teachers with high need for CPL. Contrary, the gradual diversification of governance in Australia, which makes it a multi-actor effort, complicates uniform collective organisation of CPL. Also, the conflicting interest of actors complicate complete standardisation of procedures. Consistent with our predictions, this less controlled environment coincides with the more dispersed area locations on the circumference and a slight increase in the proportion of teachers with higher needs for learning.

Common trends in Australia and England

While the dominant trend is the emerging differences between Australia and England, the two countries also share common trends. One is the relocation of the area 'student assessment practices'. In 2013, this area is located near the areas related to learning about general pedagogical skills, classroom management procedures and more advanced teaching methods. This location is consistent with a formative interpretation of assessment practices. When assessment practices are formative, assessment results are meant to inform teachers' pedagogy and teaching methods (Black & Wiliam, 2009). In 2018 teachers relocate the area student assessment practices and locate it near to the area 'knowledge of the curriculum'. This is the largest change in area location in Australia and England. The 2018 location is consistent with summative interpretations of assessment. When student assessment is summative, assessment results are meant to inform teachers' decisions about whether students pass or fail the standards. The relocation of the area student assessment practices, coincides with early 2008s policy revisions on the curriculum and learning goals. In Australia, policymakers founded ACARA, a semi-governmental organisation responsible for Australian curriculum standards and the administration of standardised assessment tests to assess students' attainment of curriculum standards. The foundation of ACARA, which manages curriculum revisions and student assessment, by itself already accentuates the connection between curriculum, standards and student assessment. Moreover, ACARA is closely linked to the AISTL, another semi-governmental organisation responsible for development and assessment of teaching standards and the allocation of resources for CPL. The gradual accumulation of experiences from 2008 onwards by Australian secondary school teachers with ACARA may have gradually changed Australian teachers' perspectives on the goals of student assessment practices. In England, the department for Education published the Framework for the National Curriculum (DfE, 2011), which informed the national curriculum revisions for primary and secondary education that came into force in 2014. The framework for the national curriculum communicated a clear desire to narrow down and more explicitly state the standards that students should attain. Transparency was meant to serve different purposes one of which was that it should enable the connection between curriculum standards and school accountability (e.g., DfE, 2011). The connection of the curriculum standards to school accountability, present strong incentives to secondary schools to link assessment outcomes with the curriculum standards. Another parallel development concerned policy interventions on secondary school assessment policies. Thomson et al. (2025) provides a detailed history of English policies on student assessment in secondary education.

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Here we accentuate the role of the debates on supposed 'grade inflation' which Thompson claimed marked the transition to an era of stricter student assessment policies from 2005 onwards. These stricter assessment policies re-assumed students' attainment of thresholds to be the primary purpose of assessment. In sum, policymakers in both countries substantially intervened in assessment and policy-interventions tended to accentuate the summative function of student assessment.

Japan: The curriculum became more central in professional learning needs

Japan often uses curriculum revisions to drive educational policy (Yamanaka & Suzuki, 2020). The central position of 'Knowledge of the curriculum' aligns with this, though its outer-cluster placement in 2013 does not. Yet, this result resonates with other studies describing key policy developments during the 2000s and early 2010s.

In the early 2000s, the government introduced Integrated Study, a new subject aimed at promoting discussion and inquiry-based learning. While consistent with earlier reforms (Yamanaka & Suzuki, 2020), Integrated Study significantly influenced teachers' practices and perceptions (Bjork, 2009; Bjork & Tsuneyoshi, 2005). It marked Japan's first attempt at cross-curricular, project-based education. Japanese policymakers intended Integrated Study to improve teaching of students' 21st century skills by mitigating the supposed traditional focus on rote learning (Yamanaka & Suzuki, 2020). However, *Integrated Study* stood apart from traditional core subjects and lacked alignment with existing National Courses of Study (Nishioka, 2017). Policies advocated for the practice of novel student-cantered pedagogical approaches which were communicated as competing with the traditional ones (Bjork, 2009). All middle school teachers were expected to teach it, often with little training or guidance on content, pedagogy, or assessment, which Japanese teachers experienced as confusing (Bjork, 2009). Simultaneously, curriculum revisions cut 30% of instructional time in core subjects to allow for *Integrated Study* and inquiry-based activities. These changes underscored MEXT's commitment to the reform but placed pressure on teachers to design their own lessons and develop new teaching methods apart from the NCS guidelines. This all directed considerable attention to 'Cross-curricular teaching methods.'

The reforms provoked intense debate. At the centre of this debate stood the curriculum and its goals and function. Supporters of the reforms emphasised the importance of developing the 'whole child' and fostering *zest for life*—a mix of knowledge, self-discipline, the ability to cooperate, empathy, resilience and emotional health (Yamanaka & Suzuki, 2020). Critics argued for the importance of providing children with a strong knowledge base and stated that the reforms diluted academic rigour and weakened Japan's knowledge-centred teaching tradition (Bjork, 2009). The 2004 'PISA shock' intensified this debate. In response, the 2008 revisions restored balance between core-subject learning and cross-curricular learning (Nishioka, 2017; Yamanaka & Suzuki, 2020), implemented nationwide from 2010 to 2012. An event that likely impacted on Japanse teachers' perceptions in 2013 was the 2011 Fukushima disaster. The disaster revitalised the importance of the attitudes promoted by 'zest for life' and made disaster-prevention education a key theme within *Integrated Study*.

Overall, the years before TALIS 2013 were marked by debates over the implementation, postion and goals of *Integrated Study*. The debates amplified disparities between the traditional educational organisation in which the curriculum and teaching approaches were outlined by the MEXT and the new educational organisation in which cross-curricular teaching methods were promoted, for which teachers had to create resources themselves. This can explain the outer location of 'Knowledge of the curriculum' and the larger distance between the areas 'Knowledge of the curriculum' and the area: 'Teaching of cross-curricular skills' in

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2013. The 2012–2013 policy revisions reduced *Integrated* Study time and refocused on core subjects, explaining the central location of 'Knowledge of the curriculum' in 2018.

The Netherlands; no changes in teachers CPL needs

The absence of changes observed with Dutch teachers' CPL needs hints at limited effectiveness of Dutch policies. This finding is corroborated by other reports (Rijksoverheid, 2022) which characterised Dutch policies as fragmented and inconsistent. Policies were impacted by teacher-organised associations that fought various policies. Dutch implementation of the teacher register (which was supposed to be mandated) ended up voluntary and, due to teacher resistance, was revoked two years after its implementation; Dutch implementation of curriculum revision, see the background, is another example of ineffective Dutch educational policy during this time window.

Policy effectiveness; some lessons learned from the four country cases

Dutch policy ineffectiveness coincides with Dutch governance being shaped by horizontal organisation (i.e. network governance [NG] and societal resilience [SR]). Horizontal organisation of governance is sometimes presented as less effective (Viennet & Pont, 2017), as intuitively a hierarchical organisation, in which one or some few actors decide, allows for greater uniformity in policy implementation. Study results concerning the Netherlands may be perceived as consistent with this intuition but we caution against such causal interpretations as our study lacks the design required for causal conclusions. We stress that the Dutch case illustrates an activistic type of SR. Dutch teachers organised themselves not to create policies but to resist and oppose them. This possibly temporary reaction was elicited by perceptions of an insensitive, rigid government. Hence, cases of horizontal organisation that would be characterised by teachers proactively organising themselves to participate in policy decisions and to shape policy implementation may impact differently on policy effectiveness. The Japanese case also counters claims of supposed ineffectiveness of horizontal organisation. Our results suggest that Japan was among the countries with the most changes in teachers' perceptions, yet its governance constitutes a mix of hierarchical organisation with an institutionalised lesson study culture at both formal and informal levels, which we classify as SR thus horizontally organised.

Another common hypothesis is that predictability and coherence explain policy effectiveness (Viennet & Pont, 2017). Policies need time to be understood and implemented well. The Japanese and Dutch case both provide evidence supporting this hypothesis. The Dutch case shows no changes while its policy has been characterised as inconsistent and incoherent (Rijksoverheid, 2022). Japan's educational policies have been highly predictive, durable and consistent (Yamanaka & Suzuki, 2020) and its case shows many changes in teachers' perceptions. Beyond Japan and the Netherlands, the Australian policies were relatively consistent and coherent during the studied time frame and, like Japan, the Australian case reports many changes. But looking at the English case, the picture obscures. Within the studied time frame, England was governed by conservative governments which consistently and coherently implemented educational policies according to principles of NPM. However, English policies yielded much less changes among English teachers' perceptions compared to Australian and Japan's. The English case feeds the idea that predictability of coherence may be required but insufficient conditions for policy effectiveness. Common to Australia and Japan, is that both mix hierarchical and horizontal types of governance. This mix may help these countries to overcome the common gap

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between policy intentions and policy implementation (Viennet & Pont, 2017). Hierarchical organisation of governance may facilitate communication of policy intentions while horizontal organisation of governance helps to involve multiple actors which may facilitate policy implementation. From this perspective the English case, with its major focus on hierarchical governance, might be an example of uniform policy intentions that do not translate into uniform policy implementation.

Study limitations

This study replicates the previously found superior fit of the circular conceptualisation of teachers' CPL needs (cf. van der Lans et al., 2024; Data S1). It also reestablishes evidence of its utility to study the impact of educational policies. Yet, current evidence is restricted to two studies based on a total of eight large two-stage cluster random samples (1000+) gathered in four different countries. Extending replications to other countries can still further benefit claims of validity.

TALIS sampling procedures and representativeness are exceptional, yet its survey design also bears some limitations. Surveys permit the study of associations, but not of causal mechanisms. Hence, while it is routine to think that policy changes contribute to societal changes, some trends might well be explained by 'confounding' variables other than policy.

Lessons learned and implications for future research

The present study illustrates the circumplex model's potential to unveil international trends in teachers' CPL needs that had gone unnoticed. A metric invariant analogue of the model was successfully applied to compare CPL needs between countries, something that has not been achieved through CFA (van der Lans et al., 2024; OECD, 2019a). We believe the study shows clear evidence of the superiority of the circular approach over the linear factor analytic and Item Response Theory approaches, at least within the context of international comparative research on teacher CPL needs.

The study did not apply the circumplex model as originally proposed by Guttman (1954) and Browne (1992). Our adapted circumplex model is extended with a item step procedure. Adaptation of the model was sought because original (unadapted) model outcomes were unstable over samples and adaption could improve interpretability. In the process of developing this adapted version, we examined performance of cumulative, nominal and adjacent item step codings (See Penfield, 2014 for description of these item step codings). In an earlier study, the model estimates using cumulative item step coding did not improve stability as much as the other item step codings and was associated with inferior model fit. The nominal and adjacent item step coding were found to perform comparable (van der Lans et al., 2024). We argued that the nominal item step method intuitively fitted better with ideas behind unfolding peak models based on which we applied that step procedure. The present study, however, found the nominal item step coding to have lower stability and worse model fit compared to the adjacent item step method. Based on these insights we advise future research to apply adjacent step coding methods.

Finally, the study successfully linked the trends observed in the circumplex with the policy developments observed within the four countries. Moreover, this was achieved with data that previous analyses had found no relevant changes (OECD, 2019b). We believe that our studies show how the circumplex method estimated outcomes can improve scientific understanding of policy effects on teachers' perceptions and behaviours. This is a major step, as our limited understanding of these associations has long been inhibiting possibilities to study

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and compare effectiveness of policy revisions (Viennet & Pont, 2017). Making policy effects understandable and transparent in the future can enhance policy effectiveness and thereby add to citizens' trust in policymakers and in their educational system.

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CONFLICT OF INTEREST STATEMENT
The authors have no competing interests to declare.

DATA AVAILABILITY STATEMENT
The data that support the study findings are available in the OECD library at https://www.oecd.org/en/data/datasets/talis-2024-database.html#data.

ETHICS STATEMENT
This study utilises data from the Teaching and Learning International Survey (TALIS) conducted in 2013 and 2018. Data are freely accessible via the OECD website. Data were collected in full accordance with the OECD's established protocols and ethical standards. As our analysis is based solely on anonymised, publicly available data and does not involve any procedures beyond those described by the OECD, no additional ethics committee approval was required. For further details, please refer to the technical reports of the TALIS survey.

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Endnotes
[1] The mode is not part of this study.

[2] OECD, TALIS 2018 Database (https://www.oecd.org/education/talis/talis-2018-data.htm).

[3] OECD, TALIS 2013 Database (https://www.oecd.org/education/talis/talis-2013-data.htm).

[4] See Online Supplemental Material for details and descriptive statistics of the sample.

[5] Note that the coding 0, 1, 2, and 3 diverges from the original coding applied by TALIS which was 1, 2, 3, and 4 for question 25. This has no effect on the interitem correlations, but did aid interpretation of results.

[6] AITSL can only revoke teacher registration in cooperation with the state and/or territorial authority. Each state has a teacher registration authority: https://www.aitsl.edu.au/teach/improve-practice/start-your-career/registration.

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