



Research paper

Exploring strategies to sustain teacher agency in the context of ‘hyper-accountability’: Reflections from ten experienced chemistry school teachers in Chile

Denise Quiroz-Martinez^{a,b,*}, Elizabeth A.C. Rushton^b^a Escuela de Pedagogías en Ciencias Naturales y Exactas, Faculty of Education Sciences, Universidad de Talca, Linares, Chile. Maria Auxiliadora, 380, Linares, Region del Maule, Chile^b Faculty of Social Sciences, University of Stirling, Stirling, FK9 4LA, United Kingdom

ARTICLE INFO

Keywords:

Teacher agency
Secondary school teachers
Education policy
Accountability

ABSTRACT

We explored teacher agency in a policy context of hyper-accountability drawing on interviews with ten experienced secondary school chemistry teachers in Chile. Constraints included successive reforms of the national curriculum, a resource-poor and high-surveillance education culture, and a low-priority culture of professional learning. Strategies enacted to sustain teacher agency included identifying ‘pockets of possibility’ to realise authentic chemistry education for all, developing trusting relationships with students and proactively nurturing their own professional development. These strategies have the potential to enhance the practice of teachers and teacher educators, and to inform a reorientation of policy away from high-stakes accountability.

1. Introduction

Governments across the world seek to increase the quality and effectiveness of their education and school systems. Approaches to this policy work frequently include a focus on the quality or effectiveness of the classroom teacher (Akiba & LeTendre, 2017; Towers et al., 2023) and underline the importance of teachers’ agency (Montecinos et al., 2022; Priestley et al., 2015; Rich, 2021). In Chile, the context for this research, schools usually have autonomy in relation to financial and administrative management and are held accountable through national evaluations (Montecinos et al., 2022). Specifically, policy makers regulate schools’ performance through different strategies, including standardised evaluation systems of school student attainment and the publication of results which inform a system of classification of school ‘performance’. This classification results in rewards (for example access to additional grants, including bonuses for teachers) and sanctions (for example teachers’ salary reduction) (Munoz-Chereau et al., 2022). This approach has been described as ‘performative accountability’ (Falabella & De la Vega, 2016; Falabella, 2020). We therefore suggest that in contexts where teachers are held accountable for school performance to the extent that this impacts their individual terms and conditions (in the case of Chile an individual teacher’s salary), this is an example of

‘hyper-accountability’.

The aim of this paper is to explore the ways in which experienced secondary school chemistry teachers (here, ‘experienced’ is understood as teaching for more than seven years post-qualification) achieve and sustain agency in the context of hyper-accountability, and the nature of the barriers and enablers of agency which they experience. Many studies have explored and theorised teacher agency (e.g. Priestley et al., 2015; Erss, 2018), including considering teacher agency in the context of teaching science in Chile (Torres Olave & Dillon, 2022). Furthermore, science teacher agency has been explored in the context of complex educational policy reforms (Ryder et al., 2018) and the ways in which beginning science teachers achieve agency (Wei & Chen, 2019). However, fewer studies have explored teacher agency of experienced teachers (Zhao et al., 2023), particularly those working in the context of hyper-accountability, in standard or ‘everyday’ roles as classroom teachers. Given the need to retain experienced teachers worldwide, including science teachers in Chile (Elige Educar, 2021), this research has the potential to contribute significant insights for education policy makers tasked with teacher retention across the globe. Furthermore, understanding how experienced teachers can achieve and sustain agency in the context of hyper-accountability has relevance for teacher educators and policy makers focused on initiatives which support

* Corresponding author. Escuela de Pedagogías en Ciencias Naturales y Exactas, Faculty of Education Sciences, Universidad de Talca, Linares, Chile. Maria Auxiliadora, 380, Linares, Region del Maule, Chile.

E-mail addresses: dquirozm@gmail.com, denise.quirozmartinez@stir.ac.uk (D. Quiroz-Martinez), lizzie.rushton@stir.ac.uk (E.A.C. Rushton).

<https://doi.org/10.1016/j.tate.2024.104787>

Received 26 January 2024; Received in revised form 5 September 2024; Accepted 6 September 2024

Available online 9 September 2024

0742-051X/© 2024 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

teachers' continuous professional learning. The overarching research questions (RQ) are as follows.

- RQ1: How and in what ways do experienced secondary school chemistry teachers in Chile achieve and sustain agency in the context of hyper-accountability?
- RQ2: In what ways does a teachers' subject specialism provide enablers and constraints to achieving agency in a context of hyper-accountability?

Firstly, we provide an overview of Chile's education context, highlighting the way 'effective' teachers are understood and measured in Chile, and we draw on this to outline the context of 'hyper-accountability'. Secondly, we explore what is understood by teacher agency, including the ecological approach to teacher agency outlined by Priestley et al. (2015) and consider how this can be developed and reimagined in the context of both hyper-accountability and subject expertise. Having outlined our methods, we present data that reveals the barriers to and enablers of agency of experienced secondary school chemistry teachers in Chile and we outline four distinct but related strategies which teachers develop to sustain agency (Priestley et al., 2012).

2. The Chilean educational system: a context for 'hyper-accountability'

Chilean government policy making frames education as a market (Cornejo et al., 2015; Falabella, 2020; Montecinos et al., 2022; Ruiz-Schneider et al., 2018) which includes a deregulated, for-profit and selective system which is subsidised by the private sector. Students are selected based on a range of factors including academic performance or religion (Falabella, 2020). This model promotes inter-school competition (Bridges & Jonathan, 2003), which many argue has had negative outcomes for public education (Falabella, 2020; Ruiz-Schneider et al., 2018). At the same time, teachers and teaching quality is recognised as central to the success of the educational system (Montecinos et al., 2022; Reyes, 2018). In other words, realising 'the minimum national coverage' (Falabella, 2020, p. 4), is mainly dependent on the efficacy of teachers. This dependence on teachers has been articulated in Chile through the concept of the 'effective teacher' (Reyes, 2018). An effective teacher is understood in this context as one who 'achieve(s) for their students' high educational performance, as demonstrated through their results in SIMCE (a Chilean national examination- Education Quality Measurement System)' (Reyes, 2018, p. 215; author one's translation). Since 2004, this conceptualisation of an effective teacher has been implemented through education policies which include individual performance-related bonuses and salary reductions for teachers in accordance with the performance of their students in national examinations (Cornejo et al., 2015; Reyes, 2018). In this context, an 'effective teacher' is understood and 'measured' by student performance in standardised national examinations (Falabella, 2020; Reyes, 2018). Falabella (2020) highlights that such an approach cultivates a culture of accountability which is rooted in a performative market approach to education.

In Chile quantifying the effectiveness of education also promotes policies which shape an individual teacher's terms and conditions including performance-based bonuses for teachers (Cornejo et al., 2015; Falabella, 2020; Reyes, 2018) and individual sanctions and salary adjustments (reductions or increases) which are in accordance with assessments of a teachers' performance (Cornejo et al., 2015). This performance is 'measured' or quantified against students' results in standardised national and international tests (Cornejo et al., 2015; Reyes, 2018; Ruiz-Schneider et al., 2018). Standardised national examinations aim mainly to evaluate the learning of content from the Chilean curriculum (Falabella, 2020; PEARSON, 2013). In these ways, Chilean teachers' professional lives are dominated by the need to ensure

that their students achieve as predicted or higher than predicted in national standardised examinations in a system of measurement which does not consider the wider socio-economic context or inequalities which students and teachers experience. This is consistent with what Ball (2003, p. 215) identified over twenty years ago as 'the terrors of performativity', where teachers are required to position themselves as, 'a response to targets, indicators and evaluations' and, 'to set aside personal beliefs and commitments and live an existence of calculation'. We argue that such a narrow conceptualisation of teacher performance and rigid approach to measurement of that performance through examination results, as evident in the context of Chile, creates a culture of hyper-accountability. Such a context of hyper-accountability can actively dissuade teachers' professional innovation (Montecinos et al., 2022), as working outside of these narrow parameters of what constitutes quality education (in this case students achieving or surpassing predicted grades in national examinations) requires teachers to intentionally and bravely 'push back' or 'step up' (Buchanan, 2015) with real risk to their professional standing, career progression and economic security. Having provided an overview of the policy and national context, we now consider teacher agency as a theoretical and analytical framework for this research.

3. Understanding teacher agency

The concept of agency has been defined through a range of disciplinary perspectives but can be broadly understood as a person's capacity to act independently and make their own choices (Jääskelä et al., 2017; Ruan et al., 2020). Bandura (2001) conceptualises agency as consisting of an individual's identification of a significant challenge, the development of a response and the implementation of that response to the identified challenge. Understandings of teacher agency as a phenomenon is part of a socio-cultural approach, where agency is dynamic and changes over time, and includes long-term goals and intentions (Emirbayer & Mische, 1998; Giddens, 1984). Although agency is variously understood, in recent times, teacher agency has been the focus of policy makers across the globe (Biesta et al., 2015; Jiang, 2021; Tao & Gao, 2017; Toom et al., 2015), with narratives of teachers as agents of change (Priestley et al., 2012), resilient professionals who resist neoliberal agendas of accountability and performativity (Ball, 2003; Bartell et al., 2019) and enactors of social justice (Pantić, 2015, 2017; Pantić et al., 2022). Teacher agency has become a central concept in understanding teachers' practices and their responses to education policy reforms and encompasses their choices, goals and beliefs as enacted throughout their professional lives (Goodson, 2003; Montecinos et al., 2022; Ryder et al., 2018).

3.1. Teacher agency and accountability

Drawing on teacher agency in the US context, Buchanan (2015) highlights teacher agency through 'pushing back' and/or 'stepping up', as teachers resist and negotiate powerful national and local accountability mechanisms. Pushing back is where a teacher resists through adapting, subverting, or rejecting a reform with which they disagree (Buchanan, 2015; Dover et al., 2016; Montecinos et al., 2022; Vähäsantanen, 2015). Stepping up is where teachers go above and beyond the expected norms of their role to ensure that they can continue to enact professional lives which are consistent with their school contexts and cultures regardless of wider policy directives (Buchanan, 2015). Turning to the context of secondary school science national curriculum and assessment reforms, Hall and Hampden-Thompson (2022) position science teachers in England as 'street-level bureaucrats', who are pivotal and agentic actors who enact teacher discretion when implementing these reforms. At the same time, Hall and Hampden-Thompson (2022) note that teachers experienced increasing difficulty in circumventing rules associated with attainment measures and teachers' discretion is heavily dependent on both the school and

national policy context. This is consistent with previous studies of science teacher agency in the context of national curriculum reform (e.g. Ryder et al., 2018).

In the context of Chile, Torres Olave and Dillon (2022) explored the agency of two teachers who held dual roles as part-time school teachers and university-based teacher educators. Drawing on Freirean conceptualisations of agency, which foreground ideas of autonomy and hope, Torres Olave and Dillon (2022) found that hybrid professional identities enabled agency. Enablers included new contexts for learning, communities of practice and the opportunity to cross traditional borders between school/university and subject specialism/pedagogy (Torres Olave & Dillon, 2022). This prior study provides significant insights as to the ways in which two experienced physics teachers working in Chile as both teachers and teacher educators can achieve agency (Torres Olave & Dillon, 2022). However, our research provides an important opportunity to further consider a different group of ten experienced science teachers (in this case, chemistry specialists) who do not already hold hybrid professional roles and to understand teacher agency as an interconnected and layered ecosystem through the ecological approach (Priestley et al., 2015).

3.2. The ecological approach to teacher agency

This research is rooted in understandings of teacher agency as an ecological approach (Priestley et al., 2015) which is not a normative western approach applied uncritically to very different social contexts, but a heuristic to support the development of new understanding, with careful consideration of the cultural and structural conditions by means of which they will be enacted. Teacher agency as an ecological approach (Priestley et al., 2015) understands agency as an emergent phenomenon, not the capacity of an individual, agency is something which people achieve or do, not what people possess. Concomitantly, teacher agency is understood as being dependent on conditions and qualities, including cultural, material, relational resources and people's ability to use them. Finally, teacher agency is recognised as temporal – informed by the past, oriented towards the future and enacted in the present (Priestley et al., 2015). Through the ecological approach, Priestley et al. (2015, p. 30) articulated three dimensions of agency. Firstly, the iterational dimension, which draws on life histories and professional histories. Secondly, the projective dimension which includes both short and long-term objectives and aspirations. Thirdly, the practical evaluative dimension which identifies a range of resources including the cultural (ideas, values, beliefs, discourses), structural (relationships, roles, power, trust) and material resources (including the physical environment) (Priestley et al., 2015). We suggest that these dimensions can support us to better understand the nuanced and overlapping ways in which a context of hyper-accountability can constrain agency and the strategies that some teachers develop to sustain agency. For example, the ecological approach supports us to challenge ideas of accountability which reduce agency to the 'performance' of an individual teacher (e.g. through the examination results their students achieve, which are ranked in performance tables). Instead, the ecological approach requires us to consider the different and layered social structures, relational resources, professional histories and policy contexts which teachers navigate as part of their professional lives. Whilst teachers' individual beliefs are important in informing agency, Biesta et al. (2015) underline the need to consider the importance of a collective understanding of the purposes of education which move beyond the individual beliefs of teachers.

In the context of fostering teacher agency, Priestley et al. (2015) have identified three levels: the macro-level of policy formation; the meso-level of policy interpretation; and the micro-level of curriculum enactment. At the macro-level, policy formation can be regulated by inputs (such as national curriculum documents) and outputs (including inspection bodies) (Priestley et al., 2015). These macro-level policies are then re-contextualised at the meso-level by a range of groups including qualification and assessment bodies, local governments and by

organisations which create curriculum resources and materials (Priestley et al., 2015). At the micro-level, teachers enact the curriculum in classroom and school settings and such curriculum making is, 'influenced and shaped by the beliefs and knowledge of teachers, the cultures and structures of schools, as well as by external pressures such as accountability demands' (Priestley et al., 2015, p. 153).

4. Methods

This research aims to explore experienced chemistry teachers' professional lives in the context of hyper-accountability, where they are teaching a subject which is a compulsory subject and is assessed as part of national examinations which strongly inform career pathways including university entrance. This includes studying teachers' experiences, such as their interpretation of the challenges and opportunities of teaching chemistry in secondary schools in Chile, the constraints and enablers to agency they experience, and the nature and scope of strategies they develop to sustain agency. The participants and data collection methods are described before outlining the analysis process.

4.1. Data collection

4.1.1. Participants

The research adhered to BERA. British Educational Research Association's (2004) ethical guidelines and was approved by the researcher's Institutional Ethics Committee prior to the commencement of the research. Ten participants for this research were drawn from author one's peers on her postgraduate education programme, all were female, aged between 30 and 35 years, and were chemistry teachers with between seven- and ten-years post-qualification teaching experience who had completed their university education at the same institution in Chile (Table 1).

In this research, experienced teachers are those who have more than seven years of teaching experience, and therefore are likely to have encountered the challenges of classroom management, are familiar with diverse teaching strategies and have been involved in curriculum development and design (Zhao et al., 2023). Given that the participants have a minimum of seven-years experience in a range of public and private schools and were educated at the same institution during a similar time-period, there is both consistency (e.g. level of teaching experience, teacher education, subject specialism) and diversity (types of schools) across the sample which provides a rich data set through which to explore teacher agency of secondary chemistry teachers in Chile. In 2006, when Author one started her undergraduate studies only 10% of her cohort were male and none of these students continued on to education focused postgraduate studies, hence why the sample for this study was composed wholly of female participants. This is consistent with the demographic of the teaching profession in Chile which is majority female (CEM, 2022).

4.1.2. Interviews

The study design focused on gathering detailed and reflective insights from participants through dialogue. Therefore, data was derived from semi-structured online interviews (each lasting approximately 90 min) with each of the ten participants completed during January and May 2018. Online interviews were held to provide flexibility for participants and were audio-recorded for transcription. Participants were understood as knowing and approving experts (Etikan et al., 2016) who had substantive experience and expertise relevant to this research (Rubin & Rubin, 2005). Drawing broadly on the iterational, projective and practical evaluative dimensions of teacher agency, participants were asked about their experiences of teaching chemistry in their past and present practice, including their ideas, values and beliefs about education, science and teaching science. Teachers were asked to share the opportunities and challenges they experienced, including the types of support they accessed, how these were identified and explored the

Table 1
Overview of participants.

Teacher	Contextual information	Demographic information
1	Undergraduate degree in Pedagogy in Chemistry and Biology (finished in 2009). Starting a second degree in Engineering. 9 years working in public schools in Chile	Female, mid-30s. At least one parents attend HEI.
2	Undergraduate degree in Pedagogy in Chemistry and Biology (finished in 2011). 7 years working in private and public schools in Chile	Female, mid-30s. At least one parents attend HEI.
3	Undergraduate degree in Pedagogy in Chemistry and Biology (finished in 2009). 9 years working in private and public schools	Female, mid-30s. At least one parent attended HEI.
4	Undergraduate degree in Pedagogy in Chemistry and Biology (finished in 2009); studying a Master in Curriculum and Assessment. 9 years working in private schools in Chile	Female, mid-30s. Parents did not attend HEI.
5	Undergraduate degree in Pedagogy in Natural Sciences and Chemistry (finished in 2011). 7 years working in private, public and adults' schools in Chile	Female, early-30s. At least one parent attended HEI.
6	Undergraduate degree in Pedagogy in Chemistry and Biology (finished in 2006). 10 years working in private and public schools in Chile	Female, mid-30s. Parents did not attend HEI.
7	Undergraduate degree in Pedagogy in Chemistry and Biology (finished in 2010). Starting a second degree in Engineering. 8 years working in public schools in Chile	Female, mid-30s. At least one parent attended HEI.
8	Undergraduate degree in Pedagogy in Chemistry and Biology (finished in 2009) Master in Science Education. 8 years working in private and public schools in Chile	Female, mid-30s. Parents attended HEI.
9	Undergraduate degree in Pedagogy in Chemistry and Biology (finished in 2010). 8 years working in public schools in Chile	Female, early-30s. Parents did not attend HEI.
10	Undergraduate degree in Pedagogy in Chemistry and Biology (finished in 2010). 8 years working in private and public schools in Chile	Female, early-30s. At least one parent attended HEI.

support they would like in the future (Table 2).

4.2. Analysis process

Following anonymisation of all transcripts, data were analysed using Reflexive Thematic Analysis (RTA) to identify patterns of meaning across the ten interviews through six iterative phases of analysis (Braun & Clarke, 2006; Braun & Clarke, 2019, 2021; Clarke et al., 2015). Consistent with the reflexive focus of RTA, through individual reflections and joint discussions, the researchers were able to consider their former experiences as researchers, teachers, and teacher educators (in the UK and/or Chile) and how these shaped their engagement with the data. For author one, the RTA process initially involved (on average) monthly reflections during the period September 2022–February 2023 to consider the ways in which participants’ experiences of and ideas about agency were visible in the data. This data included both data generated by participants and researcher reflections. The analysis was situated in author one’s familiarity with the specific ethos and pedagogy of the teacher education programme participants had completed.

For a period of about three months, beginning in March 2023, authors one and two met bi-monthly to undertake a second phase of RTA. This opportunity to include a researcher at this stage of analysis who had not had prior experience of the participants, or the pedagogy of the teacher education programme participants had completed, allowed for different ideas and insights to be identified and discussed and to ensure the trustworthiness of the data. Abductive analysis focused discussions between Authors one and two which included drawing on participants’

Table 2
Interview foci and indicative questions.

Foci	Indicative questions
Background/context	Can you tell me about your journey to become a teacher? ● Why did you decide to become a teacher? ● What experiences did you bring to your teaching? These could include professional experiences or previous study? Can you share what you think is the purpose or importance of education?
Role of a teacher	Can you describe what sort of teacher you are? ● What values or ideas do you have about teaching? ● Can you describe how the work you do as a teacher reflects your values? ● Why have you remained a teacher? Can you tell me about your ideas around your subject? ● What contribution can science and chemistry make to young people? The world? ● Tell me about your ideas of science and teaching science? ● Have your ideas about science changed during your time as a teacher?
Professional practice	Can you tell me about your current teaching role? ● Which classes do you teach? ● Which topics or subjects do you teach? ● What roles do you hold within the school? ● Do you have any specific responsibilities within school? What challenges do you experience in your current role? ● How and/or why do they occur? ● What are the consequences of those challenges to you, colleagues and your students? ● Have you experienced challenges in the past? Was it possible to overcome these? If so, how? What opportunities do you experience in your current role? ● How and/or why do they occur? ● Have your opportunities changed over the course of your career? What do you most enjoy in your professional life as a teacher? ● What is important to you about your role as a teacher? Why are these aspects important to you? ● Has your enjoyment of your professional life changed over time? ● How would you like to develop your career in the future? ● What aspect of teaching would you like to develop in the future? Why is that?
Professional support and collaboration	What resources do you have access to in your professional life? ● What support would like to receive in the future? What would be the priority? What support do you currently receive from school leaders and other colleagues? ● What support would you like to receive in your professional life? Can you tell me about a period of your professional life where you received the most support? Can you tell me about a period of your professional life where you receive the least support? What opportunities do you currently have for collaboration in your professional life? ● What would you like in the future? What has been helpful in the past? ● Do you encounter any barriers to collaboration? Is it possible for these to be overcome?

data, researcher reflections and published literature focused on teacher agency (e.g. Priestley et al., 2015). Across the data, we sought to understand the ways in which the iterative, projective and practical-evaluative dimensions of teacher agency were evident and the ways in which agency could be achieved and constrained. Prior to data analysis discussions the authors agreed that should there be conflicts in

our interpretations or analysis we would return to the key questions to consider when reviewing themes as outlined by Braun and Clarke (2012) as a framework for our decision making.

5. Findings

In response to RQ1, our findings are focused on eight themes, four related to the constraints to agency teachers experienced (Table 3) and four related to the strategies they develop in the context of hyper-accountability (Table 4). A summary of all eight themes, and their representation across the dataset is presented in Table 5. The four themes focused on constraints to agency (Table 3) included: firstly, teachers identified a gap in the value of science which they held and in the value of science held by their students and wider public (Theme A) and secondly, teachers worked in an education culture which is high-surveillance and low-trust (Theme B). Thirdly, the national curriculum is experienced by teachers as narrowly conceived, restrictive and bureaucratic (Theme C) and lastly, teachers experienced a resource-poor and low-priority culture of professional learning (Theme D). Four strategies were identified by teachers as enabling them to sustain agency in the context of hyper-accountability. These included: holding a professional purpose focused on enabling students to think scientifically (Theme E), identifying ‘pockets of possibility’ to realise chemistry education as valuable to all students (Theme F), developing trusting and authentic student relationships with students is a core pedagogical practice (Theme G) and, proactively nurturing their own professional development (Theme H). In response to RQ2, teachers’ subject specialism is visible across both the constraints to agency (for example in the value of science (Theme A) and the national curriculum (Theme C) as well as the strategies for agency (for example enabling students to think scientifically (Theme E) and chemistry as having value for all (Theme F). Tables 3–5 provide an overview of the themes and our analysis process.

5.1. Constraints to agency which teachers’ experienced in a culture of hyper-accountability

Across the four constraints to agency, we found varied aspects of dimensions of agency identified in the ecological approach (Priestley et al., 2015).

5.1.1. A ‘gap’ in ideas of the value of science education

Teachers identified a gap between the value science has as part of a high-quality education, and the low value placed on science which teachers encountered in attitudes from some of the students they teach and wider society, as teacher two reflected:

“When I teach ... a class which ... only has four students that are interested in science, it is a huge challenge to motivate them to learn chemistry. I think that it is the hardest challenge for me: to motivate students ... who do not aspire to a career in science ... to learn chemistry.”

This is an example of the cultural aspect of the practical evaluative dimension of teacher agency, where collective ideas, values and beliefs facilitate and/or inhibit agency (Theme A, Table 3). In this study, teachers held a collective belief of the educational value of science which was challenged by their awareness that the wider public, including some of the students they taught, held negative attitudes towards science, particularly those who do not aspire to scientific careers (Theme A, Table 3). Teacher nine suggested that people in general ‘undervalue’ science in general in Chile, which can lead to negative attitudes and that this context sometimes led teachers, including teacher two, to question why they should teach chemistry and why students should learn chemistry. In this way, teachers’ collective educational idea (Biesta et al., 2015) of the value of science for all is inhibited when this is challenged by more apathetic and negative attitudes in the classroom,

Table 3

Constraints to teacher agency experienced in the context of hyper-accountability.

Themes derived from teacher interviews	Indicative quotes
Theme A ‘Gap’ identified in the value of science held by teachers and their students and the wider public.	I think that in Chile, people undervalue science. It is like science is not important. I think that is the reason why students do not want to study a scientific career, for instance. (T9) When I teach ... a class which ... only has four students that are interested in science, it is a huge challenge to motivate them to learn chemistry. I think that it is the hardest challenge for me: to motivate students ... who do not aspire to a career in science ... to learn chemistry. (T2)
Theme B Teachers work in a high-surveillance and low-trust education culture.	If you are teaching nuclear energy, in practice you only teach isotope definition and how to formulate nuclear equations. You do not link that topic to historical and social events like world wars, Hiroshima, Nagasaki. You do not explore what students’ perspectives are on these topics. You lose that kind of discussion and debate because you do not have enough time and you ... as a teacher ... know this topic [nuclear chemistry] is going to be tested in the national university entrance exam. (T8) Here, in this school ... our aim is to get the best results in the national examination in the city, and students to achieve the maximum national score ... so ... they can study the career they want. (T6)
Theme C The national curriculum is experienced by teachers as, narrowly conceived, restrictive and bureaucratic.	If a teacher wants to develop a topic related to ... biotechnology ... and maybe they could approach it from an ethical perspective ... The curriculum is not clear about how to do it ... It is hard to think of how you, as a teacher, can help students to develop such skills. It is a big challenge in the context of teaching chemistry from a ‘for the exam’ perspective. (T4) There is no continuity in the curriculum. The contents from the curriculum are, like, not related to each other. And, it has a lot of content ... I feel like people who develop the curriculum have never been in a classroom in their lives. (T9) The national curriculum continuously is changed and re-structured. I think it makes teaching chemistry more difficult. (T10) So, of course, the first years of teaching, as I told you, it was all very theoretical. And I tried to teach them (students) what it was (the chemistry content in the curriculum), and it seemed that it was very difficult for them. It was like they really did not understand me. I was just starting my experience as a chemistry teacher, and I think I demanded that they had to know everything. I was like “no, but how do they not understand that?” But later I realised that well, the educational realities are different, and therefore you also have to learn how to lower your academic requirement. (T8)
Theme D Teachers experience a resource-poor and low-priority culture of professional learning.	When you think that on average, a teacher is teaching 40 h per week ... preparation outside of this ... when do teachers have time to reflect on their practice to improve it? (T2) If you ask teachers to do things

(continued on next page)

Table 3 (continued)

Themes derived from teacher interviews	Indicative quotes
	differently, for example to look for new activities or practical work, it takes time for them to do it. So, they will say to you 'I do not have time, I always have done my classes in this way, and it works'. (T4)
	It [teaching chemistry] is especially hard in a country in which, for example, laboratories are really bad ... [Chemistry teaching] is mainly taught theoretically inside a classroom. (T9)

which are perhaps reflective of wider society.

5.1.2. High-surveillance and low-trust educational culture

Teachers described how they worked in a high-surveillance and low-trust educational culture (Theme B, Table 3). This is connected to the structural aspect of the practical-evaluative dimension of teacher agency (Priestley et al., 2015). This culture means that teachers reported that they frequently could only focus on curriculum content, which is included in national assessments, including the university entrance assessment (Table 3). This need to focus on curriculum content which would be assessed in national exams, is arguably exacerbated by a culture of hyper-accountability, where teachers' pay, conditions and career prospectives could be improved or reduced depending on the performance of their students in these examinations. This was illustrated with a compelling example by teacher eight, who highlighted how this focus on teaching towards examination results limited the ways in which teachers linked their teaching of topics (e.g. nuclear energy) to a broader socio-cultural context and did not have the opportunity or time to consider students' ideas, perspectives, and attitudes:

"If you are teaching nuclear energy, in practice you only teach isotope definition and how to formulate nuclear equations. You do not link that topic to historical and social events like world wars, Hiroshima, Nagasaki. You do not explore what students' perspectives are on these topics. You lose that kind of discussion and debate because you do not have enough time and you ... as a teacher ... know this topic [nuclear chemistry] is going to be tested in the national university entrance exam."

This connects to the structural aspect of the practical-evaluative dimension, as teachers do not experience the trust to teach in the way they believe will realise the best outcome for students. The cultural aspect of the practical-evaluative dimension is also evident in teachers' beliefs about the ways in which science should be taught which is in opposition to a narrow focus on examination outcomes. Furthermore, national examinations do not assess attitudes, values or ethics and so teachers are less likely to incorporate or foreground this in their teaching and, instead, focus on teaching 'for the exam' approach (T4). This focus on examination outcomes as a key purpose of education, rather than simply an aspect of schooling is also linked to the first constraint, where there is a disconnect between teachers' collective educational ideas of the value and purpose of science education and that of their students. It is perhaps unsurprising that students and society in general perhaps undervalue science if school science/chemistry education in Chile as it is currently experienced does not encompass aspects of values, ethics and the ideas and perspectives of students.

5.1.3. The national curriculum is narrow, restrictive and bureaucratic

The third theme of constraints explores the ways in which teachers experienced the national curriculum as narrowly conceived, restrictive and bureaucratic (Theme C, Table 3). Teachers described how the content heavy curriculum limits opportunities to use a range of pedagogical approaches, including experiments. This constraint arguably

Table 4

Strategies used by teachers to sustain their agency in the context of hyper-accountability.

Themes derived from interviews	Indicative quotes
Theme E Professional purpose to enable students to think scientifically.	One promotes scientific thinking one makes children think scientifically. That's why I like to teach it like this. To support them (students) to question why what is happening is happening. That is scientific thinking. (T1) I need at least a child that questions something. That if tomorrow in his/her life s/he questions something and tries to give it an answer. At the end it worked, science education worked because I taught him to think a little. (T8) And well, we have worked transversally with science teachers to teach children to think. Let them question everything ... The curriculum allows us to deliver the content and do very little laboratory work, but we try to get them (students) to question everything ... The students were very quiet, so we started to support them to question everything about society based on what they learnt in science subject. (T9)
Theme F Pockets of possibility to realise chemistry education as valuable to all students.	I always try to give the students a sense of the everyday context of what they are learning. For example, if we are looking at solutions, I explain to them that if the exact percentage of physiological saline was not known, people would have good hospital treatments - I want to connect chemistry to their daily life experiences. (T3) Incorporating experimentation in the classroom has been super important. Whether it is coming to the laboratory and showing them that maybe they are having a chemical reaction with just simple water and mixing sugar which doesn't need expensive equipment or telling them that their body is a laboratory ... connecting chemistry to their daily life experience, that is very close to them, or else they don't engage. Connect the teaching of chemistry with issues of everyday life, aspects which interest students. (T6) The truth is that in all the years I did classes I tried to find a more relevant meaning ... when a child comes along and say, 'Miss, but why should I learn it?' ... Acids, pH contents of different substances that are in the house, for example, I started this unit 'acids and bases' and had them bring different foods and we measured the pH one by one. So, there they had to inform me of the pH if it was acidic, basic, neutral. And then we started with the complete unit. At the beginning there was always an introduction where they measured the pH of their saliva and the pH of the drinking water. (T10)
Theme G Developing trusting & authentic student relationships is a core pedagogical practice.	What has worked for me is to try to search through, perhaps, the emotions and closeness with the children, because, at least for me, the fact of creating bonds with the students makes them have a better disposition in my classes ... it is not that I am challenging them, nor that I am demanding performance from them, but deep down because I have a good relationship with them, they feel committed to learn. (T5) Understanding them (students), not

(continued on next page)

Table 4 (continued)

Themes derived from interviews	Indicative quotes
Theme H Teachers proactively nurture their own professional development.	closing yourself off, but rather that the children see in you as a patient teacher who can teach them, who will understand them and explain things to them. (T9) I realised the pedagogical tools that I had were very limited ... so I started a master's degree in Science Education. (T8) I have worked as a chemistry teacher in different educational contexts, in different types of schools. Today, I work in a school, where students have a lot of economic and social issues. They do not have a study routine, so I need to look to develop more strategies myself to better support them to learn, to promote the best they can give. (T3)

compounds the previously discussed constraint of teachers having to focus their teaching on what will be examined due to a high-surveillance and low-trust educational culture. Teacher six described these curriculum-based challenges very strongly, saying:

“The curriculum is always your enemy ... because we do not have time to use different kinds of pedagogies like ... scientific enquiry ... I would love to use different teaching strategies in my classes because I think it helps students to learn. But it is not possible. There is not enough time”.

The majority of teachers identified that the curriculum was challenging to contextualise within the wider world and stated the national curriculum lacked a coherent structure and which made sequencing challenging (Table 3). Furthermore, working with a national curriculum which was ‘constantly in a stage of change and re-structuring’ made ‘teaching chemistry more difficult’ (T10). Again, these aspects of constraints to agency are exacerbated in a context of hyper-accountability, where students’ results in high-stakes national examinations determine teachers’ pay and conditions. A constantly changing curriculum which lacks coherence will arguably make it more likely that teachers will

Table 5

Overview of the eight themes across the data derived from interviews with ten teachers.

Themes derived from teacher interviews	Teacher 1	Teacher 2	Teacher 3	Teacher 4	Teacher 5	Teacher 6	Teacher 7	Teacher 8	Teacher 9	Teacher 10
Theme A ‘Gap’ identified in the value of science held by teachers and their students and the wider public.		✓	✓	✓	✓	✓	✓	✓	✓	✓
Theme B Teachers work in a high-surveillance and low-trust education culture.		✓	✓	✓	✓	✓		✓	✓	✓
Theme C The national curriculum is experienced by teachers as, narrowly conceived, restrictive and bureaucratic.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Theme D Teachers experience a resource-poor and low-priority culture of professional learning.	✓	✓		✓			✓	✓	✓	
Theme E Professional purpose to enable students to think scientifically.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Theme F Pockets of possibility to realise chemistry education as valuable to all students.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Theme G Developing trusting & authentic student relationships is a core pedagogical practice.			✓	✓	✓		✓	✓	✓	✓
Theme H Teachers proactively nurture their own professional development.			✓	✓			✓	✓		

focus on what is examined (Theme B) and this will further devalue science for students (Theme A). These ideas of the national curriculum as bureaucratic and restrictive speak to the structural aspect of the practical-evaluative dimension of teacher agency, where the structures do not exist, and teachers are not trusted to enact the national curriculum in the ways they understand will best meet the needs of their students. The projective dimension of agency, where teachers consider agency in both the short and long term, is also apparent in this theme. For example, teacher eight reflects on changes over the course of their career which were prompted by their own experiences of the changing national curriculum:

“In the first years of my teaching ... it was all very theoretical ... I tried to teach students ... it seemed very difficult for them. It was like they did not understand me. I was just starting my experience as a chemistry teacher and I think I demanded that they had to know everything ... But later I struggled with the changes of the curriculum and that made me realise I had to change myself.”

Arguably, this quotation demonstrates not only the constraint of the curriculum and the structural and projective dimensions of agency, but also how this teacher sees this as a stimulus to reflect on and change their own practice with their students and so, could be understood as an enabler of agency.

5.1.4. Resource-poor and low-priority culture of professional learning

Through the fourth theme of constraint to agency teachers shared their experiences of a resource-poor and low-priority culture of professional learning (Theme D, Table 3) which underlines further examples of the structural aspect of the practical-evaluative dimension of teacher agency (Priestley et al., 2015):

“When you think that on average, a teacher is teaching 40 hours per week ... preparation outside of this ... when do teachers have time to reflect on their practice to improve it?” (Teacher two)

“If you ask teachers to do things differently, for example to look for new activities or practical work, it takes time for them to do it. So, they will say to you ‘I do not have time, I always have done my classes in this way, and it works’”. (Teacher four).

In summary, features of this theme include a lack of material resources, including a lack of time for teachers to reflect upon their practice and incorporate new pedagogical approaches, inadequate access to teaching resources, including functional school-based laboratories and, a lack of time and financial support from schools to access continuous professional development (Theme D, Table 3).

The context of hyper-accountability is visible across all four themes of constraints to agency but is perhaps strongest in teachers' experiences of working in a high-surveillance and low-trust education culture (Theme B) and where the national curriculum is narrow, restrictive and bureaucratic (Theme C). Arguably, a high-surveillance and low-trust education culture could be understood as a direct result of context where measures of effective teaching and/or high-quality education are solely focused on performance in national examinations and a narrow, restrictive and bureaucratic national curriculum could be viewed as both symptomatic of and a consequence of such an education culture. In contrast other constraints, such as the low value of science (Theme A) and limited culture of professional learning (Theme D) are likely exacerbated by a context of hyper-accountability but could equally exist in less stringent policy contexts.

5.2. Strategies to enable agency within a culture of hyper-accountability

As with the four constraints to agency, the ecological approach to teacher agency provided a framework through which to identify strategies to sustain agency and consider varied dimensions of agency evident in our findings (Priestley et al., 2015).

5.2.1. Professional purpose rooted in enabling students to think scientifically

A consistent theme across all teachers who contributed to this research was a sense of professional purpose which is rooted in a professional identity as teachers who enable their students to think scientifically (Theme E, Table 4). Teacher nine outlined their rationale in this compelling contribution:

"I feel that a quiet nation can always be manipulated ... if no one thinks and we citizens are like little sheep that obey everything. I believe that by questioning we can generate great social changes. I think young generations ... need to experience teaching which enables them to question so they can bring about change and not live in fear if they complain and question."

Across this theme, teachers drew on their collective ideas and beliefs of the value and purpose of chemistry/science education, the cultural aspect of the practical-evaluative dimension of agency (Biesta et al., 2015; Priestley et al., 2015), and how this sustains and nurtures their professional agency. In so doing agency is perhaps sustained by connecting with and acting upon their purpose and professional identity as an educator in general, a teacher of science more specifically and someone who values science as a core part of education for all. Such an idea of education as bringing about change, is very apt for teachers who are experiencing hyper-accountability, which arguably generates the fear and requires teachers themselves to challenge and question which teacher nine describes above.

5.2.2. Realising pockets of possibility in the chemistry national curriculum

The first strategy of remaining rooted to a professional purpose as a science teacher, is connected to the second strategy to sustain agency, where teachers identified pockets of possibility within the national curriculum, to realise chemistry education which is valuable to all students (Theme F, Table 4). A strong focus across this strategy is the need to incorporate everyday examples of science or 'the immediate functionality' (T3) of chemistry when teaching, and to overcome the material constraints to agency of a lack of laboratory space and equipment by implementing low-cost options, which is also underpinned by teachers' ideas and beliefs about the value of practical science for all students.

Other examples of teachers adapting their teaching include making cross-disciplinary links so that students experience chemistry as a subject that is of value whether or not they intend to pursue a science-focused career. For example, teacher seven said:

"I carry out experimental demonstrations and it helps students to learn ... another strategy which motivates them is educational outings to places where they can see how science is used in context. So, they can make sense of what they have learnt".

Teacher five outlined ways to make cross-disciplinary links explicit for students as an approach to making chemistry relevant to a broader group of students:

"I try to look for how the [chemistry] content could be related to other subjects such as history ... for example, how to link thermodynamics with the industrial revolution. When I do so, humanities students participate in the lesson, they talk ... they see how chemistry could be related to the other subject that they like".

The projective dimension of agency is also visible in this theme, as teachers considered examples when they have attempted to implement an approach to find a more 'relevant' meaning of aspects of chemistry for their students, including the example teacher ten shares about teaching acids and bases, and linking this to testing the pH of saliva and drinking water (Table 4).

5.2.3. Developing trusting relationships with students

Teachers identified that developing trusting relationships with students was key to sustaining agency in the context of pedagogical practice (Theme G, Table 4). Creating 'closeness' and 'bonds' (Teacher five and nine) with their students included employing humour and patience to encourage and include all students they taught chemistry. For example:

"What has worked for me is to try to search through ... the emotions and closeness with the children, because, at least for me, the fact of creating bonds with the students makes them have a better disposition in my classes ... deep down because I have a good relationship with them, they feel committed to learn." (Teacher five)

"Understanding them ... not closing yourself off, but rather that the children see in you as a patient teacher who can teach them, who will understand them and explain things to them." (Teacher nine)

These examples draw on the structural aspect of the practical evaluative dimension of teacher agency, including student-teacher relationships and ideas of trust (Priestley et al., 2015). Relatedly, teacher three reflected on the different support needed by students and their role in providing this, saying:

"I have worked as a chemistry teacher in different educational contexts, in different types of schools. Today, I work in a school, where students have a lot of economic and social issues. They do not have a study routine, so I need to look for strategies for supporting them to learn, to promote the best they can give".

This example, and across this theme are collective educational ideas and beliefs of the value of education for all students which withstand a context of hyper-accountability that can reduce education to students' performance in national examinations. This underlines the importance of teachers' shared educational ideas which can exist and persist even when they are evidently challenged by other teachers, students, policy makers and wider society, as evident across the constraints previously outlined. Seemingly, these collective ideas can be sustained by individuals as they experience the impacts of hyper-accountability and can prompt and motivate teachers to nurture their own professional lives as outlined in the final strategy.

5.2.4. Teachers proactively nurturing their own professional development

Across this theme, teachers demonstrated and sustained agency by

recognising the need to proactively nurture their own professional development (Theme H, Table 4). This could be understood as an agentic response to the resource-poor and low-priority culture of professional learning outlined in Theme D (Table 3). For example, teacher eight's response to the realisation their 'pedagogical tools ... were very limited' was to embark upon a post-graduate degree in science education. Similarly, when teaching a group of students with a range of needs beyond teacher three's existing experience and expertise, they recognised the need to proactively develop more strategies to promote learning. This theme of agentic professional learning is consistent with the cultural aspect of the practical-evaluative dimension of agency, where teachers' ideas, beliefs, and values are that they are responsible for responding to their own professional learning needs. At the same time, this theme draws on the material resources of the practical evaluative dimension, namely the time and financial resources required to engage in some types of professional learning, for example postgraduate study (Theme H, Table 4).

Across these eight themes, we can see different ways in which some teachers are able to achieve agency for example by leveraging pockets of possibility within the existing curriculum (Theme F) or through a focus on structural resources such as building effective relationships with students (Theme G) or drawing on material resources to fund their own professional development (Theme H). At the same time, teachers experience their agency being constrained by a range of factors including their perceptions of societal attitudes towards the value of science (Theme A), the constraints of working in a high-surveillance and low-trust education culture (Theme B), and the disruption and restriction posed by successive reforms of the chemistry national curriculum (Theme C) as well as working within resource-poor and low-priority culture of professional learning (Theme D). In the following discussion and drawing on Priestley et al.'s (2015) conceptualisation of teacher agency we consider the different ways agency is enabled and constrained in different ways and levels.

6. Discussion

When sharing their experiences, participants across the sample recognised that the Chilean educational system placed a strong emphasis on ensuring students were prepared for national exams (e.g. completing multiple-choice questions) through expositive and didactic teaching to ensure coverage of curriculum content. The teachers involved in this research were teaching chemistry as a compulsory subject which is assessed as part of national examinations and therefore have outcomes which strongly inform career pathways including university entrance. Expositive science lessons, with an emphasis on teacher-led learning of scientific facts and theories are common in Chile (Cofré et al., 2010). Consistent with previous research (Mamluk-Naaman et al., 2015; Nielsen & Holmegaard, 2015) teachers in this study highlighted that such an emphasis limited the time and resources available to develop and implement a wide range of pedagogical approaches, including practical work and debates (Theme C, Table 3). At a macro-level of policy, teachers' agency is reduced to ensuring students achieve good examination results in these exams and means that teachers prioritise curricular coverage (Falabella, 2020; PEARSON, 2013). Therefore, teachers recognised the impact of a performative market approach to education since they perceive it is their duty to focus their practice on ensuring strong results for students in national examinations, in a context where the wider value of science is questioned (Theme A, Table 3). Challenges to teacher agency when teaching chemistry in the Chilean educational system are also related to the national science curriculum since, according to teachers, some content is highly abstract and technical, which can be complex for students to learn. For example, challenging topics such as electronic structure are presented in the abstract rather than contextualised within the wider world, which can demotivate students as this knowledge appears disconnected from their daily lives (Childs et al., 2015; Taber, 2015). Traditional approaches to teaching chemistry

in Chile present the subject as a selection of concepts and facts to memorise and apply (Freire et al., 2019; Sevian & Bulte, 2015), for example, writing electronic configurations and balancing chemical equations. According to teachers across the group who contributed their experiences to this study, such an approach to chemistry education, with an emphasis on memorising hard and abstract content transmitted through expository lessons (Hofstein & Kesner, 2015; Nielsen & Holmegaard, 2015; van Berkel et al., 2009), does not appeal to learners and this reduces their agency as teachers. Seven of the ten teachers stated that the Chilean national curriculum is built upon content that is important for those students who want to continue studying a scientific career or any other career that requires science (e.g., engineering) but has limited value for students who wish to pursue careers in other domains. Teachers in our study recognised that expository approaches to teach chemistry were more appropriate for students who are interested in further study and careers in science or science related careers (Hargreaves & Shirley, 2009; Stuckey et al., 2013). However, such approaches did not motivate all students and focussing on transmission of knowledge can promote and compound a view of chemistry as complex, boring, and irrelevant to their lives (Childs et al., 2015; Roth & Barton, 2004). In this context, it is hard for teachers to justify why students should learn this kind of content other than because they need it to pass an examination and thus reduces their professional agency.

According to Priestley et al. (2015), teacher agency is a process of balancing autonomy and accountability (see also Ryder et al., 2018). Nevertheless, in the context of hyper-accountability, such as the Chilean educational context, it seems difficult for teachers to promote such a balance. Therefore, teachers' intentionality becomes fundamental for understanding their responses to education policy since personal goals are crucial resources for teacher action (Ryder et al., 2018). In this study, all teachers identified the need –and responsibility– to question why they should teach chemistry and why students should learn chemistry. Specifically, all of them recognised the need to promote in their teaching a 'skill development' perspective (Theme E, Table 4). This approach to understanding chemistry education purpose is closely related to the personal domain of purpose for education, which questions how learners can gain independence of thought, (moral) judgement and action (Priestley et al., 2015). According to all teachers, by presenting chemistry teaching from a 'skill development' perspective, they could promote meaningful learning rather than merely memorising content for an exam. Wei and Chen (2019) underline that teachers' agency can be conceived as both teachers' perspectives and action when implementing a curriculum and that perspectives shape actions. In other words, perspectives at micro-level curriculum enactment influence the actions happening at such a level. However, findings from this research show that teachers' interpretation of curriculum enactment does not completely align to what they implement in their teaching. Teachers perceive and articulate a tension between what the system asks of them (what they perceived as their duty as a chemistry teacher in Chile), which is rooted in a culture of accountability (Cornejo et al., 2015; Falabella, 2020; Reyes, 2018), and contrasts with the type of chemistry education they would like to foster with their students.

Although teachers recognise the macro-level policy limit and constrain their practice, they identify opportunities within the micro-level to 'push back' (Buchanan, 2015) and develop four distinct but related strategies which, in the context of hyper-accountability practices, resist barriers and constraints to their professional agency. Hence, their agency can be reflected in actions – happening at micro-level – to resist macro-level policy practices through 'pushing back' (Buchanan, 2015). This is perhaps most clearly visible in teachers' strategies to sustain agency, by identifying 'pockets of possibility' in the national curriculum, where they can implement pedagogical approaches which are consistent with their ideas and values. In this way teachers' are sustaining their professional agency by ensuring that all students experience chemistry education that is authentic and of value to them even given the constraints of the restrictive and bureaucratic national

curriculum. For example, in seeking to regularly incorporate simple experiments as part of classroom teaching which do not require expensive equipment, or making links to chemistry which students experience as part of their everyday lives, teachers are ‘pushing back’ or resisting a national curriculum which is not consistent with their access to laboratory space and equipment (material resources). It is also an example of teachers ‘stepping up’ or going beyond what is expected, to ensure that what they teach is consistent with their professional ideas and values of teaching chemistry in ways that are authentic (cultural aspect of the practical-evaluative dimension of agency) and meaningful for their students (structure aspect of the practical evaluative dimension of agency). Such ‘pushing back’ or ‘stepping up’ is associated with identifying spaces for agency (Rushton & Bird, 2024), or ‘spaces for manoeuvre’ (Priestley et al., 2012) through actions happening inside and outside the classroom. Identifying spaces for agency can include building trusting and authentic relationships with students (Theme G, Table 4) and seeking out opportunities to nurture their own professional development (Theme H, Table 4). We also underline the ways in which ideas of teaching science, of science education and of science itself is threaded through both constraints to agency which teachers experience and as a source which underpins teachers’ strategies to sustain agency. For example, the gap in ideas of the value of science itself between teachers and their students and wider society is a key constraint to agency. At the same time, teachers sustain agency by rooting their professional identity as a teacher of chemistry who enables all students to think scientifically and to question what they learn and experience in the world. A substantial body of research has considered the ways in which science teachers’ professional identities are informed by connection to their subject and disciplinary expertise (Rushton et al., 2023). At the same time, further research could helpfully consider in more detail the connections and tensions between subject identity and constraints and enablers of agency.

Finally, Consistent with Leijen et al. (2020), who highlight the importance of reflective approaches to strengthening teacher agency, we suggest that these themes of both constraints and enablers to teacher agency provide a useful starting point for reflection. Such reflections could be undertaken by teachers individually, in peer groups within schools, as part of initial teacher education and career-long professional learning activities. For example, the eight themes could be framed as stimuli or questions for teachers to consider the ways in which their own experiences of agency are similar or different and to continue to identify the cultural, structural, material aspects which enable and constrain agency over time. Whilst is valuable to understand the ways in which teachers can sustain agency in the context of hyper-accountability, we continue to argue for educational cultures which consistently enable and sustain teachers’ professional agency, rather than requiring teachers to ‘push back’ or ‘step up’ in response to constraints to agency at different levels and during different stages of their careers. Instead, we advocate for policy makers to move away from high-stakes accountability systems which create winners and losers (Munoz-Chereau et al., 2022) and instead, attend to resourcing and enabling the strategies which sustain teacher agency. In this study these strategies were rooted in the opportunity to teach chemistry such that all students experienced science as authentic and of value to their lives. This is consistent with the findings of Dover et al. (2016), where justice-oriented teachers embrace, reframe and resist the impact of educational reform, responding strategically to changing educational mandates.

7. Conclusion

Reflecting on this study, we recognise that the data are drawn from a relatively small number of participants (ten teachers) and as such we do not claim that these are representative of the teaching population at the time of data collection. Opportunities to strengthen the study could have included a second stage of data collection, where the themes identified through analysis of interview data could have been triangulated through

a large-scale survey of participants and/or a second phase of interviews. Indeed, in our future work we intend to develop this study through subsequent phases of data collection.

Drawing on teacher agency through the ecological approach as a conceptual framework we have been able to look across the education system in Chile to consider the conditions required for teachers to achieve agency and understand the constraints and enablers they experience. This takes our understanding beyond a focus on the experiences and views of cohorts or individual teachers and therefore the ‘development’ that they might require. In this way, we as researchers are seeking to ‘push back’ against a culture of ‘hyper-accountability’ which teachers in Chile continue to encounter through this period of educational reform. Furthermore, this research adds to the body of knowledge concerning teacher agency in Chile as it utilises the ecological approach to teacher agency to develop new understanding which foregrounds specific cultural and social contexts. This is distinct from previous research which has considered teacher agency in Chile and has drawn on other conceptual frameworks which foregrounds Freirean ideas of autonomy and hope (Torres Olave & Dillon, 2022). We provide some final reflections and implications from our research of relevance to the wider teacher education and education research communities.

Firstly, we argue for policy makers in Chile and beyond to urgently reflect on the ways in which national evaluation policies and curriculum reform inhibit teachers’ agency and restrict opportunities to respond with creativity and innovation in ways which meet the needs of the students and communities in which they teach. Teachers who were able to achieve agency developed approaches to teaching and learning which they perceived provided all students with authentic chemistry education. Secondly, we underline the need for the chemistry national curriculum to be of value for all students, not only those who wish to pursue future careers in chemistry and/or related fields. This research underlines the importance of ensuring that experiences and expertise of teachers and students are meaningfully incorporated into future iterations of national curriculum frameworks which we contend is a necessary and important next step for chemistry education in Chile.

Finally, we reflect on the affordances of small-scale research studies which accompany teachers over the course of key periods of their professional lives. Such studies require little in terms of financial resources when compared to large-scale randomised controlled trial studies. Furthermore, by developing clear themes of constraints to agency and strategies which teachers employ to sustain agency, this interview-based research has created further opportunities for professional reflection for practising teachers and teacher educators focused on nurturing and strengthening teacher agency. In this way, this research has the potential to enhance science teachers’ practices across Chile and in other international contexts where high stakes school accountability cultures persist, including across the UK and the USA. As we look to the future, we note the various ways in which teachers’ subject specialism, in this case chemistry, informs both constraints to agency and strategies which they develop to sustain agency. Future research could valuably focus on the linkages and tensions between subject-specialism, teachers’ professional identity and teacher agency. Such research will have significant insights for initial teacher education and teachers’ career-long professional learning.

Ethics declaration

Institutional ethical approvals were obtained prior to the commencement of this study (Ethical Approval Number Z6364106/2018/05/170).

Patient consent statement

All research participants consented to take part.

Funding

This work was supported by Agencia Nacional de Investigación y Desarrollo- BECAS CHILE [grant number 557/2015].

Disclosure statement

No potential conflict of interest was reported by the authors.

ORCID iD authorship contribution statement

Denise Quiroz-Martinez: Writing – review & editing, Writing – original draft, Validation, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Elizabeth A.C. Rushton:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors have no relevant interest(s) to disclose.

Data availability

The data that has been used is confidential.

References

- Akiba, M., & LeTendre, G. K. (Eds.). (2017). *International handbook of teacher quality and policy*. New York: Routledge. <https://doi.org/10.4324/9781315710068>.
- Ball, S. J. (2003). The teacher's soul and the terrors of performativity. *Journal of Education Policy*, 18(2), 215–228. <https://doi.org/10.1080/0268093022000043065>
- Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology*, 52(1), 1–26. <https://doi.org/10.1146/annurev.psych.52.1.1>
- Bartell, T., Cho, C., Drake, C., Petchauer, E., & Richmond, G. (2019). Teacher agency and resilience in the age of neoliberalism. *Journal of Teacher Education*, 70(4), 302–305. <https://doi.org/10.1177/0022487119865216>
- BERA. British Educational Research Association. (2004). Revised ethical guidelines for educational research. <https://www.bera.ac.uk/publication/ethical-guidelines-for-educational-research-2018>.
- Biesta, G., Priestley, M., & Robinson, S. (2015). The role of beliefs in teacher agency. *Teachers and Teaching*, 21(6), 624–640. <https://doi.org/10.1080/13540602.2015.1044325>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp0630a>
- Braun, V., & Clarke, V. (2012). Thematic analysis. In H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, & K. J. Sher (Eds.), *APA handbook of research methods in psychology, research designs* (Vol. 2, pp. 57–71). Washington: American Psychological Association. <https://doi.org/10.1037/13620-004>.
- Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, 11(4), 589–597. <https://doi.org/10.1080/2159676X.2019.1628806>
- Braun, V., & Clarke, V. (2021). One size fits all? What counts as quality practice in (reflexive) thematic analysis? *Qualitative Research in Psychology*, 18(3), 328–352. <https://doi.org/10.1080/14780887.2020.1769238>
- Bridges, D., & Jonathan, R. (2003). Education and the market. In N. Blake, P. Smeyers, R. D. Smith, & P. Standish (Eds.), *The Blackwell guide to the philosophy of education* (pp. 126–145). Malden, MA: Wiley-Blackwell. <https://doi.org/10.1002/9780470996294.ch8>.
- Buchanan, R. (2015). Teacher identity and agency in an era of accountability. *Teachers and Teaching*, 21(6), 700–719. <https://doi.org/10.1080/13540602.2015.1044329>
- CEM. (2022). Apuntes 17: Informe Estadístico del Sistema Educativo con Análisis de Género 2021. Santiago Retrieved from https://centroestudios.mineduc.cl/wp-content/uploads/sites/100/2021/12/APUNTES-17_2021_fd02.pdf.
- Childs, P. E., Hayes, S. M., & O'dwyer, A. (2015). Chemistry and everyday life: Relating secondary school chemistry to the current and future lives of students. In I. Eilks, & A. Hofstein (Eds.), *Relevant chemistry education* (pp. 33–54). Brill. <https://doi.org/10.1007/978-94-6300-175-5>.
- Clarke, V., Braun, V., & Hayfield, N. (2015). In J. A. Smith (Ed.), *Qualitative psychology: A practical guide to research methods* (pp. 222–248). London: SAGE Publications.
- Cofré, H., Camacho, J., Galaz, A., Jiménez, J., Santibañez, D., & Vergara, C. (2010). La educación científica en Chile: debilidades de la enseñanza y futuros desafíos de la educación de profesores de ciencia. *Estudios Pedagógicos*, 36(2), 279–293. <https://doi.org/10.4067/S0718-07052010000200016>
- Cornejo, R., Albornoz, N., Castañeda, L., Palacios, D., Etcheberrigaray, G., Fernández, R., Gómez, S., Hidalgo, F., & Lagos, J. I. (2015). Las prescripciones del trabajo docente en el nuevo marco regulatorio de políticas educativas en Chile. *Psicoperspectivas*, 14(2), 72–83. <https://doi.org/10.5027/psicoperspectivas-Vol14-Issue2-fulltext-580>
- Dover, A. G., Henning, N., & Agarwal-Rangnath, R. (2016). Reclaiming agency: Justice-oriented social studies teachers respond to changing curricular standards. *Teaching and Teacher Education*, 59, 457–467. <https://doi.org/10.1016/j.tate.2016.07.016>
- Elige Educar. (2021). Estudio proyecta que podrían faltar más de 26 mil docentes idóneos para 2025. <https://eligeeducar.cl/notas-sobre-nuestros-estudios/estudio-proyecta-que-podrian-faltar-mas-de-26-mil-docentes-idoneos-para-2025/>.
- Emirbayer, M., & Mische, A. (1998). What is agency? *American Journal of Sociology*, 103(4), 962–1023. <https://doi.org/10.1086/231294>
- Erss, M. (2018). 'Complete freedom to choose within limits'—teachers' views of curricular autonomy, agency and control in Estonia, Finland and Germany. *Curriculum Journal*, 29(2), 238–256. <https://doi.org/10.1080/09585176.2018.1445514>
- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1–4. <https://doi.org/10.11648/j.ajtas.20160501.11>
- Falabella, A. (2020). The ethics of competition: Accountability policy enactment in Chilean schools' everyday life. *Journal of Education Policy*, 35(1), 23–45. <https://doi.org/10.1080/02680939.2019.1635272>
- Falabella, A., & De la Vega, L. F. (2016). Políticas de responsabilización por desempeño escolar: Un debate a partir de la literatura internacional y el caso chileno. *Estudios Pedagógicos*, 42(2), 395–413. <https://doi.org/10.4067/S0718-07052016000200023>
- Freire, M., Talanquer, V., & Amaral, E. (2019). Conceptual profile of chemistry: A framework for enriching thinking and action in chemistry education. *International Journal of Science Education*, 41(5), 674–692. <https://doi.org/10.1080/09500693.2019.1578001>
- Giddens, A. (1984). *The constitution of society: Outline of the theory of structuration*. Polity Press.
- Goodson, I. (2003). Professional knowledge. *Professional lives: studies in education and change*. (Professional learning series). Open University Press. <http://mcgraw-hill.co.uk/html/0335204112.html>.
- Hall, M., & Hampden-Thompson, G. (2022). The teacher as street-level bureaucrat: Science teacher's discretionary decision-making in a time of reform. *International Journal of Science Education*, 44(6), 980–999. <https://doi.org/10.1080/09500693.2022.2059588>
- Hargreaves, A. P., & Shirley, D. L. (2009). *The fourth way: The inspiring future for educational change*. Corwin Press.
- Hofstein, A., & Kesner, M. (2015). Learning from and about industry for relevant chemistry education. In I. Eilks, & A. Hofstein (Eds.), *Relevant chemistry education* (pp. 285–299). Brill. <https://doi.org/10.1007/978-94-6300-175-5>.
- Jääskelä, P., Poikkeus, A. M., Vasalampi, K., Valleala, U. M., & Rasku-Puttonen, H. (2017). Assessing agency of university students: Validation of the AUS scale. *Studies in Higher Education*, 42(11), 2061–2079. <https://doi.org/10.1080/03075079.2015.1130693>
- Jiang, J. (2021). Teaching a minimal citizenship in China: Testing, official discourse, and teacher agency. *Teaching and Teacher Education*, 106, Article 103441. <https://doi.org/10.1016/j.tate.2021.103441>
- Leijen, A., Pedaste, M., & Lepp, L. (2020). Teacher agency following the ecological model: How it is achieved and how it could be strengthened by different types of reflection. *British Journal of Educational Studies*, 68(3), 295–310. <https://doi.org/10.1080/00071005.2019.1672855>
- Mamluk-Naaman, R., Abels, S., & Markic, S. (2015). Learning about relevance concerning cultural and gender differences in chemistry education. In I. Eilks, & A. Hofstein (Eds.), *Relevant chemistry education* (pp. 219–240). Brill. <https://doi.org/10.1007/978-94-6300-175-5>.
- Montecinos, C., Cortez, M., Valenzuela, J. P., Zett, I., & Zoro, B. (2022). Teachers' agentic actions in tight and loosely coupled effective secondary schools in Chile. *Teaching and Teacher Education*, 115, Article 103731. <https://doi.org/10.1016/j.tate.2022.103731>
- Munoz-Chereau, B., González, Á., & Meyers, C. V. (2022). How are the 'losers' of the school accountability system constructed in Chile, the USA and England? *Compare: A Journal of Comparative and International Education*, 52(7), 1125–1144. <https://doi.org/10.1080/03057925.2020.1851593>
- Nielsen, J. A., & Holmegaard, H. T. (2015). Innovation and employability: Moving beyond the buzzwords—a theoretical lens to improve chemistry education. In I. Eilks, & A. Hofstein (Eds.), *Relevant chemistry education* (pp. 317–334). Brill. <https://doi.org/10.1007/978-94-6300-175-5>.
- Pantić, N. (2015). A model for study of teacher agency for social justice. *Teachers and Teaching*, 21(6), 759–778. <https://doi.org/10.1080/13540602.2015.1044332>
- Pantić, N. (2017). An exploratory study of teacher agency for social justice. *Teaching and Teacher Education*, 66, 219–230. <https://doi.org/10.1016/j.tate.2017.04.008>
- Pantić, N., Galey, S., Florian, L., Joksimović, S., Viry, G., Gašević, D., Knutes Nyqvist, H., & Kyritsi, K. (2022). Making sense of teacher agency for change with social and epistemic network analysis. *Journal of Educational Change*, 23, 145–177. <https://doi.org/10.1007/s10833-021-09413-7>
- PEARSON. (2013). Informe final evaluación de la PSU Chile. *Educar Chile*. https://educacion2020.cl/wp-content/uploads/2013/01/201301311058200.chilepsu-resumen_ejecutivo.pdf.
- Priestley, M., Biesta, G., & Robinson, S. (2015). *Teacher agency: An ecological approach*. Bloomsbury Publishing.
- Priestley, M., Edwards, R., Priestley, A., & Miller, K. (2012). Teacher agency in curriculum making: Agents of change and spaces for manoeuvre. *Curriculum Inquiry*, 42(2), 191–214. <https://doi.org/10.1111/j.1467-873X.2012.00588.x>
- Reyes, L. (2018). El «profesor efectivo» en Chile: ¿profesionalización o disciplinamiento? (1980-2018). In C. M. Ruiz-Schneider, J. F. Herrera-Jeldres, & L. Reyes-Jedlick (Eds.), *Privatización de lo público en el sistema escolar. Chile y la agenda global de*

- educación (pp. 207–233). LOM Ediciones. <https://repositorio.uchile.cl/handle/2250/168037>.
- Rich, K. M. (2021). Examining agency as teachers use mathematics curriculum resources: How professional contexts may support or inhibit student-centered instruction. *Teaching and Teacher Education*, 98, Article 103249. <https://doi.org/10.1016/j.tate.2020.103249>
- Roth, W. M., & Barton, A. C. (2004). *Rethinking scientific literacy*. Routledge. <https://doi.org/10.4324/9780203463918>
- Ruan, X., Zheng, X., & Toom, A. (2020). From perceived discrepancies to intentional efforts: Understanding English department teachers' agency in classroom instruction in a changing curricular landscape. *Teaching and Teacher Education*, 92, Article 103074. <https://doi.org/10.1016/j.tate.2020.103074>
- Rubin, H. J., & Rubin, I. S. (2005). Qualitative interviewing. *The art of hearing data* (2nd ed.). SAGE Publications, Inc. <https://doi.org/10.4135/9781452226651>
- Ruiz-Schneider, C. M., Herrera-Jeldres, J. F., & Reyes-Jedlick, L. (2018). Privatización de lo público en el sistema escolar: Chile y la agenda global de educación. *LOM Ediciones*. <https://repositorio.uchile.cl/handle/2250/168037>.
- Rushton, E. A., & Bird, A. (2024). Space as a lens for teacher agency: A case study of three beginning teachers in England, UK. *Curriculum Journal*, 35, 254–270. <https://doi.org/10.1002/curj.224>
- Rushton, E. A., Rawlings Smith, E., Steadman, S., & Towers, E. (2023). Understanding teacher identity in teachers' professional lives: A systematic review of the literature. *The Review of Education*, 11, e3417. <https://doi.org/10.1002/rev3.3417>
- Ryder, J., Lidar, M., Lundqvist, E., & Östman, L. (2018). Expressions of agency within complex policy structures: Science teachers' experiences of education policy reforms in Sweden. *International Journal of Science Education*, 40(5), 538–563. <https://doi.org/10.1080/09500693.2018.1435921>
- Sevian, H., & Bulte, A. M. (2015). Learning chemistry to enrich students' views on the world they live in. In I. Eilks, & A. Hofstein (Eds.), *Relevant chemistry education* (pp. 55–78). Brill. <https://doi.org/10.1007/978-94-6300-175-5>.
- Stuckey, M., Hofstein, A., Mamluk-Naaman, R., & Eilks, I. (2013). The meaning of 'relevance' in science education and its implications for the science curriculum. *Studies in Science Education*, 49(1), 1–34. <https://doi.org/10.1080/03057267.2013.802463>
- Taber, K. S. (2015). Epistemic relevance and learning chemistry in an academic context. In I. Eilks, & Hofstein (Eds.), *Relevant chemistry education* (pp. 79–100). Brill. <https://doi.org/10.1007/978-94-6300-175-5>.
- Tao, J., & Gao, X. (2017). Teacher agency and identity commitment in curricular reform. *Teaching and Teacher Education*, 63, 346–355. <https://doi.org/10.1016/j.tate.2017.01.010>
- Toom, A., Pyhalto, K., & Rust, F. O. C. (2015). Teachers' professional agency in contradictory times. *Teachers and Teaching*, 21(6), 615–623. <https://doi.org/10.1080/13540602.2015.1044334>
- Torres Olave, B., & Dillon, J. (2022). Chilean physics teacher educators' hybrid identities and border crossings as opportunities for agency within school and university. *Journal of Research in Science Teaching*, 59(10), 1795–1821. <https://doi.org/10.1002/tea.21774>
- Towers, E., Rushton, E. A. C., Gibbons, S., Steadman, S., Brock, R., Cao, Y., Finesilver, C., Jones, J., Manning, A., Marshall, B., & Richardson, C. (2023). The "problem" of teacher quality: Exploring challenges and opportunities in developing teacher quality during the covid-19 global pandemic in England. *Educational Review*, 1–17. <https://doi.org/10.1080/00131911.2023.2184771>
- Vähäsantanen, K. (2015). Professional agency in the stream of change: Understanding educational change and teachers' professional identities. *Teaching and Teacher Education*, 47, 1–12. <https://doi.org/10.1016/j.tate.2014.11.006>
- van Berkel, B.v., Pilot, A., & Bulte, A. M. (2009). Micro–macro thinking in chemical education: Why and how to escape. In A. H. Johnstone (Ed.), *Multiple representations in chemical education* (pp. 31–54). Springer. https://doi.org/10.1007/978-1-4020-8872-8_3.
- Wei, B., & Chen, N. (2019). Agency at work: Two beginning science teachers' stories in a context of curriculum reform in China. *International Journal of Science Education*, 41(10), 1287–1302. <https://doi.org/10.1080/09500693.2019.1600205>
- Zhao, T., Zhu, X., Zeng, X., & Yu, Y. (2023). Better to lose than to gamble? The typology of career differentiation and agency of experienced teachers in rural areas in China. *Teaching and Teacher Education*, 124, Article 104029. <https://doi.org/10.1016/j.tate.2023.104029>