A Comparison of Classroom Pedagogical Practice Named by Middle School Mathematics Teachers in Australia and Chile

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The professional lexicons of middle school mathematics teachers in communities around the world were documented as part of The International Classroom Lexicon Project. This vocabulary captured teachers' naming of classroom pedagogical practice. Reported in this paper are attributes of the lexicons of teachers from Australia and Chile. A comparison of the lexical items revealed commonalities and differences in the named phenomena and in the schema employed for their organisational structure. The analysis revealed differences attributable to cultural and contextual factors. A categorisation system was developed to classify the complexity of similarity of lexical items of one lexicon with another.

Background

The International Classroom Lexicon Project began with the recognition that classroom practices named by one educational community are not necessarily named by others (Mesiti et al., 2021a). Some communities have had their named activities translated into English in ways which misrepresent their true meaning, whilst other named activities have been omitted from the *lingua franca* of research (Clarke, 2006). Research undertaken in the field of mathematics education and language has generally focussed on the language of the learner; the language brought by the teacher to the classroom; and the language arising from the practice of mathematics (Planas et al., 2018; Austin & Howson, 1979). These domains appear to exclude studies of teachers' professional language about phenomena of the mathematics classroom. In response, the primary goal of the International Classroom Lexicon Project was to document the professional vocabulary of teachers to describe middle school mathematics classrooms. These are the words that teachers use to talk *about* the classroom when in conversation with colleagues. At the core of the research project was a recognition of the importance of teacher knowledge, a commitment to document teacher knowledge, and a commitment to share this knowledge with the wider community to improve teachers' reflective practice.

The professional lexicons of Australian and Chilean mathematics teachers are expressed in English and Spanish. English is spoken by 1.348 billion people (370 million native speakers) whilst Spanish (the official language of Chile) is spoken by 543 million people (471 million native speakers). English is the most spoken language and Spanish is the fourth most spoken language around the world (Lane, 2021). The professional lexicons are a collection of terms by which teachers name the objects and events that constitute their professional activity. In this paper we compare the lexicons of the Australian and Chilean middle school mathematics teachers to build our understanding of the variation possible within two teaching communities that speak two of the most common languages in the world by asking the following research questions:

1. *When comparing the national lexicons from Australia and Chile in what ways are they the same and in what ways do they differ?*
2. *How might these differences be categorised?*

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Teachers' Professional Vocabulary

The identification of a technical or professional language in English, to support the description and analysis of classroom practice is underdeveloped (Grossman et al., 2009; Lampert, 2000; Lortie, 1975). Few opportunities are present in the school environment to engage with peers about the problems and challenges of practice (Connell, 2009). This absence of informal learning opportunities results in an English "language of practice [that] remains flat or nonexistent" (Lampert, 2000, p. 90). Similarly, in two case studies reporting the development of communities of practice using videotapes in Chile, participants reported that they were entirely unfamiliar with the idea of creating communities to engage with discussions about various aspects of practice (Grau et al., 2017). Successful learning communities are characterised by professional experiences, opportunities and the sharing of a common language (Grossman et al., 2001).

Theoretical Framework

Researchers have argued that differences amongst languages, both linguistic and semantic, influence our lived experience (Boroditsky, 2001; Levinson, 2003). This position, a weaker interpretation of the much-debated Sapir-Whorf hypothesis that "language shapes thought" (Sapir, 1949), has been characterised as *linguistic relativity*. Others have similarly argued that "categories set up, and hence the distinctions made by language, not only express the social structure but also create the need for people to conform to the behavior associated with these categories" (Marton, Runesson & Tsui, 2004, p. 28). The theoretical position adopted for this project is in line with the notion of *linguistic relativity;* that differences and absences in vocabulary matter and these may indicate a diversity of teachers' view of the classroom.

Research Methodology

The International Classroom Lexicon Project: The Research Design

The International Classroom Lexicon Project involved research teams from Australia, Chile, China, Czech Republic, Finland, France, Germany, Japan, Korea and the USA. In each participating country, experienced teachers of middle school mathematics participated as legitimate members of both the research teams and their wider practitioner community, representing insiders, informers as well as collaborators. The research teams enacted a "negotiative" methodology (Mesiti et al., 2021a) by participating in collaborative consultations with teacher partners regarding the identification and inclusion of terms in the lexicon. This approach ensured authority was accorded to teacher voice in the generation of each national lexicon. Each resulting lexicon was then negotiated with its wider community through a thorough, structured, iterative process of validation to refine and ratify the structure and content of this national lexicon. The main phases for the documentation of national lexicons and each community's validation processes have been detailed elsewhere (Mesiti et al., 2021b).

The Australian and Chilean Lexicons

The lexicons consist of terms (or short phrases) that are familiar, have an agreed meaning, and are in use by middle school mathematics teachers. These terms are illustrated with a description from the classroom, an example and sometimes a non-example and this detail has been translated into English by the country team of origin (see Table 1 for a selection from the Australian and Chilean Lexicons). All items included in the lexicons have been validated locally and nationally.

Table 1
Example of Lexical Items from the Complete Australian and Chilean Lexicons (Mesiti, Hollingsworth, Clarke et al., 2021; Grau et al., 2021)

Lexical Item	Australian Lexicon	Chilean Lexicon
Term name	prompting	puesta en común (putting in common)
Description	The teacher guides the student (usually with a verbal comment) towards a more appropriate or effective response of solution method.	The teacher orchestrates the joint review of a completed task without giving out the right answer. This implies that knowledge is distributed among students and the teacher.
Examples	A teacher comments: "Check your working." Or "Try multiplying."	The class is reviewing the results of a worksheet. The teacher asks: "Did anyone get a different result? Why?"
Non-examples	The teacher provides the next step in the solution.	

In the table above, the operational definition of each of the terms *prompting* and *puesta en común* are operationalised with a description, examples and non-examples. A non-example, something that might be thought of as indicative of the practice but is not, was sometimes included to assist with the provision of a fuller definition.

Comparison of the Australian and Chilean Lexicons: The Research Design

Phase 1: Independent Reviewing

The members of the cross-national team included an Australian researcher (speaker of English and Italian) and three Chilean researchers (speakers of both English and Spanish). Each member independently reviewed both lexicons to identify terms that were identical, similar with regards to pedagogical intention, as well as entirely absent from the other lexicon.

Phase 2: Group Negotiation

Phase 1 was followed by a whole group negotiation. Each candidate pairing of terms was examined and members of the team discussed possible lexical similarity. This involved considering the items in terms of:

- agency (whose action);
- observable form;
- inferred function;
- breadth (range); and
- relation to mathematical content.

Discussion centred around revealing the 'fullness' of the definition – deciding which characteristics were crucial in understanding the meaning of the term and what action, activity or cognitive activity was being represented. This was supported with readings and re-readings of the operational definitions (definitions, examples and non-examples). The members of the cross-national team approached this challenging task mindful of respecting the origins of the lexicons as representing the teachers' vocabulary and their definitions. Once terms were identified as "similar" or related in some way, various types of associations were detailed. These included:

- *Exact* (match in name and intention);
- *Containment* (where one term was a subset of another term);
- *Inter-Related* (terms with properties in common); and,
- *No correspondence* (unique to its lexicon).

These relationships, as well as critical distinctions, were revisited at a following meeting to validate initial pairings.

Results and Discussion

The Organisational Structure

The Australian Lexicon contains 61 terms as representative of a professional vocabulary of middle school mathematics teachers (see Table 2). The terms are generic in nature, feature a significant number of gerunds. Students' voice, action and participation are significant characteristics (Mesiti, Hollingsworth, Clarke et al., 2021). The Chilean Lexicon features 74 terms in total mostly constituted of short phrases as opposed to single-word terms (see Table 2). These phrases refer to generalist concepts of pedagogy not specific to mathematics, and feature terms that focus on lesson structure. Most of the terms that involve agency are actions performed by teachers (Calcagni et al., 2021).

Table 2
Lexicon Characteristics of the Australian and Chilean Lexicons

Lexicon Characteristics	Australian Lexicon	Chilean Lexicon
Number of terms	61	74
Number of organisational categories	5	5
Terms belonging to more than one category	37	5

Table 3
Organisational Category Names of the Australian and Chilean Lexicons

Lexicon	Organisational Category Names (number of terms)
Australian	Administration (8) Assessment (11) Classroom Management (7) Learning Strategies (27) Teaching Strategies (49)
Chilean	*Didáctica de la disciplina* - subject-matter didactics (22) *Metodologías generales* - general pedagogies (18) *Interacción pedagógica* - teaching interactions (16) *Estructura/rutina* - structure/routine (12) *Clima de aula* - classroom climate (9)

The number of terms identified in the lexicons are similar in number and are communicated with an organisational system encompassing five categories (see Tables 2 and 3). Both systems were inspired by classroom teachers' groupings of lexical items and the names they gave to these groupings. When comparing these organisational structures, category names and terms grouped within were examined. The following findings were identified:

- only the Chilean category *Didáctica de la disciplina* (subject-matter didactics) includes terms with a mathematical focus, this category also includes a number of practices that are classified within the Australian *Teaching Strategies* category;
- the Australian category *Assessment* includes terms that can be found within the Chilean category *Metodologias generals* (general categories);
- the Australian category *Classroom Management* appears similar to intention to the Chilean category *Clima de aula* (classroom climate); and,
- the Chilean *Interacción pedagógica* (teaching interactions) category includes terms similar to those within the Teaching Strategies category.

Whilst most of the terms in the Chilean Lexicon belong only to one category, five terms have been assigned to two (see Table 2). For example, the Chilean term argumentar (arguing) is found in both the *Didáctica de la disciplina* (subject-matter didactics) and the *Interacción pedagogica* (teaching interactions) categories. In contrast, the Australian Lexicon includes 37 terms that belong to more than one category and significant overlap of 24 terms is found between the *Learning* and *Teaching Strategies* categories (see Table 2). One possible explanation is that the Australian terms indicate a flexibility in teacher pedagogical expertise as many practices can be seen as providing both teaching and learning opportunities. This includes terms such as: *answering questions*, *applying*, *defining* and *justifying* as well as *reasoning* and *summarising*. On the other hand, the Chilean categorisation system indicates a nuanced understanding of *didactics* (locally defined as "the art of teaching"): the consideration of content knowledge, student cognitive characteristics and pedagogy within the scope of learning and teaching.

The Named Phenomena

A summary of the results of the analysis of exploring commonality and difference between the lexicons of Australia and Chile is given in Table 4. (Note that a term may be involved in more than one pairing, for example, consider the Australian term *questioning* in Figure 1.)

Table 4
Comparison of the Australian and Chilean Lexicons by Term Correspondence

Type of term correspondence	Australian Lexicon	Chilean Lexicon
Exact	10 pairs	
Containment (by Australian term)	12 pairs	
Containment (by Chilean term)	4 pairs	
Inter-Related (terms with properties in common)	12 terms	16 terms
No correspondence (unique to the lexicon)	28 terms	33 terms

About half the terms (33 Australian terms; 41 Chilean terms) corresponded in some way (whether exactly, containing or contained, or inter-related). Many more Australian terms contained the Chilean terms and indicated a difference with level of detail. The Australian Lexicon is distinctive in its identification of general pedagogical practices and this comparison highlights the level of specification. Whereby the Australian Lexicon identifies the phenomena of *questioning* the Chilean Lexicon has indicated four questioning-related terms (see Figure 1). Another form of inter-relatedness includes the pairing with respect to peer support. In this case

the construct differed by actor. The Australian term refers to the student activity of peers assisting each other; the Chilean term refers to the teacher promoting such student activity.

Exact

Australian Term	Chilean Term
group work	trabajo en grupo (group work)
justifying	fundamentar (providing justifications)
monitoring	monitoreo del aprendizaje (monitoring learning)
positive reinforcement	refuerzo positive (positive reinforcement)

Inter-Related

Australian Term	Chilean Term
peer support	promover apoyo entre pares (promoting peer support)
questioning	pregunta per informacion (information question) contra-preguntar (counter-asking) pregunta metacognitiva (metacognitive question) pregunta por elaboración (elaboration question)

Containment by Australian Term

Australian Term	Chilean Term
summarising	sistematización (systematisation)
worked example	resolución en conjunto de tareas matemáticas (solving a mathematical task together)

Containment by Chilean Term

Australian Term	Chilean Term
clarifying	facilitar el aprendizaje (facilitating learning)
questioning	secuencia pregunta-respuesta (question-and-answer sequence)

Figure 1. Examples from the lexicons of type of term correspondence.

No correspondence

Australian Terms (absent from the Chilean Lexicon)	
engaging (engagement)	on task
motivating	reflecting
elicit understanding	guiding
giving praise	modelling

Chilean Terms (absent from the Australian Lexicon)	
enunciar el plan de la clase (stating the lesson plan)	desarrollo de la clase (lesson development)
curso normalizado (normalised class)	petición de ayuda (asking for help)
uso del humor (use of humour)	valorar procedimientos (valuing procedures)
presentar contenidos con contexto de la vida real (presenting contents in real-life contexts)	

Figure 2. Examples from the lexicons of 'No Correspondence' (absent terms).

Many of the terms in this comparison were determined as unique to their constituent lexicon: 28 Australian terms (46%) and 33 Chilean terms (45%) (see both Table 4 and Figure 2). The Chilean terms absent from the Australian Lexicon include terms related to structure of the lesson (*conectar con plan curricular*; connecting with the curricular plan), stages of the lesson (*inicio de la clase*; beginning of the lesson), resource use (*uso de material concreto*; use of concrete materials), and problem-solving approaches (*simplificación de un problema*; simplification of a problem). The Australian terms absent from the Chilean lexicon relate to areas of affect (*encouraging*), management (*collecting work*), assessment (*feedback*), student work (*student responses*) and thinking processes (*prompting, applying*) [additional examples have been given in brackets]. Of particular interest to the Chilean researchers was the emphasis

of terms related to thinking processes, both dialogical (*guiding*) and imitative (*demonstrating*), in the Australian Lexicon. Affect-related terms are almost entirely absent from the Chilean Lexicon (except for the term *uso del humor;* use of humour).

Research studies in Chile focusing on mathematics teaching have consistently reported that lessons are characterised by teacher-led instruction and question-and-answer sequences and the Chilean Lexicon appears to reflect this finding. The lesson begins with the presentation of concepts and procedures and is followed by individual student work to practise skills (Preiss et al., 2016). One of the enduring difficulties with teachers' continuous education is the lack of coherence between the needs of professional development and the courses and methodologies currently offered by the programs. They tend to be based in direct instruction, instead of focusing on teachers' reflections about their own practice (Grau et al., 2017). Australia continues to endure a stubborn shortage of qualified mathematics teachers in schools (Weldon, 2015), which results in teachers without specific training in mathematics education teaching "out-of-field" (Weldon, 2016). This situation would likely affect teachers' naming of practices about the mathematics classroom, thus professional development involving comparing lexicons might well be useful to promote teachers' nuanced understanding about classroom practice.

Conclusion

In this paper we compared the lexicons of the Australian and Chilean middle school mathematics teachers to indicate the variation possible within two teaching communities that speak two of the most common languages in the world. These lexicons capture the words familiar and in use by teachers when identifying the phenomena of their mathematics classroom. The lexicon documented is in the teachers' native language (and translated into English) and is supplemented with a description and illustrative examples from the classroom. Together these elements work together to provide a full and rich operational definition for each of the lexical items.

In contrasting the Australian Lexicon with the Chilean Lexicon, we were able to identify differences and commonalities in structure, phrasing, specification, and context. More than half the terms in the lexicons were related. The methodological approach detailed in this paper allowed for the development of a five-type correspondence categorisation that improved the identification and naming of complexity around the notion of similarity. This was made possible with collaborative detailed discussions to characterise the complexity of correspondence by the members of the cross-national team. The analysis outlined in this paper confirms the cross-national researchers' commitment to document and share teacher knowledge as an initial step towards improving teachers' reflective practice.

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