MOVING FROM LANGUAGE AS RESOURCE TO LANGUAGE AS SOURCES OF MEANING IN MATHEMATICS EDUCATION

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In multilingual mathematics classrooms, language is often conceptualised as a resource, a supportive tool that teachers may deploy to assist learners in accessing mathematical content. While this perspective has contributed significantly to equity-oriented practice, it risks treating students' linguistic repertoires instrumentally and fails to recognise the epistemic functions of language in constructing mathematical meanings. Drawing on classroom empirical illustrations from probability lessons, this paper advances a theoretical and practice-oriented shift from understanding language as a resource to understanding languages as sources of meaning (Barwell, 2018). Implications for teaching practice are discussed, emphasizing the centrality of multilingual meaning-making in shaping mathematical thinking in statistics classrooms.

INTRODUCTION

In multilingual classrooms, teachers have long been encouraged to view students' linguistic backgrounds as valuable assets for learning. The concept of language as resources emerged as a response to deficit perspectives that positioned linguistic diversity as a barrier to mathematics learning (Planas, 2018). This shift reframed multilingualism as a pedagogical strength, recognizing that students' home languages can support comprehension and meaning-making in mathematics classrooms, student engagement, and supporting students' identity affirmation. However, while this "resources" framing has been powerful in promoting inclusion, it can also, as Barwell (2018) argues, limit language primarily as a tool to access a given Westernised knowledge rather than as a medium through which knowledge itself is created. This conceptualisation also risks marginalising multilingual epistemologies that contribute to mathematical meaning making and challenge the widely held assumption that mathematics is culturally neutral (Bishop, 1988; Farsani, 2022; Sharma, 2014).

In this paper, we take Barwell's (2018) language as sources of meaning approach and provide examples from probability lessons to support epistemic potential of multiple languages in the classroom. Our focus is on the mathematical topic of probability which has been shown to be challenging for students with diverse language backgrounds. This view positions language as not only supportive but fundamentally generative in mathematical thinking. This paper draws on secondary classrooms vignettes, linguistic analyses, and examples from research to illustrate multilingual

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meaning-making in probability learning. The paper contributes to international conversations on language as meaning making perspective and to the growing scholarship on cultural politics in knowledge systems.

CONCEPTUAL FRAMEWORK- LANGUAGE AS SOURCES OF MEANING

A growing body of research (Barwell, 2018; Ryan & Parra, 2019) now invites educators to move beyond the idea of language as a static resource toward understanding language as a source of meaning-making. In this view, language is not merely an external support for cognition; it is central to how learners think, reason, and make sense of disciplinary ideas. Each language embodies particular ways of organizing experience, expressing relationships, and conceptualizing the world. When students engage in learning through their home languages, they do not simply translate existing meanings—they actively construct new ones. The discursive dimension, which involves multiple sources of meaning that multilingual students draw on during mathematics tasks, view mathematics as socially and culturally diverse (Prediger & Uribe, 2021; Ryan & Parra, 2019).

This perspective aligns with sociocultural theories of learning which conceptualize language as a semiotic system through which meaning is made in social contexts. Learning, from this standpoint, is the process of participating in and appropriating new discourses. Meaning-making occurs as students use language to reason, justify, compare, and question ideas. Thus, every act of learning involves a transformation of meaning through linguistic and cultural mediation (Ryan & Parra, 2019). Socio-semiotic and discursive perspectives (Halliday, 1978; Sfard, 2008) treat mathematics as a form of specialised discourse. Understanding mathematics requires engaging with its linguistic, symbolic, and visual representations. Mathematical reasoning is therefore deeply intertwined with linguistic and cultural repertoires (Prediger & Uribe, 2021; Ryan & Parra, 2019).

This paper conceptualizes probability learning as a language-mediated process of meaning-making, in which students construct, negotiate, and refine probabilistic understandings through discourse. The framework positions language—not as a neutral conduit for mathematical ideas—but as a central epistemic resource through which probabilistic concepts become intelligible. Students move fluidly across perspectives, blending them within explanations. This movement is understood as productive meaning-making rather than conceptual confusion. In the next sections, we provide examples from the probability lessons to support the language as sources of meaning orientation to teaching and learning and research.

EVIDENCE FROM PROBABILITY LEARNING

In contemporary mathematics education research, language is increasingly theorised not as a neutral conduit for transmitting mathematical ideas but as the very medium through which learners construct, negotiate, and transform meaning (Sfard, 2008; Moschkovich, 2018). This orientation shifts the focus from viewing linguistic features

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as “resources” to recognising language as a “source of meaning-making". In the context of probability, a domain characterised by uncertainty, ambiguity, and interpretive flexibility, language plays a particularly powerful role (Farsani, 2022; Sharma, 2014). Students rely on linguistic, cultural, narrative, and multimodal forms of communication to render probabilistic situations understandable. This section provides empirical illustrations, and evidence from research literature to argue that students’ language practices—everyday metaphors, home languages, gestural discourse, argumentation, and cultural narratives—are central to conceptualising probability concepts such as randomness, fairness, likelihood, sample space, and distribution.

Everyday Metaphors for Interpreting Randomness

Metaphorical language is a cornerstone of probabilistic reasoning. Lakoff and Núñez (2000) argue that metaphor structures mathematical thinking, enabling learners to make abstract concepts more tangible. In probability learning, students often rely on metaphors that reflect culturally shared ways of understanding uncertainty (English, 1998). For instance, a student reasoning about why a die does not favour a particular outcome after a long streak explained: “The die has no memory—each roll starts again.” This metaphor encapsulates the idea of independence: the likelihood of each outcome remains constant regardless of previous events. The student’s phrasing invokes a mental model where the die is conceptualised as a non-sentient agent incapable of tracking past events.

Such everyday metaphors are not mere linguistic conveniences—they actively organise cognitive processes. They shape how learners perceive statistical phenomena and influence how they engage in probabilistic explanation. Teachers attuned to these metaphors gain insight into students' conceptual landscapes, enabling more responsive and inclusive instruction (Batanero et al., 2016; Prediger & Uribe, 2021).

Home Language Use for Negotiating Meaning

Sociolinguistic research demonstrates that multilingual learners use their full linguistic repertoires to negotiate meaning in mathematics (García & Kleyn, 2016; Planas, 2018). Translanguaging — fluid movement between languages — enables learners to articulate nuanced explanations that may be less accessible in the language of instruction. This is consistent with Moschkovich (2018), who argues that multilingual practices are central to constructing mathematical meaning rather than peripheral to it. In a New Zealand probability classroom, Tongan-speaking students engaged in a discussion about a spinner divided into unequal sectors. One student explained in Tongan: “Ko e vaega loloa ’eni… ’Oku lahi ange ’ene avanoa,” (meaning “of this long section, this is more spacious”) before restating in English, “It’s bigger, so more chance”. Being able to talk about unequal sectors on a spinner in Tongan and English allowed student to make a discursive shift to draw on conceptual precision in their home language and disciplinary terminology in English (Sharma, 2024).

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Moreover, translanguaging, here, functions as a meaning-making bridge, enabling students to connect geometric representation (area) with probabilistic interpretation (likelihood). The use of home-language in probability learning can surface conceptual distinctions that may remain hidden in English-only discourse as highlighted in research by Barton et al. (2007) and Hunter et al. (2022). Prediger and Uribe (2021) emphasise the importance of providing opportunities for students to move between informal and formal registers. Rather than viewing home languages as ancillary, this perspective recognises them as epistemic tools.

Cultural Storytelling to Understand Sample Space

Developing the concept of sample space (all possible outcomes of a random experiment) is fundamental in promoting growth in probabilistic thinking. Students, however, need to coordinate and co-construct multiple concepts (eg theoretical and experimental probabilities) in the development of sample space. All the possible outcomes can be listed systematically, using combinations, tally charts, tables, tree diagrams, and graphs. Cultural narratives offer students powerful interpretive frameworks for conceptualizing combinatorial structures. Ethnomathematics literature (Barton et al., 2007; Bishop, 1988) has long argued that mathematical ideas are embedded in cultural practices. The two examples below illustrate how students use cultural storytelling to construct meaning for sample space.

The first example presents the student's use of kapa haka as an organising structure reflects Māori epistemological orientations that emphasise relationality, structure, and collective coordination (Bishop & Glynn, 1999). In a classroom exploring simple sample spaces, students were asked to list all possible combinations of two attributes (e.g., food and drink choices). A Māori student drew on kapa haka organisation to explain the structure of the sample space: "It's like kapa haka groups choosing who stands where—you get different combinations depending on who stands with who." Rather than functioning as a contextual embellishment, the cultural reference provided an interpretive framework for understanding how combinations are generated and organised. This explanation parallels formal combinatorial reasoning, where systematic variation across attributes generates an exhaustive set of outcomes (English, 2016).

Another example concerns naming a child. Naming a child is perceived to be an important parochial occasion in many cultures. Children are named after their parents, their grandparents and perhaps their uncles. Some even share the name with several previous generations. Farsani (2022) presented the Two-Child Problem involving conditional probability to Chilean students. Students were presented with the problem "Carlos and Maria have two children. We know that one of the children is called Daniel. What is the probability that the other is a female?". A typical response in the classroom was: "It is obvious that Daniel is the second son, with the first-born son being called Carlos, of course, just like his father". Therefore, the response implies that the probability of having a female child is 0. Rather than using mathematics logical,

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the response is based on cultural practice of naming children. The response raises awareness of the interaction between conditional probability and established cultural patterns of beliefs and raises the question of whether mathematics is neutral in its discourse. This response has the potential to support to develop a deeper understanding of compound events.

Research in culturally responsive and ethnomathematical approaches to probability learning highlights that such culturally grounded explanations enable learners to make sense of abstract mathematical structures by drawing on familiar collective practices (Gay, 2018; Farsani, 2022). The above examples illustrate how students' cultural and linguistic repertoires operate as sources of mathematical meaning, shaping how sample spaces are conceptualised and represented.

Narratives for Interpreting Probabilistic Statements

Narrative reasoning is a primary mode of human understanding. Students frequently use narrative structures to interpret probabilistic language. Probabilistic terms such as "60% chance of rain" are notoriously misinterpreted; many learners assume they refer to a duration or geographical coverage. In Gigerenzer & Hoffrage's (1995) study, a student reframed the statement narratively as "It's like saying out of 10 days like tomorrow, it rains on six". This narrative unpacking aligns with a frequentist interpretation and grounds the abstract percentage in experiential time (co-ordination of experimental and subjective notions). The response indicates that students' interpretations of formal probability expressions often emerge *through* language rather than being applied *to* language.

This re-expression does not simply translate an abstract percentage into more accessible terms; instead, it constitutes the probabilistic meaning itself by reconfiguring the situation as a temporal narrative. In this sense, language functions as a generative source of meaning, enabling students to construct probability through familiar experiential structures such as repetition over time. Such reasoning is consistent with research showing that probabilistic understanding is grounded in natural frequency representations and narrative sense-making, rather than in formal numerical symbolism alone (Gigerenzer & Hoffrage, 1995; Borovcnik & Kapadia, 2014). By translating probability into narrative, students create meaningful contexts that connect abstract measures to lived experience. Teachers can build on such narratives to deepen probability literacy and confront common misconceptions.

Argumentation Language in Collaborative Probability Tasks

Argumentation and collective reasoning are central mechanisms through which students make sense of probability. Moschkovich (2018) highlights that engaging in mathematical argumentation requires learners to use language to justify, negotiate, and refine ideas. In Sharma study (2024), students debated whether Lulu game was fair. Their discussion employed discourse markers such as "because…," "but…," and "doesn't matter…" to articulate claims and counterclaims. For instance, one student

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said the game was fair because all outcomes are equally likely. Through this discursive negotiation, they clarified the distinction between geometric fairness and misconceptions about physical bias.

Such interactions illustrate how argumentation language not only reflects but actively shapes conceptual development (García & Kleyn, 2016). The collective discourse becomes the medium through which fairness, likelihood, and randomness are constructed.

Gestural–Verbal Integration for Understanding Distributions

Gestures are an essential component of mathematical communication. Radford (2014) notes that gestures, language, and symbolic representations collectively mediate mathematical meaning. In Sharma's class, when explaining why the sum of two dice yields a normal distribution, a student gestured a peak while stating: "Five, six, seven are the middle sums—there are many ways to get these." The gesture made visible the notion of multiplicity of outcomes, complementing verbal reasoning (Sharna, 2024). This multimodal explanation demonstrates how bodily expression supports abstraction. In probability contexts, gestures often reveal students' attention to structure, frequency, and representation.

Students' linguistic, cultural, and narrative resources actively shape how they conceptualise randomness, sample space, distribution, and fairness. Viewing language as a source of meaning shifts instructional focus from correctness of vocabulary to the richness of students' discursive practices. This orientation aligns with contemporary perspectives in mathematics education that emphasise discourse, identity, and cultural-linguistic diversity as central to learning.

IMPLICATIONS FOR PRACTICE

As educational contexts become increasingly diverse, teachers, researchers, and policymakers are challenged to develop pedagogies that honour linguistic plurality as a source of insight and innovation. Moving toward a meaning-making perspective invites us to see that languages do not merely carry knowledge, they create it. This understanding expands what it means to learn, to teach, and to know in multilingual educational spaces. Understanding language as a source of meaning-making challenges teachers to design pedagogies that go beyond inclusion toward epistemic engagement. This perspective allows us to draw on several implications for probability teaching and learning.

First, there is a need to pay more attention to translanguaging as a practice in its own right. Rather than focus on the languages an individual speaks as distinct, one from the other, translanguaging posits that the languages with which learners and teachers come to school are fluid and flexible rather than codes between which the code switcher moves back and forth. Translanguaging practices, for example, allow students to move fluidly between languages as they explore ideas (García & Wei, 2014). Rather than seeing home language use as a bridge to English or as a temporary support,

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translanguaging becomes a creative act of knowledge construction. Students draw upon the full range of their linguistic repertoires to reason and communicate in ways that deepen their understanding. For instance, in statistical or probabilistic reasoning, students might use expressions from their home languages that capture uncertainty or chance in culturally distinctive ways. These linguistic forms can open new conceptual pathways and metaphors that enrich collective understanding.

Second, viewing language as meaning-making also reshapes how teachers interpret and assess student learning. When learners express ideas in multiple languages, they demonstrate not confusion but cognitive flexibility and depth of reasoning. Assessment practices should therefore focus not only on linguistic accuracy or adherence to disciplinary English but on the quality and complexity of the meanings being constructed across languages.

Third, the shift from "language as a resource" to "language as meaning-making" also carries implications for how educators understand knowledge itself. It invites recognition that knowledge is not neutral or universal but always mediated through language and culture. The cultural explanations about sample space draw our attention to the potential these explanations have in making tasks personal and culturally meaningful. The cultural storytelling and home languages provide a stable structure for systematic enumeration and familiar organisational practices to understand abstract combinatorial logic. In a multilingual classroom, multiple epistemologies coexist and interact. Teachers who engage with this plurality create opportunities for students to negotiate meanings collaboratively and to see that disciplinary concepts—such as those in mathematics, statistics, or science—can be understood and expressed through diverse linguistic and cultural frames.

Ultimately, this reconceptualization moves from inclusion toward transformation. Treating language as a resource values diversity; treating language as meaning-making reconfigures learning itself as a multilingual, multimodal process of constructing knowledge. Such an approach foregrounds the active role of language in thinking and positions students' linguistic repertoires not as supplementary supports but as integral to the intellectual work of the classroom.

CONCLUSION

This paper argues for a shift from understanding language as a resource to recognising languages as sources of mathematical meaning. Through examples from multilingual classrooms, the analysis shows that students' linguistic repertoires contribute culturally embedded interpretive frameworks that reshape probabilistic reasoning. Recognising this expands possibilities for theory, pedagogy, and research in mathematics education. Embracing linguistic and cultural diversity not merely as support but as epistemic richness enhances the mathematical experiences of all learners. Students will learn that mathematics is a creative discipline that has been shaped by the contributions of diverse people and cultures over time.

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