Teachers' Praxis in Mediating Student Understanding Using Authentic Contexts

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This study examines how teachers mediate upper secondary students' understanding of measurement through the strategic use of authentic real-life contexts, situated within the praxis of enacted classroom pedagogy. Measurement is a foundational mathematical domain, yet low-performing, disengaged students consistently struggle to develop transferable conceptual understanding. Attending to how teacher intention translated into enacted praxis, ethnographic methods captured moment-by-moment pedagogies through which real-life contexts were actualised revealing the conditions under which authentic contextualisation produced genuine mathematical engagement.

Introduction

Measurement is a key area of study for secondary mathematics through which students develop numeracy and mathematical competence for life beyond school. Despite its practical significance, low-performing upper-secondary students may have trouble connecting formal measurement with concepts their application in life and work (Bolstad, 2023). These difficulties may be exacerbated by classroom practices that privilege abstract procedures and textbook learning over meaning-making through tools, real-life representations, and situated problems. This paper reports on an aspect of a larger study investigating what teachers and students value when a numeracy model (Goos et al. 2012) is enacted in the classroom. The study employed a person-oriented methodology, using ethnographic classroom observations and interviews in six upper secondary mathematics classrooms over a 14-month period in Australia.

Authenticity in mathematics education has historically been determined by those who design curriculum, write textbooks, and produce classroom resources. As a result, teachers in practice may not always meaningfully select authentically contextualised materials (Gravemeijer et al., 2017). Conceptual and analytical frameworks developed by scholars such as Goos et al. (2012), FitzSimons (2013) and Gravemeijer et al. (2017), have provided valuable tools for defining and categorising authentic tasks, and for examining how teachers approach their design and selection. Yet, analytical frameworks of this kind, however theoretically robust, do not adequately address the question of how tasks are perceived and experienced by students themselves, how authenticity is felt, negotiated, and valued in the lived reality of the classroom. This study aims to shift the focus, relocating authenticity from the domain of curriculum design to the domain of enactment, and re-centring the perspectives of students and teachers as arbiters.

Drawing on numeracy model (Goos et al., 2012), this study examines how students valued the mathematics concepts that were learnt when teachers and upper-secondary students engaged meaningfully with authentic contexts. The Goos et al. numeracy model has four key components: contexts, dispositions, mathematical knowledge, and tools, and this is considered with a critical orientation (2012). Previous studies have considered the importance of using authentic tasks that are drawn from life (Frankenstein, 2009; Geiger et al., 2023; Sakurai & Goos, 2023) and from the workplace (Fitzsimons, 2013). However, few studies have looked at how mathematics is enacted in the classroom and the impact of teacher praxis. This is defined in this study as the reflexive and purposeful interaction and theoretical knowledge between teachers and students (Grootenboer, 2013; Kemmis et al., 2014). Addressing authenticity through the lens of praxis moves the question beyond task design toward the realities of enactment. Our conception of authenticity therefore is situated, relational and concerned with

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how students themselves perceive the enactment of mathematical tasks and what values they and their teachers bring to that encounter. It is this intersection of teacher intention, student perception, and enacted praxis that the present study sets out to examine. Hence, the research question is, how does the numeracy model (Goos et al., 2012) support mathematics learning for students who experience disengagement? And furthermore, what is the role of authentic contexts when using the numeracy model?

Literature Review

Numeracy and mathematical literacy are widely endorsed as central aims of secondary mathematics education, yet their operationalisation in senior secondary classrooms remains theoretically and pedagogically contested, with evidence suggesting that teachers' enactment is often fragmented and reduced to procedural fluency rather than rich mathematical practice (Geiger, Goos, & Forgasz, 2015). Internationally, mathematical literacy is framed as the capacity to formulate, employ, and interpret mathematics in real-world contexts, requiring judgement, reasoning, and communication (OECD, 2019). Australian senior secondary curricula similarly emphasise application, modelling, and interpretation, positioning numeracy as a general capability that extends beyond procedural competence (ACARA, 2022). However, these policy aspirations may sit uneasily alongside entrenched classroom practices that continue to privilege abstraction, efficiency, and symbolic manipulation.

Numeracy is frequently treated as an implicit outcome of mathematics learning rather than an explicit object of teaching (Geiger et al., 2015; Goos et al. 2012; Gravemeijer et al., 2017). This assumption is particularly pronounced in upper secondary mathematics, where curriculum density and assessment practices encourage a narrowing of pedagogical focus. As a result, numeracy risks being marginalised or reduced to superficial contextualisation, rather than enacted as a form of situated mathematical practice. This suggests that simply aligning tasks with curriculum language is insufficient; rather, numeracy must be theorised and examined as a distinct form of mathematical activity.

Authentic task design has been explored as a means of engaging students in learning the mathematics. Liljedahl (2015) found that authentic tasks moved the students from abstraction to concrete understanding. In designing and using tasks, teachers may shift their pedagogical practices to accommodate contexts that encompass real life. However, teacher informed praxis, involving careful contextualisation of the mathematics may be hard for teachers to sustain in the face of abstraction in textbooks and teacher resources.

Low-performing students of mathematics found in upper secondary classrooms, often have not had success with traditional approaches to teaching. Abstraction often requires the removal of contexts and a restructure extracting the essential algorithms or patterns to generalise the mathematics into broad universal rules (Liljedahl, 2015). Yet, in the classroom reality, much of the student thinking happens in a concrete space before abstraction can occur (Gula & Lovric, 2024).

Teaching itself can be understood as a form of praxis, a morally complex activity with enduring "affective, intellectual and social consequences" (Grootenboer & Edwards-Groves, 2014, p. 277), a definition drawn from Aristotle. In this framing, education serves a dual purpose: to meet the needs of individuals and to fulfil the needs of society (Grootenboer, 2013) and is practiced across domains that are simultaneously socio-political, cultural-discursive, and material-economic (Grootenboer & Peter-Koop, 2024). Kemmis et al. (2014) similarly positions education as a means of helping "people live well in a world worth living in" (p. 2). Central to this view is the recognition that mathematics should not exist in a vacuum, devoid of the real-world contexts from which it is derived. Mathematical practices are embedded in everyday life, in shopping, in driving, and in countless other activities. Yet these are rarely recognised in classroom settings as authentic experiences. Instead, mathematics education tends toward abstract or contrived contexts, and the mathematics encountered in real life is often perceived as less important than traditional school mathematics. (Lave, 2019) reinforces this concern, arguing that learning should be situated in real life and not to be separated from it.

Mathematics teaching is inherently value-laden and carries significant moral, ethical, and caring dimensions (Grootenboer, 2013). When teaching fails to honour these dimensions, students risk becoming disengaged from the subject. Grootenboer's (2013) study identified the fragile nature of some students, and the tension teachers face in attending to their social and emotional needs while simultaneously engaging them with abstract or complex mathematical ideas. Grootenboer and Peter-Koop (2024) further suggest that situating mathematics teaching within authentic practice may support students in transferring their knowledge from the classroom to real life, affirming the broader utility of mathematics beyond schooling. The present study draws on these perspectives, employing authentic and relevant contexts to support students' emotional and social engagement, grounded in the understanding that such contexts are situated within the spheres of life students already inhabit.

Research Gap

Goos et al. (2012) provide a conceptual analytical theoretical framework for the teaching and learning of mathematics concepts (Geiger et al., 2015; Goos et al., 2020). Their framework has provided a way for researchers and teachers to see themselves as taking the primary role in situating the mathematics in the real world, bridging the gap between classroom and workplaces (Geiger et al., 2015; Goos et al., 2020). Important though numeracy frameworks are, researchers and teachers may still be seen as the primary arbiters of what is authentic. Hence, the need to expand these frameworks to help understand how students perceive and what factors support them to engage with authentic mathematics in the classroom.

A substantial body of literature has established the pedagogical value of real-life contexts in mathematics education, documenting their capacity to enhance motivation, support conceptual understanding, and render abstract content meaningful to students (Geiger et al., 2015; Goos et al., 2020) Analytical and conceptual frameworks have made significant contributions to understanding how authentic tasks might be defined and how teachers approach their design and selection. Yet as Grootenboer (2014) and Goos et al. (2012) have noted, the field has attended more closely to the theoretical rationale for contextualised mathematics than to the conditions of enactment. Crucially, these frameworks do not adequately address the question at the level of the student: how do students themselves perceive, recognise, and engage authentically with mathematical tasks, and what social, emotional, and cognitive values they bring to that encounter (Seah, 2016).

Numeracy development in upper secondary measurement cannot be assumed to arise from context-rich tasks alone. Attention should be focussed on the conditions in which students experience tasks as genuinely meaningful rather than merely contextually dressed. Drawing on the numeracy framework in which learning is understood as situated and contextually constituted, (Goos et al., 2012), this study sought to examine how authentic contexts work in practice, how they are selected, orchestrated, and received, and what students and teachers value in the pedagogical practices. This paper aims to respond to calls from Geiger et al. (2015), Goos et al. (2020), and Grootenboer & Peter-Koop (2024) for research that attends to the praxis of contextualised mathematics teaching and extends that work by treating student perception and value as the primary focus.

Research Question

Given that using real world contexts for authentic task design in numeracy lessons is well accepted in the literature, it is important to examine how these tasks are enacted with low-performing students who are also likely to exhibit disengagement from the mathematics. This paper seeks to explore how mathematics teaching and learning is enacted, and what is valued by the teachers and low-performing mathematics students when using the numeracy model.

Methodology

This study employed qualitative data collection methods including ethnographic classroom observations (Mills & Morton 2013) and semi-structured interviews with teachers and students using person-oriented approaches (POA) (Bergman & Wångby, 2014). POA allows for deep study of a small number of individuals within the classroom environment (Sakurai et al., 2023), considering all individuals as unique, and that on a global level, patterns may emerge to provide insights (Bergman & Wångby, 2014) .POA acknowledges that people are complex with multiple layers of interconnected systems of cognition, social, cultural and emotional domains. Given this study seeks to examine how values were enacted in foundational mathematics classrooms of low-performing upper-secondary students, small numbers of subjects were selected to allow for richer, more nuanced insights to emerge.

Six classes from five experienced teachers with a total of 40 students were studied to determine what values were enacted in upper-secondary classes of low performing students with recurring patterns of poor behaviour consistent with high disengagement from learning. Approximately eight classroom observations were conducted per class over a 14-month period, with individual interviews for teachers and small group interviews for students at the end of each observation period. Hence, POA approaches allowed the researcher to be embedded in the classroom as an accepted presence by the students and their teachers. Classes were drawn from metropolitan and regional Victoria, Australia and from a mix of government and private schools. Classes were determined by the teacher to be low performing with students studying a foundational mathematics program. Narrative ethnographic notes (Cohen et al., 2018; Moschkovich, 2019) using the numeracy framework (Goos et al., 2012) provided a detailed account of how values were enacted within the classroom, capturing the lived experiences of both teachers and students. These notes served as a primary lens through which the praxis of validation techniques could be observed and interpreted within the naturalistic setting of a foundational mathematics classroom (Cohen et al., 2018; Moschkovich, 2019).

Measurement activities in this study were deliberately designed by teachers around authentic familiar contexts to make measurement concepts accessible and meaningful to low-performing upper-secondary students and situated in the numeracy model (Goos et al., 2012). This contextualisation provided authentic pedagogical opportunities and supported the decision to situate the data collection and analysis in the Goos et al. (2012) Numeracy model.

Data analysis was conducted using POA methodology (Vargha et al., 2015). A systematic interpretation was undertaken of narrative field notes to distil individuals' behaviour to uncover patterns of teacher and student behaviour within the foundational mathematics classrooms. The ethnographic narratives were imported into ATLAS.ti. Codes were developed and refined in alignment with the numeracy model (Goos et al., 2012), allowing themes to emerge that reflected how values, contexts, and mathematical knowledge were enacted. Trustworthiness was established through "credibility, transferability, dependability, and confirmability" (Cohen et al., 2018, p.319), and operationalised via member checking, factual reporting, over-inclusion, an ATLAS.ti audit trail, and researcher reflexivity in relation to the guiding numeracy model (Cohen et al., 2018).

Results

Specifically, this study considered how teacher intention translates into enacted praxis; the moment-by-moment pedagogical work through which real-life contexts are actualised in the classrooms of low-performing upper-secondary students. All six observed classrooms enacted authentic, real-life numeracy tasks consistent across the dataset. The following results demonstrate how students engaged in mathematical reasoning and what that engagement reveal about their values and motivations.

Teacher A deliberately selected an image of a bus partially submerged in floodwater which was sourced from contemporary media and presented it without mathematical framing. The intention was to elicit spontaneous quantitative engagement. The lesson was characterised by rapid, overlapping student contributions which were competitive in tone, iterative in structure, and self-sustaining until a verifiable answer was collectively reached, as shown in Table 1.

Table 1

Student discussion about the height of a bus in floodwater

Student	Conversation
A	It's not a coach, is a public transport bus
B	1.5m
A	No
B	2m
C	NOOO
A	No-one is as tall as a bus. 1.5m is a normal height
C	Nah, it's the roof mate 1.5m!
TEACHER	I'm 1.65m
A	But you're short!
B	She's taller than the bus!
A, B, C	SHOUTING
A	How big is a bus?
B	2m?
A	3m?
C	No way!!!!
A	7 foot, that's over 2m. Let's look it up…. 3.25m
C	Bro, do you think he's the size of a bus, he's half a bus

This discussion unfolded as students examined the teacher's carefully chosen image of a bus submerged in Queensland floodwater. Although no formula had been given and no mathematical task was explicitly set, what followed constituted mathematical reasoning: estimation, proportional reasoning, and verification. The exchange progressed from student conjecture (Teacher: I'm 1.65m) to externally verified knowledge (let's look it up), resulting in a collective answer. The teacher's pedagogical design was deliberate: by withholding explicit mathematical framing, thereby creating the conditions for students to consider the problem and participate in an intrinsically motivated activity. This discourse considers what conditions do students elect to engage in mathematical reasoning.

Students across this study consistently distinguished between knowing a formula and understanding what it means in practice. For many, the formula as traditionally used in the classroom was an obstacle to learning: "I can know a formula but sometimes I still won't know the answer. I can have the formula in front of me and the numbers, but the formula can still be just more confusing." Another put the same insight more plainly: "I reckon the formula is useless, unless you understand what you're doing or like how to use it."

When understanding was absent, students exhibited a characteristic withdrawal: “it just didn’t really click for me, and I didn’t have much interest as well”; “I lose my **** and don’t bother doing it”. The teachers in this study referred to this by firstly embedding the formula in an experience. One teacher introduced s = d/t not as an equation to be memorised but through a running drill in which students measured their own speed, another teacher had students consider why the triangle was the strongest shape for truss bridges. As Teacher A noted with the bus task, their students were considering a genuine real-life question (how tall is that bus?) before they realised the mathematics underpinning the task. Understanding and engagement were simultaneous in these enactments.

Relevance was a value that students cited consistently. However, students were not deceived by contextual packaging: “even when they put algebra into a real-life situation it still doesn’t have much relevance to me... just because they put it into a real-life situation ... it has to have importance.” Importance, for these students, was material and specific. Percentages mattered because “when I’m out shopping... find something worth 35 bucks, you get 20 percent off, just chuck the formula in the calculator.” Measurement mattered because “you can’t waste anything, so you make sure you use the correct pieces”, and more urgently, “when I’m at work if I’m gonna cut some timber... you do it again, then you waste, waste some money.”

By contrast, content experienced as relevant only to school provoked strong critique such as two students considered that Pythagoras appears in an exam but nowhere else. They reported “you’re still held to such a high standard to expect to know that... it’s not required to know that outside of getting that score... school forces you to know it.” The language of compulsion using words like *forced, required, held*, described a relationship with mathematics shaped entirely by obligation. The emotional consequent was explicit: “causing stress over something that really just doesn’t add up.” The students were not, however, outright rejectors of the mathematics, “I know I say like this is stupid, this is stupid, but it’s like it could actually help us in the long run”. This statement suggests that the value of mathematics should be made visible. This is supported by Grootenboer and Peter-Koop (2024) demonstrating that when the mathematics values are inherent, students may engage more strongly with the learning.

The teachers in this study responded precisely to this demand, and they looked for mathematics latent in situations students were already attending to. The bus task was one such moment. The teacher did not construct the scenario but recognised its potential and fostered students’ curiosity as a pedagogical tool. Another example asked about the height of the McDonald’s sign. “How many of you work at McD’s? How many times have you seen the sign out front, have you ever considered how tall it is? And they go, What.” The teacher used the “What?” as the engagement tool, linking the mathematics to an authentic and familiar context as supported by (Grootenboer & Edwards-Groves, 2014). The teacher revealed the mathematics in objects so familiar they had become invisible: “it’s about incorporating everyday objects that they know but never thought about. Humanising the mathematics.” A parallel strategy involved designing open-ended practical tasks oriented toward students’ vocational aspirations. Teacher B was direct about their reasoning: “[these tasks] mostly work as most of these kids want to be tradies, want to work”, and the tasks were constructed accordingly, giving students “a realistic understanding of what they’re working towards.” The open-endedness is deliberate; “they’re free to explore”. This teacher valued autonomy and relevance as central to engagement, not incidental to it. Students corroborated this: “hands on makes me want to learn”; “if it matters to you then that influences you towards learning it.”

What the data reveals is that students may not be disengaged from mathematics itself, but a particular, institutionalised form of it. The bus exchange showed students estimating, arguing, and self-correcting. That is doing exactly what mathematics education sets out to. The gap may not be between students and mathematics, but between *mathematics-as-lived* and *mathematics-as-schooled* as noted by Grootenboer and Edwards-Groves (2019).

Discussion and Implications for Practice

The findings of this study consider the praxis conditions where real-life contexts may produce genuine mathematical engagement among disengaged upper secondary students. Consistent with the work of Geiger et al. (2015), Goos et al. (2020), and Grootenboer and Peter-Koop (2024), the data confirms that contextualised tasks may hold significant pedagogical potential. Yet they also substantiate the field's emerging recognition that context alone is insufficient. The quality of enactment may support student engagement, this may include teacher intention, pedagogical design, and critically, the degree to which students perceived the task as carrying authentic consequence. This aligns with Seah's (2016) contention that student engagement with mathematics is fundamentally value-laden, and shaped by social, emotional, and cognitive orientations that analytical frameworks focused on task design alone cannot capture. The findings echo calls by Grootenboer et al. (2024) for research that attends to the enacted, relational dimensions of contextualised mathematics teaching.

Methodologically, this study is constrained by its ethnographic scope and localised sample. To study deeply the issues of praxis, to uncover the implicit values of teachers and students, means that only a small number of individuals can practicably be studied. Additionally, POA methodology is time consuming, and the issue of temporality dictates that the data collection period is protracted. It is recommended more in-depth case studies may further this knowledge.

All five teachers in this study were observed using authentic contexts pedagogically when teaching measurement concepts. The transferability of measurement concepts for students was most evident when students were required to make assumptions about the mathematics in situations that carried genuine consequence in the world. The students demonstrated the capacity to perceive and act on mathematical structure beyond the classroom, as supported by Gravemeijer et al. (2017) and Grootenboer and Edwards-Groves (2014). This stands in contrast to students' accounts of conventional pedagogical approaches, where mathematics may appear to the students as a set of formulae to be held in memory until the exam, which they characterised as an obligation rather than mathematical agency. Students positioned within authentic contexts reached autonomously for mathematical tools. The bus-in-floodwater task demonstrated this dynamic that the literature has long identified as a condition of deep understanding (Goos et al., 2020; Lave, 2019). The teacher elicited spontaneous mathematical reasoning from the students and engaged students who in the past self-reported that they rarely encountered this type of mathematics in formal classrooms.

The deliberate integration of authentic contexts has positive effects on students observed and self-reported engagement. In authentic tasks, mathematical skills of estimation, proportional reasoning and verification arise as necessary rather than imposed. An open-ended, praxis-grounded pedagogy may well provide a more robust model for how teacher intentions can be translated into enacted classroom experience that students perceive as meaningful and relevant to their lives. These findings reinforce broader calls for curriculum and pedagogical reform that creates space for contextualised, process-oriented mathematical activity (Goos et al., 2020; Grootenboer & Peter-Koop, 2024) in upper secondary mathematics classrooms.

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