Mathematics Leaders as Agents of Project Sustainability

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This paper explores the complex problem of project sustainability, focusing on the leadership of three primary school mathematics leaders. Using cultural-historical activity theory (CHAT), the leaders' efforts are reported, highlighting their contribution to project sustainability. The CHAT-informed research design supported the generation of findings, revealing how the mathematics leaders enacted a form of resourceful practice. This paper contributes new knowledge about mathematics leaders, characterising how they acted as agents of project sustainability. Implications for mathematics education project design are also offered.

Project sustainability in mathematics education is defined as the continuous adaptation and integration of reform efforts that remain true to the project's intent and content in response to the ever-changing post-project contexts within which the efforts are enacted (Clements et al., 2012; Tirosh et al., 2015). The sustainability of project reforms is a complex problem because the development initiated during the life of the project tends to cease once participation in the project concludes (Tirosh et al., 201), and there is also a lack of research about how reform efforts continue beyond project participation (Bobis, 2011). It is recognised that school leadership acts as a crucial factor of project sustainability, but this tends to focus on principal leadership (Coburn et al.), neglecting the influence of middle leading practice enacted by mathematics leaders. Drawing on concepts from cultural-historical activity theory (CHAT), I report on the efforts of three mathematics leaders working as middle leaders in their schools (Grootenboer, 2018). I aim to present their contribution to project sustainability as a form of the CHAT-aligned activity known as *resourceful practice* (Edwards, 2010). By doing so, I characterise how the mathematics leaders acted as agents of project sustainability, providing a new perspective on the leadership activity of mathematics leaders enacted in primary schools.

Background Literature

Project sustainability involves the maintenance of the impact on student learning outcomes and the continued influence of the reform on mathematics teaching practice beyond project participation (Clements et al., 2015; Coburn et al., 2012). The sustainability of projects requires fidelity to the project intent and content (Clements et al., 2015), and it also involves engagement in processes of self-renewal where new routines and practices surface (Coburn et al., 2012; Zehetmeier, 2017). As such, there is a need for school staff to adapt and integrate project intent and content in response to the changed conditions that face schools beyond project participation (Tirosh et al., 2015). Fullan (2008) named school staff who engage in project sustainability as *change agents*, but this title was reserved for principals and executive leaders only.

Studies of project sustainability have focused on the factors that sustain practice reform, recognising their potential to enable and constrain sustainability efforts (Saito et al., 2012; Zehetmeier, 2017). Sustainability factors *within* schools are considered *internal* factors (Saito et al., 2012). Internal factors focus on the primacy of *school leadership* with other factors mediated by that school leadership factor including *staff turnover, school-based professional learning*, and *project resource use* (Bobis, 2011; Datnow et al., 2005; Kaur, 2015; Fishman et al., 2011; Pritchard & McDiarmid, 2006; Tirosh et al., 2015; Warren & Miller, 2016).

School leadership is critical in project sustainability, with principals featured predominately within the literature due to their authority in creating the conditions that maintain the project-

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initiated reform and development (Coburn et al., 2012; Datnow et al., 2005; Saito et al., 2012; Tirosh et al., 2015). Principals can make decisions, set expectations, and provide the resources for continued teacher professional learning (Bobis, 2011; Warren & Miller, 2016). A lack of principal leadership can constrain sustainability efforts, leading to practice regression that sees the resurfacing of pre-reform pedagogies (Tirosh et al., 2015). Rare cases in the literature have reported teacher leaders who have contributed to project sustainability, naming them as *school-based facilitators* (Bobis, 2011) and *reform coordinators* (Datnow et al., 2005).

Staff turnover is understood as the changes at the teacher (Pritchard & McDiarmid, 2006), principal (Saito et al., 2012), and district levels (Datnow et al., 2005). Staff turnover tends to constrain sustainability, disrupting the continuity of institutional knowledge and practice initiated through project participation (Pritchard & McDiarmid, 2006). Staff turnover requires professional learning for newly appointed staff which tends to revise project content rather than extend practice development (Saito et al., 2012). Continued professional learning is crucial for sustaining practice development, with principals positioned as the leaders who create the conditions and provide resources necessary for school-based professional learning (Bobis, 2011; Saito et al., 2012; Warren & Miller, 2016; Zehetmeier, 2017). It is vital that post-project professional learning maintains fidelity to the project's intent and content (Clements et al., 2015; Kaur, 2015). This fidelity extends to the continued use of project resources with leaders and teachers maintaining shared understanding of the pedagogical potential of resources following project participation (Fishman et al., 2011; Saito et al., 2012; Warren & Miller, 2016).

In recent years, mathematics leadership has received attention from mathematics education researchers as a form of school leadership (Driscoll, 2017; Grootenboer, 2018; Sexton, 2023). Mathematics leadership has been conceptualised as middle leading practice different from teacher leadership because mathematics leaders tend to hold formal school leadership positions and undertake teaching responsibilities (Grootenboer, 2018). Mathematics leaders practise leadership in the space *between* the principal and the teachers working in classrooms (Grootenboer, 2018; Sexton, 2023). As middle leaders, mathematics leaders engage in leadership that influences teaching practice due to their unique positioning and proximity to classrooms (Grootenboer, 2018). Their influence is realised in the ways they lead school-based professional learning (Jorgensen, 2016; Sexton, 2023) using co-teaching episodes (Driscoll, 2017), developing assessment practices (Jorgensen, 2016), leading staff meetings (Driscoll, 2017), and developing visions for mathematics teaching practice (Sexton, 2023). Jorgensen (2016) named mathematics leaders as *change agents* due to their influence on teaching practice in ways that principals may not because of their executive positioning.

Despite knowledge of its factors, project sustainability remains a complex problem for schools and mathematics education researchers (Bobis, 2011; Clements et al., 2015). This problem tends to exist because project-initiated reforms tend not to last once project participation ceases (Tirosh et al., 2015), and most research reports about project impact tend to focus only on the change that happens during the life of projects (Coburn et al., 2012; Fishman et al., 2011). While existing literature emphasises the pivotal role of principal leadership as a sustainability factor (e.g., Tirosh et al., 2015), a notable knowledge gap exists regarding how the efforts of mathematics leaders, as middle leaders within school leadership systems, contribute to project sustainability. To address the research problem, I pose the following question: *How do mathematics leaders contribute to project sustainability through their post-project leadership activity as middle leaders in schools?*

Research Design

This paper is drawn from my doctoral study (Sexton, 2023), that investigated mathematics leaders' contribution to project sustainability. Recognising mathematics leadership as a form of

middle leading practice (Grootenboer, 2018), the practice-based theory of CHAT was chosen to investigate mathematics leadership as a form of activity (Engeström, 2015).

Theoretical Framework

CHAT understands activity as *object-oriented* and draws psychological and practical development forward in simultaneous ways. The CHAT concept of the *activity system* acts as the unit of analysis, providing ways of understanding activity by situating it within the context in which the activity occurs (Engeström, 2015). Within the activity system, the *subject* (individuals or a collective group) acts on the *motive-object(s)* in order to transform it, using *cultural tools* through a process known as *mediation* (Engeström, 2015). The subject directs their activity towards the motive-object to achieve a desired and valued *outcome* (Engeström, 2015). Motive-objects are interpreted as the driving force of activity (Leont'ev, 1978) and are understood as the *problem space* at which the subject directs their activity (Engeström, 2015).

Mediation within the activity system occurs through the influence of mediational means beyond cultural tools, which include *rules* that are the implicit and explicit norms and routines that govern interactions within the activity system (Engeström, 2015); *community*, which includes the other people involved in the activity as human activity does not exist outside of social relations (Leont'ev, 1978); and, the *division of labour* that includes the distribution of power and responsibility for tasks and actions enacted within the activity system (Engeström, 2015). In CHAT, the subject enacts a series of *actions* that mediate motive-objects (Leont'ev, 1978) whilst using the mediational means present and available within the activity system.

Resourceful Practice

Resourceful practice, a contemporary CHAT concept, has explanatory power to understand how the subject, when faced with *practice problems* (Edwards, 2010), uses resources creatively to resolve contradictions or tensions within the activity system (Edwards & Thompson, 2013). Resourceful practice recognises resources as the cultural tools, rules, and division of labour within and beyond the subject's activity system. It also highlights the subject's use of the transformative potential of resources (Edwards, 2010). Resourceful practice also theorises the agentic role of the subject in driving activity forward amid contradiction resolution.

Resourceful practice is characterised by several actions, including *reconfiguring motive-objects*, *adapting cultural tools*, *rule-bending*, and *accessing distributed expertise* (Edwards, 2010; Edwards & Thompson, 2013). Reconfiguration of motive-objects is realised when the subject objectifies *what matters* in new ways when faced with practice problems (Edwards & Thompson, 2013). Tool adaptation involves using resources in adaptive and creative ways to resolve contradictions by attributing new meaning to them to pursue reconfigured motive-objects (Edwards, 2010). Rule-bending entails adapting norms and routines by modifying or breaking historically followed rules (Edwards & Thompson, 2013). As a collective process, resourceful practice also emphasises engagement with others within and across activity systems. Accessing distributed expertise involves using resources from various practices and using expertise from neighbouring systems to drive activity forward (Edwards, 2010).

Context and Participants

Contemporary Teaching and Learning of Mathematics (CTLM) was a large-scale project that involved 82 Catholic primary schools in Victoria between 2008 to 2012 inclusive. Each CTLM school participated in a two-year program supported by Australian Catholic University (ACU) and Catholic education staff members. As a requirement, participating schools nominated at least one staff member to undertake the mathematics leadership role. During CTLM, mathematics leaders led teaching practice development in accordance with the project's intent and content. Their leadership was realised through the facilitation of teachers' planning

meetings, co-teaching lessons with colleagues, the organisation of demonstration lessons undertaken by ACU staff, and the leadership of fortnightly professional learning meetings.

Three mathematics leaders, Penny, Cindy, and Rachel (pseudonyms), who worked in three schools that participated in the CTLM project in 2011 and 2012, were participants in my study. Each mathematics leader remained in the role for the entirety of the data generation period, where they engaged in leadership activity that saw them leading teachers' professional learning, completing management tasks associated with their schools' mathematics program, and undertaking mathematics teaching responsibilities in classrooms.

Data Generation and Analysis

The research design included a prolonged data generation period involving site visits to the mathematics leaders' schools from November 2014 to February 2018. The extended data generation period was enacted to investigate the lasting effect of project sustainability (Zehetmeier, 2017). Semi-structured interviews were coupled with observations of the mathematics leaders' practice, with interviews used prior to (~15-min interview) and after (~60-min interview) observations of professional learning opportunities (~70-min observations). This was done to mitigate methodological issues related to the reliance on self-reports of project sustainability efforts, which can impact validation of findings (Tirosh et al., 2015). Documents were collected as cultural tools used by the leaders. Each mathematics leader was visited at least five times during the data generation period. Interviews and observation records were transcribed and uploaded into NVivo^{TM} with the retrieved documents for data analysis.

To analyse data, I used concepts from CHAT and resourceful practice as sensitising concepts to support a deductive thematic analysis (DTA) approach (Fereday & Muir-Cochrane, 2006). This allowed the opportunity to create and use a coding scheme that supported the generation of evidence of theoretical concepts within the dataset. The concepts within the scheme were also used as nodes in NVivo^{TM}, and data were tagged and captured within those nodes. The DTA approach also supported the development of themes from the deductively coded data. The analysis involved seeking evidence of concepts through reading, coding, and interrogating data with my doctoral supervisors, ensuring the saturation of themes. The themes supported naming the mathematics leaders' efforts as leadership actions, thus explaining the mathematics leaders' contribution to project sustainability.

Findings and Discussion

I report and discuss findings together in relation to the theoretical and background literature (Sutton & Austin, 2015). This is done to support achievement of my aim which is to present the mathematics leaders' contribution to project sustainability as a form of resourceful practice.

Before explaining the mathematics leaders' contribution, it is essential to state that they were afforded that contribution because of their principals' commitment to maintaining the mathematics leadership role after CTLM had ended. This supports previous evidence that, as a school leadership factor, principals play a critical role in engaging their authority that sets the direction for project sustainability (Bobis, 2011; Datnow et al., 2005; Warren & Miller, 2016). In the case of my study, this principal direction setting was concerned with the continuation of funding for the mathematics leadership role and maintaining Penny, Cindy, and Rachel in their leadership roles in the six years following CTLM participation.

Leadership Actions: Realising Resourceful Practice

I now focus on explaining the leadership actions enacted by the mathematics leaders that realised their contribution to project sustainability. The six leadership actions are evidenced through the discussion of data, supporting my explanation of the mathematics leaders' contribution to project sustainability as a form of resourceful practice.

Committing to Sustaining Project-Initiated Reforms

Despite facing the changed post-project school conditions (Tirosh et al., 2015), which included the practice problems of withdrawn district leadership and shifted principal support, teacher turnover, and diminished priority and frequency of mathematics professional learning, the mathematics leaders enacted a clear commitment to sustaining the CTLM reforms. Penny evidenced this when she explained what motivated her leadership in the years following CTLM participation:

> This is what I know to be right, and these are the things that a leader needs to be doing, but lack of time and maths priority is stopping me. But I keep going because I care for the students and the teachers. I care about maths and what we started in CTLM, so I try to be creative. (26.03.15)

The leaders' commitment to project sustainability focused on care for improving students' learning, maintaining the project-initiated practice development, and honouring the historical changes in practice initiated through CTLM participation. This focus on "what mattered to them" (Edwards & Thompson, 2013) was their way of reconfiguring the motive-object of their leadership activity in response to the post-project practice problems they faced.

Influencing Principals to Maintain Facilitated Mathematics Planning Meetings

Facilitated mathematics planning meetings were established as a routine in the mathematics leaders' schools during CTLM. Post-CTLM participation saw the mathematics leaders engage in leadership that sustained that project-initiated routine (Clements et al., 2015). This was realised in their efforts to persuade their principals to retain the planning meetings as a school routine. Rachel confirmed this when she explained the reason why facilitated planning meetings remained an enduring routine and why the leadership of them stayed part of her work activity:

> You've got to keep the planning meetings going for the changes we started to become part of the common practice and shared practice. I keep the principal informed about how the planning meetings are important because change takes time, and I want them to continue. (29.04.15)

This "influencing principals" action was also highlighted by Penny in 2016, "I spend time sharing, especially with the principal, that we should keep the facilitated planning meetings here. I tell him that we should keep them." Acknowledging their middle leadership role and their limited authority (Grootenboer, 2018), the mathematics leaders knew that principal endorsement was crucial for maintaining facilitated planning meetings as routines that sustained practice development. This is an example of how the SMLs leveraged the division of labour within their activity system (Engeström, 2015) and engaged in resourceful practice by accessing the distributed expertise of their principals within their activity system (Edwards, 2010). This action also mediated the leaders' focus on what mattered through their reconfigured motive-object realised in their commitment to project sustainability (Edwards & Thompson, 2013). Enactment of this action saw the mathematics leaders maintain facilitated planning meetings as a routine and co-opt those meetings as professional learning opportunities. This action resourcefully addressed the practice problem of diminished mathematics professional learning opportunities they faced following CTLM participation.

Co-Opting Facilitated Planning Meetings as Professional Learning Opportunities

All three leaders claimed that mathematics professional learning became scarce following CTLM participation because other curriculum areas claimed space in school improvement agendas. This was highlighted by Penny when she shared: "Our PLTs [professional learning team meetings] used to be numeracy and literacy, and that was a fortnightly seeing each team [of teachers], but now, I am very lucky to have two PLT meetings a term" (25.03.15).

The mathematics leaders creatively repurposed facilitated planning meetings as teachers' professional learning opportunities to resolve that practice problem. This move became a recurring leadership action observed during each school visit, emphasising its prevalence in

their contribution to project sustainability. Cindy evidenced what I have interpreted as rule-bending (Edwards, 2010) through her co-option of facilitated planning meetings:

> I use the facilitated planning meetings as PD with teachers. I mean, we don't have the PD in maths like we used to in the "CTLM days", so the planning meetings are a way for me to get around that and so that we can keep going on with what we started in CTLM. (06.11.14)

The mathematics leaders repositioned facilitated planning meetings by attributing new meaning to them and adapting the meetings as a resource to mediate their reconfigured motive-object of what mattered for project sustainability (Edwards, 2010; Edwards & Thompson, 2013). They created spaces for continued professional learning, understood as a factor of project sustainability (Bobis, 2011; Kaur, 2015; Pritchard & McDiarmid, 2006). Their enactment of this action further realised resourceful practice (Edwards, 2010) as they adapted to the changed condition of reduced professional learning opportunities following CTLM participation.

Repurposing Project Resources as Sustainability Tools

The mathematics leaders also demonstrated resourceful practice by repurposing CTLM resources as sustainability tools. As the leaders co-opted facilitated planning meetings as professional learning opportunities through rule-bending (Edwards, 2010), they redefined the purposes of project resources. Those resources included mathematics tasks highlighted in CTLM workshops and planning documentation created during CTLM participation. As evidenced by Penny, the mathematics leaders preserved and extended the use of the project resources, acknowledging their historical significance and potential as sustainability tools:

> By using those tasks from CTLM, we are keeping CTLM going here and what we started in CTLM keeps going. It's important that those who went through CTLM use them so that teachers who didn't do CTLM get to know about them, and they use them in their teaching, too. (02.12.16)

This repurposing was not merely a continuation of resource use (Fishman et al., 2011). Instead, the CTLM resources strategically served as cultural tools that mediated the motive object of what mattered to the leaders' sustainability efforts (Edwards & Thompson, 2013). Furthermore, the mathematics leaders extended their resourceful practice to engage in tool adaptation and rule-bending (Edwards, 2010). This was done as they attributed new meanings to the CTLM resources as enduring cultural tools within their activity system. This leadership action highlights the importance of access to and use of project resources (Bobis, 2011; Fishman et al., 2012; Warren & Miller, 2016) and contributes new knowledge about how mathematics leaders resourcefully repurposed them as project sustainability tools.

Using Student Assessment Data as a Convincing Tool

Another leadership action concerned the innovative use of student assessment data. While the CTLM project developed practices for data use to inform teachers' planning decisions, the mathematics leaders redefined the significance of data following CTLM participation. As they facilitated planning meetings, the leaders used data as a cultural tool to persuade teachers to continue using the teaching practices developed during CTLM. This was exemplified by Rachel when she explained why she used NAPLAN data during facilitated planning meetings:

> It's good to use the NAPLAN data with teachers to show them that by continuing with what we started with CTLM, we have kept going, and we saw improvements in the NAPLAN data. That's why we have to keep going, too. The NAPLAN data is good for that. (19.11.15)

I interpret this as further evidence of resourceful practice by how the mathematics leaders engaged in tool adaptation and rule-bending (Edwards, 2010). Due to their commitment to what mattered, the leaders attributed new meaning to data as convincing tools by bending the rules about data use. Data were no longer only used to inform teachers' planning decisions; instead, data were used to persuade teachers to maintain the use of CTLM resources, including mathematical tasks, and to continue using teaching practices developed during the project.

Seeking Support From External Mathematics Educators

The final leadership action that I interpret as the mathematics leaders' resourceful practice concerned how they sought support from outside their schools. Faced with the contradiction of changed district and principal leadership, the leaders proactively sought relationships and assistance from mathematics educators beyond their school sites. This included mathematics leaders in other schools, mathematics consultants, and university mathematics educators. Cindy exemplified this leadership action as she explained how she dealt with diminished support from her principal and withdrawn assistance from Catholic office district staff:

> Having an outside person from the school who is into maths is so helpful for me as the maths leader. That person acts as a 'sounding board' because I know I cannot access the [central Catholic office] staff, and the principal support has really dropped off with maths. You need that outside person who 'gets it' for advice on ways to continue what we started. (23.10.18)

I interpret this action as a new routine for the mathematics leaders and as evidence of accessing distributed expertise beyond the mathematics leaders' activity system (Edwards, 2010). They acted in agentic ways as they sought advice from others' practice in neighbouring activity systems. The mathematics leaders recognised the expertise of others and engaged in volitional action as they accessed distributed expertise (Edwards, 2010).

I have focused on the efforts of the mathematics leaders, presenting them as leadership actions and interpreting them as their contribution to project sustainability. This provides a new perspective on how mathematics leadership, as a form of middle leading, acts as a school leadership factor neglected in previous project sustainability studies (e.g., Datnow et al., 2005; Saito et al., 2012). I evidenced that through the enactment of middle leading practice by focusing on what mattered, engaging in rule bending, adapting cultural tools, and accessing distributed expertise, the mathematics leaders surfaced new and adapted routines that contributed to sustained practice development (Coburn et al., 2012; Tirosh et al., 2012). The mathematics leaders were not only change agents who engaged in project sustainability and influenced teaching practice (Fullan, 2008; Jorgensen, 2016), but they sought to lead in agentic ways by driving practice development forward amid the post-project practice problems they faced (Edwards, 2010). Drawing together my interpretation of their efforts, I claim that the mathematics leaders' contribution to project sustainability was realised through a form of resourceful practice that saw them act as agents of project sustainability.

Conclusion and Implications

Addressing the complexity of project sustainability requires an expanded understanding of school leadership beyond principal leadership. While existing literature focuses on principals and, to some degree, teacher leaders, I drew on CHAT and the explanatory power of resourceful practice to claim that mathematics leaders acted as agents of project sustainability. This is a new contribution to mathematics education research about project sustainability that theorises mathematics leadership activity as a crucial element of the sustainability factor of school leadership. Recognising that CHAT interprets activity within the context in which it occurs, further investigations must take place into how other mathematics leaders act as agents of project sustainability in situations different from the one reported in this paper.

The impact of my study for mathematics education relates to project design. Projects can be costly endeavours with their impact fading once projects cease. One implication to mitigate this phenomenon concerns leveraging the role of mathematics leaders in project design. By building in intent and content that supports practice development for mathematics leaders focused on efforts that sustain reforms, the continued impact of projects could be mediated. This could happen by offering school leaders the concepts of resourceful practice during project participation and exploring how other mathematics leaders have enacted leadership of project sustainability. Findings about Rachel, Penny, and Cindy's leadership could be used as "stories

of resourceful practice" to inform the design of school project sustainability plans that utilise the mathematics leader as an agent of project sustainability.

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