Social Theories of Learning: A Need for a New Paradigm in Mathematics Education

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This paper is theoretical in orientation and explores the limitations of the current field of mathematics education which has been dominated by social theories of learning. It is proposed that the field is approaching its limits for these theories and there is a need for shift that moves from the idiosyncratic possibilities of subjective meaning making and identity formation to a more profound position of "knowledge making". There have been few, if any, advances in equity target group performance so questions are posed as to the viability of social theories for changing the status quo. If equity target groups are to be successful, then success needs to be more aligned with knowledge-making processes.

Australia lags behind many other OECD countries in terms of our equity outcomes. Under the current Liberal governments—state and federal—there is a growing recognition that despite considerable funding, there is a significant problem with the outcomes in Indigenous education in particular and equity target groups in general. The rhetoric of "return on investment" is the mantra of current educational policy and the "investment" of policy, reform, research and intervention has yielded minimal educational gains for Australia's most disadvantaged social and cultural groups. Many states have conducted reviews of education and outcomes, particularly in order to identify key issues and the implications of funding and outcomes (e.g. Wilson, 2014). Through this theoretical paper, I seek to explore the literature on how students come to make meaning from their mathematical experiences, and how these theories and positions may be supporting or hindering the future of mathematics education, particularly for those who are traditionally excluded from mathematics. I propose that current approaches to theorising and framing mathematics learning may be constraining the learning for Australia's most disadvantaged learners and that news ways of thinking about teaching and learning may be required in order to redress systemic inequality.

Making Sense or Meaning in Mathematics: The Field of Mathematics Education

To provide a brief snapshot of the field of mathematics education as to how various terms are used as explanations of how students come to make meaning, there are a few key signifiers used. Many terms, such as meaning making and sense making are used to describe how learners come to create understandings of their experiences of mathematics classrooms and mathematical concepts and processes. More recently, with the growth of papers on identity, meaning making has been extended to making meaning about oneself. Since the surge of papers and projects purporting to use social approaches to learning, the field of mathematics education has moved from one that was predominantly based in psychologistic discourses to one where the emphasis has remained with the individual but that recognises the powerful influence that the social context has on any meaning making that transpires. The move from constructivist theories of learning that dominated the latter

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part of the 1900s to more social theories of learning represented a shift from cognition that resided in the mind, to a more encompassing view of learning. This was famously captured by Lerman (2000) when he spoke of this change to more social theories of learning. He referred to this as the "social turn". Lerman's work was taken up by the field, as shown by a Google search for "Lerman, social turn" – a yield of 6.1m hits are reported, while on Googlescholar the same search terms yielded 22,500 hits. While these are unlikely to refer solely to Lerman's work, it does give some indication of the uptake of this idea within the field of mathematics education

Taking the term "field" from the social theorist Pierre Bourdieu (1991), I argue that shifts occur within the field, that these shifts reflect similar shifts in power, and that the field changes but in many ways remains the same. Bourdieu (1990) also reminds us of the limits of fields as well. If one considers the dominance of psychology in the 1980s and 1990s with constructivism being the pinnacle theory to describe and locate research outcomes, then there has been a marked shift. I contend that the field had reached its limits with constructivism and so evolved in order to take greater account of the social. At some point in the field, theories such as those posited by Lave and Wenger (1991) were taken up to account for a greater acknowledgement of the impact of the social context on learning and learners. Lave and Wenger's social theory moved the field in novel ways. For Lave and Wenger, and those who support a social theory of learning, there is a sense of relativism since the meaning that the participant makes is shaped by the context of learning. This meaning making is very subjective, in some individuals taking on board the ideas embedded in constructivism but extending to account for variables not accounted for within constructivism. In a similar way, the corpus of research based in what is broadly seen as Activity Theory, which includes derivations such as Zone Theory (Goos, 2012) or third generation Activity Theory or Cultural-Historical Activity Theory (Roth, 2012) or the notion of communities of practice (Kanes & Lerman, 2007), have been heavily influenced by both activity theory and Lave and Wenger's work. These works all consider meaning as being socially located and hence shaped by the context within which it is located. Collectively in such works, knowledge is seen to be mutually constituted by the individual and through a social medium. This is summed up thus:

> Knowledge is what is produced in a learning environment, but this involves mediation between learners' activity and historical conventions or authoritarian views of meaning, and is seen as individual and/or distributed. (Watson & Winbourne, 2007, p. 3)

Within the literature, there is some contention as to how meanings are made with regard to mathematical concepts and processes. While some researchers are located clearly within a field whereby meanings are related to the embodiment of mathematical constructs (Alibali & Nathan, 2011), others focus on the power of the social context or environment within which learning occurs (Björklund & Pramling Samuelsson, 2012). Simultaneously in this epistemological stance, there is a recognition of the reciprocity of learning and identity formation. For example, in her analysis of students undertaking homework, Landers (2013) showed not only how students made sense of their mathematical homework, but also that undertaking the practice of homework (and success with mathematics) shaped the identity of the learners. Many studies of the impact of streaming in mathematics classrooms (e.g. Boaler, William, & Brown, 2000; Zevenbergen, 2005) have shown that students not only come to make sense of mathematical concepts, but also create a sense of self as a mathematical learner. Much of this work has been applied to students in school and preservice teachers.

These social theories have gained precedence in the field up to this point in time, but I want to disrupt this power base and question whether this position is creating a sense that the social conditions within which learning mathematics occurs is shifting focus away from the core learning of mathematics. My reason for this challenge is the continuing (and perhaps even growing) number of students from socially, culturally and linguistically diverse backgrounds who are still not performing well in mathematics. In the 1970s Bowles and Gintis (1976) created a significant stir in education when they proposed a critical sociology of American education, arguing that inequity may be structural and not something random. That is, schools and education are structured in ways that re/produce inequality. Similar concerns were raised by Connell and colleagues in Australia (Connell, Ashendon, Kessler, & Dowsett, 1982). Some forty years later, and despite considerable research and investment in education, we have failed to redress the concerns noted by Bowles and Gintis in American schooling or Connell and colleagues in Australia. Questions need to be asked as to how the difference in achievement persists given our growing knowledge of education, access, equity and success. Consideration of the billions spent under the "Closing the Gap" initiative, including many educational reforms, the money allocated through National Competitive Grants (such as Australian Research Council Grants and DEEWR grants) as well as many state-funded initiatives, and the lack of gains, or worse still, a worsening of performance across many measures, raises questions about the actions being taken by policy makers, educational reformers and education systems. It is my contention that those theories that pervade current educational discourses and research paradigms that are framed by social theories—such as situated cognition, Activity Theory, or sociocultural theory—may have explanatory value but they may be causing educational research to be "barking up the wrong tree".

The strength of social theories of learning was that they moved to a much broader understanding of how the social milieu in which learning occurred was also implicated in the learning process. Lerman (2006) aptly sums this position up:

> The social theories that are increasingly being used in educational research in general and mathematics education research in particular offer language for describing learning as development within socio-cultural historical practices, and that see meaning, thinking, and reasoning as products of a social activity. The sociocultural perspective thus sees all meanings as socially produced, physical experience too being interpreted through the local cultural practices. (p. 172)

To put this into some frame or context, consider the learning of mathematics by remote Indigenous learners. A number of frames are evident in the current literature on learning and research. While researchers, of which I am one, have bought into the discourses of social theories of learning, as a means of better understanding the social conditions of mathematics classrooms and the impact this has on learners, a critical question becomes "So how is this making a difference to learners?" For example, in studies of streaming in mathematics across diverse countries (Boaler et al., 2000; Gamoran, 1992; Zevenbergen, 2005) similar outcomes are noted—students in groups internalise a sense of themselves as learners of mathematics. While this may be a profound learning, and certainly illustrates the power of a social theory of learning, as a field, we have learnt little about the root of the problem, and, more importantly, we have not learnt how to redress this problem. What is also known is that the grouping by achievement is not socially random—it falls largely into social strata as well. This reinforces social commentary from the 1970s and yet the problem still persists. Indeed, it can be seen from current thinking of many politicians that a return to such practices may well be on their reform agendas. This further highlights the problematic nature of this research when it has little influence on policy makers.

The Foregrounding of Identity

Much like Lerman's earlier work on the social turn, the significance of situated learning has created another "turn" where identity has now become foregrounded. Learning mathematics is as much about the mathematics as it is about becoming a learner of mathematics within a particular context. The power relations within a given community have been explored by a number of critical researchers, most notably those who attend the Mathematics Education and Society conferences. This corpus of work explores the differential power relations involved in learning mathematics from large macro analysis (such of policy and curriculum) through to micro analysis (of social interactions within a given context).

Chronaki (2011) argues this point when she recognises the tension between the identities that learners bring to the school context, which are often stereotypes and devalued by the schools, and the discourses around the mathematical identities that learners are expected to align with the dominant views of mathematics:

> … how deeply endorsed narrative about identity relate to participation in school mathematical activities, and on the other hand, how "self" and "other" positions embodied in those formal learning practices are polyphonic and potentially dialogical. (Chronaki, 2011, p. 208)

For Chronaki, and others who recognise the powerful influence of identity on mathematics learning—both positive and negative—these standpoints have been valuable in highlighting the embodiment of mathematical practices in learners. Further, these researchers also consider how the embodiment of these practices impacts on issues of engagement, resilience and perceptions of mathematics that will ultimately have a large influence on learners and learning. Chronaki has been a strong figurehead in the area of identity in mathematics and contended that this area may be the next step in the evolution of the field as it moves from social theories of learning. But there still remains the question as to how theorising the identities of learners will help advance mathematical learning for all students, and most notably for those who have been disenfranchised by the very practices that identity research has exposed as being problematic.

Troubling Social Theories and Identity

In the earlier sections I have provided an overview of the current state of play of the field and how a social theory of learning has shaped new ways of thinking about mathematics education. Throughout this summary, I have hinted at the limits of this theory. The theory and its derivations have been powerful in terms of offering a richer theory of learning than its predecessor (cognitive psychology), by creating more profound awareness of the personal and mathematical meaning-making processes that are situated within particular contexts. However, the social theory has failed to make any substantive inroads into challenging the status quo in terms of equity, access and/or success. It is almost as if mathematics has become quite secondary to any analysis. In the contemporary context of mathematics education where the demise of STEM is increasingly recognised as problematic for schools and employment, there needs to be some new ways to reinvigorate engagement and enthusiasm in mathematics (and science, etc.). What is lacking from most of the social theories is the engagement with mathematical concepts and processes.

The potentially solipsistic positions engendered by social theories of learning mathematics have failed to engage with the deep learning of mathematics. The contribution of social theories has been to highlight the non-universality of mathematics learning and to articulate the impact of the social context on meanings being made by participants—about mathematics as a field, their position within that field and potentially any future that they may have with the field. In this sense, there has been a significant contribution about the powerful impact of the context in a much broader sense than mathematics per se. But, such a position is limiting within this field. It could be applied to almost any field, and thus render the mathematics per se as silent. At this important juncture in time where there is a growing concern about the demise of STEM, and the importance of mathematics within that area, greater attention needs to be redirected to the mathematics in mathematics education.

Mathematical Knowledge: What Is This?

The vast literature on situated learning has highlighted the different forms of mathematics that are used in everyday contexts such as shopping (Lave, Murtaugh, & de la Rocha, 1984); workplace mathematics (Noss, 1998; Zevenbergen, 2004); and the mathematics used by mathematicians (Burton, 1999). A range of studies have also been based in classrooms and formal learning contexts, in which mathematics has become known as school mathematics. The discourses imbued with social theories of learning have highlighted the very different forms of mathematics used within particular contexts. These perspectives have shown how people undertake mathematical practices that are shaped by the context and illuminate why there is often little transfer between contexts. This corpus of work has brought to the fore the nuanced mathematics within a given context. It has also created a diverse body of research around the idiosyncratic meanings that students make of mathematics—in terms of both the concepts/constructs expected of them through curriculum and the meanings of the field as a whole.

Although, as I have sought to argue, social theories have been useful in examining identities of learners and their relationship to/with mathematics, they may be limiting in terms of not creating strong opportunities for students to learn, and be successful in, mathematics. The differentiating between context, identities and mathematics may be creating arbitrary divisions that are counter-productive to strong learners of mathematics. This is particularly salient when considering the most marginalised learners. Many of these students are being "othered" in terms of their access to mathematics and hence their marginality is being expanded. In the many large studies that are now being generated around access for Indigenous learners, there is a strong recognition of how the learning context shapes the identities of Aboriginal learners towards mathematics. Most notable is that despite the millions of dollars being invested in a multitude of programs, there has been minimal return. While it is important to acknowledge how the social context of learning may create very different opportunities for students to construct a sense of themselves as learners of mathematics, such a position is limiting in terms of moving forward. The lack of outcomes highlights the need for a new paradigm in which to locate mathematics learning, particularly for our most vulnerable, at risk and disadvantaged learners. An example of a program that foregrounds mathematics learning for Indigenous students is QuickSmart (Pegg & Graham, 2013) which focuses on automaticity of number concepts through a computer program and extra support mechanisms.

But at this point, I want to stress that we should not return to old paradigms as they did not work in the past. As a field we have learnt much and perhaps it is now time to tie the pieces together and make a coherent program. There have been significant learnings across many projects but, at the moment, they exist in a fragmented state, where there is no coherence or threads to link them into a coherent program.

Reproductive or Transformative Knowledge Making

In the remainder of the paper, I seek to advocate for a program of research and education reform that explores the ways in which genuine practices can be created that build strong learners of mathematics. To do this, there is a need to acknowledge the term "mathematics". The situated learning paradigm has brought to the fore a recognition that mathematics is contextually bound. But there is also recognition that curriculum demands around mathematics are quite particular. This is readily observable when the National Curriculum documents are considered. While some circumspection is needed with such prescriptive documents, it is argued that the emergence of such documents and the level of prescription is a manifestation of recognition that there is some need for standards around expectations of learning and learners of mathematics. To this end, I contend that a new paradigm—knowledge-making—is called for. In this knowledge-making paradigm, the task for education is to provide learning contexts that enable learners to build knowledge systems that are enabling and reflect the dominant views of mathematics. It is not sufficient to assume that groups of students—based on their language, culture, social background or otherwise—are offered an impoverished mathematics curriculum. What becomes critical is providing a learning environment that enables students to build deep understandings of mathematics. Previous paradigms in mathematics education offer much to support this approach, but these paradigms are limited.

There are two forms of knowledge making that come to mind. The first is reproductive knowledge making and is based on adapting what has been common practice for the past fifty years. This has been a challenge in school mathematics—the reproduction of known mathematical activities and approaches into contemporary contexts. Little of the old practice is changed. In contrast, a new approach is needed. In the case of Australian (and most Western) curricula are the systems and practices that have permeated mathematics education since the New Maths system was introduced in the early 1960s. In this approach, there are hierarchies in learning and the programs have no empirical basis to their structure. There are standard mathematical activities that have been used throughout this time and are continually recycled but fundamentally remain the same. In contrast, the Dutch, through the Freudenthal Institute, formed a very different epistemology to mathematics education (based on intuitive reasoning, realistic mathematics and progressive mathematisation) and strongly founded in an empirical basis on students' thinking around mathematical ideas. These two parallel programs of mathematics education offer insights into how an approach different from the one currently used in most Western curricula may be limiting.

Adopting a knowledge-making epistemology in reform education may offer new conceptions for mathematics education. But with anything novel, there is always the risk of what Piaget termed assimilationist learning, where the reform takes what is known and established within a field, then amends practice in ways that are not changing. An example of this are reproductionist approaches to reform education that can be found in Indigenous education. Often there is a focus on quality learning and high expectations of learners, justified within the rhetoric that Indigenous students can learn mathematics, but the reform is simply business as usual but with some "tizz". For example, some hegemonic and ideologically conservative approaches that have emerged in the recent past engender the adoption and adaptation of resources that have been used across many classrooms for decades, but with the addition that the resources are "Aboriginalised" through the use of graphics. This is often pejoratively referred to by critical mathematics educators as using "kangaroos and didgeridoos" to make the resources inclusive. Alternatively, examples may be altered so that the objects and artefacts are changed to resemble those found in Aboriginal communities—instead of block counters, stones, shells, or insects found in the local area are used. These changes are seen to make the resources more relevant or culturally inclusive for the learners. This is simply "old wine in new bottles" and is likely to result in the same outcomes as previous paradigms, since the fundamental epistemologies and pedagogies have not been changed.

What is needed is a transformative approach to mathematics learning. In such an approach, the collective wisdom gained from a plethora of research can be built into a system where teachers and educators can develop strategies that help to build knowledge. The practices of the past need to be changed as they clearly have not worked, and, as situated learning has shown, can have quite damaging effects on the ways in which learners (and teachers) come to understand themselves in relation to mathematics.

Lessons from the Past: Building a Transformative Knowledge-Making Paradigm

There are many salient and poignant lessons that have been learnt from past paradigms that can be incorporated in a knowledge-making paradigm. For example, a number of large-scale projects have shown key learnings that need to be heeded in building a transformed mathematics education. Hattie's (2008) extensive work on meta-analysis of research programs has highlighted two key features—being transparent about learning intent and the importance of high-quality and specific feedback. The Queensland Longitudinal Reform Study (Education Queensland, 2001) has shown that the teaching of mathematics is the poorest of all curriculum areas in terms of deep learning and teachers make students "feel good" about themselves rather than focusing on the content to be learned. Others (Hill & Rowe, 1998) have shown the key importance of the teacher in bringing about success. Conversational analysis (Sidnell, 2010) and interactional linguistics (Heritage & Clayman, 2010) have illuminated the power of language and interactions in shaping knowledge making. Collectively, this type of research has provided some food for thought in shaping new agendas to support teachers' work in bringing about deep mathematical knowledge making. Building learning environments that powerfully shape the potential for mathematical knowledge making for ALL students becomes the agenda for the future paradigm. The intent of mathematics education needs to move to knowledge making. This paradigm is one where all students are effectively scaffolded by excellent teachers who are able to create knowledge making. The integration of what is already known about quality teaching and learning will aid in the building of knowledge-making communities. Our knowledge of professional learning will be useful in supporting teachers to move from the (ineffective) teaching practices of the past to ones that will enable learners to build robust understandings of mathematics and to become strong in their identity as learners of mathematics.

References

Alibali, M. W., & Nathan, M. J. (2011). Embodiment in Mathematics Teaching and Learning: Evidence From Learners' and Teachers' Gestures. *Journal of the Learning Sciences, 21*(2), 247-286. doi: 10.1080/10508406.2011.611446

Björklund, C., & Pramling Samuelsson, I. (2012). Challenges of teaching mathematics within the frame of a story – a case study. *Early Child Development and Care, 183*(9), 1339-1354. doi: 10.1080/03004430.2012.728593

Boaler, J., William, D., & Brown, M. (2000). Students' experiences of ability grouping - disaffection, polarisation and the construction of failure. *British Educational Research Journal, 26*(5), 631-648.

Bourdieu, P. (1990). *The logic of practice.* London: Polity Press.

Bourdieu, P. (1991). Epilogue: On the possibility of a field of world sociology. (L. J. D. Wacquant, Trans.). In P. Bourdieu & J. S. Coleman (Eds.), *Social theory for a changing society.* (pp. 373-387.). Boulder: Westview Press.

Bourdieu, P. (1992). Thinking about limits. *Theory, Culture and Society, 9*, 37 - 49.

Bowles, S., & Gintis, H. (1976). *Schooling in capitalist America*. London: Routledge and Kegan Paul.

Burton, L. (1999). The practices of mathematicians: What do they tell us about coming to know mathematics? *Educational Studies in Mathematics, 37*, 121-143.

Cahan, S., & Linchevski, L. (1996). The cumulative effect of ability grouping in mathematical achievement: A longitudinal study. *Studies in Educational Evaluation, 22*(1), 29-40.

Chronaki, A. (2011). "Troubling" Essentialist identities: Performative mathematics and the politics of possibilities. In M. Kontopodis, C. Wulf, & B. Fichter (Eds.), *International perspectives on early childhood and development: Volume 3* (pp. 207-246). Dordrecht: Springer.

Connell, R. W., Ashendon, D. J., Kessler, S., &, & Dowsett, G. W. (1982). *Making the difference: Schools, families and social division*. Sydney: George Allen & Unwin.

Education Queensland. (2001). *The Queensland school longitudinal reform study*. Brisbane: GoPrint.

Gamoran, A. (1992). Is ability grouping equitable? *Educational Leadership, 50*(2), 11-17.

Goos, M. (2012). Sociocultural perspectives in research on and with mathematics teachers: A zone theory approach. *ZDM: The International Journal on Mathematics Education, 45*(4), 521-533.

Hattie, J. (2008). *Visible learning: A synthesis of over 800 meta-analyusis relating to achievement*. Abignton, UK: Routledge.

Heritage, J., & Clayman, S. E. (2010). *Talk in action: Interactions, identities and institutions*. Boston: Wiley-Blackwell.

Kanes, C., & Lerman, S. (2007). Analysing concepts of community of practice. In A. Watson & P. Winbourne (Eds.), *New directions for situation cognition in amthematics education* (pp. 303-328). Dordrecht: Springer.

Landers, M. (2013). Towards a theory of mathematics homework as a social practice. *Educational Studies in Mathematics, 84*(3), 371-391. doi: 10.1007/s10649-013-9487-1

Lave, J., Murtaugh, M., & de la Rocha, O. (1984). The dialectic of arithmetic in grocery shopping. In B. Rogoff & J. Lave (Eds.), *Everyday cognition: Its development in social context.* (pp. 67-94). Cambridge: Cambridge University Press.

Lave, J., & Wenger, E. (1991). *Situated Learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.

Lerman, S. (2000). The social turn in mathematics education research. In J. Boaler (Ed.), *Multiple perspectives on mathematics teaching and learning* (pp. 19-44). Westport: Ablex Publishing.

Lerman, S. (2006). Cultural psychology, anthropology and sociology: The developing 'strong' social turn. In J. Maass & W. Schloglmann (Eds.), *New mathematics education research and practice* (pp. 171-188). Rotterdam. Holland: Sense.

Noss, R. (1998). New numeracies for a technological culture. *For the Learning of Mathematics, 18*(2), 2-12.

Pegg, J., & Graham, L. (2013). A three-level intervention pedagogy to enhance academic achievement of Indigenous students: Evidence from QuickSmart. In R. Jorgensen, P. Sullivan, & P. Grootenboer (Eds.), *Pedaogiges to enahcen learning for Indigenous students: Evidence-based practices* (pp. 123-138). Dordrecht: Springer.

Roth, W.-M. (2012). Cultural-historical activity theory: Vygotsky's forgotten and suppressed legacy and its implication for mathematics education. *Mathematics Education Research Journal, 24*, 87-104.

Sidnell, J. (2010). *Conversation analysis: An introduction*. Chichester: Wiley.

Watson, A., & Winbourne, P. (2007). Introduction. In A. Watson & P. Winbourne (Eds.), *New directions for situated cognition in mathematics education* (pp. 1-12). Dordrecht: Springer.

Wilson, B. (2014). *Review of Indigenous education in the Northern Territory*. Darwin: NT Government.

Zevenbergen, R. (2004). Technologising numeracy: Intergenerational differences in working mathematically in New Times. *Educational Studies in Mathematics, 56*(1), 97-117.

Zevenbergen, R. (2005). The construction of a mathematical habitus: Implications of ability grouping in the middle years. *Journal of Curriculum Studies, 37*(5), 607-619.