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Regulated time and *expansive time* in primary school mathematics

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ABSTRACT

School life in England (and beyond) is temporally structured, with learning planned as a time-limited activity, both within lessons and across units of work. Discourses of performativity and measurement pervade school life in many societies and, what we call *regulated time* controls school-based learning. In particular, primary mathematics learning is often marked by a focus on speed and pace and on children and teachers demonstrating progress against fragmented goals. Taking this as an exemplar, and in the context of the pedagogical approaches promoted through two curriculum development projects, we consider disruptions to regulated approaches to learning as children and teachers work collaboratively on mathematical activities. We argue that the *expansive* timescape that emerges is generated through extended timescales and through an acceptance of unfinishedness, a key change from usual school mathematics that leaves mathematical meaning making open to revision, providing a more meaning-full experience of primary mathematics.

Keywords: primary mathematics; time, timescapes; regulated time; expansive time; pedagogy; tasks; social justice

Introduction

Time is important to the process and to the experience of learning. Although time is an important constitutive dimension of experiences in education (Compton-Lilley 2015), it is relatively under discussed and theorised, particularly in relation to mathematics education, even though intensification of labour for teachers and for learners is a feature of performative education systems (Ball 2003; Hall and McGinity 2015; Adams and Povey 2018, Perryman, 2009).

We mobilise social theoretical concepts developed in relationship to other disciplines and to sociological analysis of time more generally. We devise two theoretical constructs - *regulated time* and *expansive time* - and take the case of primary school mathematics in England as an exemplar. School mathematics education in England is marked by a focus on speed, pace and demonstrating immediate progress against fragmented, time-limited goals (Adams and Povey 2018; Brown, Brown and Bibby 2008; Nardi and Steward 2003); similar patterns are found in other systems in which high stakes testing and narrow curricular goals shape practice in mathematics teaching (see, for example, Horn 2018, in the USA).

In developing a time-sensitive social theory (Adam 2000), we argue that *expansive time* is generated by extended timescales, an acceptance of unfinishedness, a commitment to meaning-fullness (after Jardine 2013) and a broadening of spaces physical, experiential and metaphorical. We describe two curriculum projects and associated pedagogical approaches, analysing the ensuing disruptions to the usual way that time is enacted in mathematics classrooms. We argue that the expansive timescape that emerges is generated by these pedagogies, through extended timescales and through an acceptance of unfinishedness that leaves meaning making open to revision, providing a more meaning-full experience of learning. We conclude that interrogating usual school mathematics using the lens of *regulated* and *expansive time* supports both the uncovering of oppressive and de-humanising practices and also a way of understanding the need for, and possibility of enabling, worth*while*ness to enter the primary mathematics classroom. By considering time in mathematics classrooms, we provide an additional means to understand them and to enact alternatives to dominant practices there. We also anticipate that looking at time for learning through this lens will have relevance more widely within much contemporary schooling in understanding and developing alternative experiences to those of performative regimes.

***Regulated* and *expansive* timescapes in theory and in primary mathematics**

Our analysis is rooted in phenomenological and hermeneutic insights of the relationship between the experience of time and the experience of learning (Jardine 2008, 2012, 2013); it also draws on the sociological concept of *timescapes* (Adam 2000; Compton-Lilley 2015) which we use in this section to theoretically frame our discussion. Timescape points to the complex and overlapping dimensions of time that include physical time and subjective experiences of time - human time (Schatzki 2006; Compton-Lilley 2015). It acknowledges the multidimensional, recursive, non-linear lived experience of time.

Other related theories of time support this argument, for example, philosophical views that place time as central to the pedagogical relationship (Roy 2019), sociocultural conceptions such as that of chronotope drawn from Bakhtin (Matusov 2015), or insights of post-modern theory, developed by critical geographers, for example Harvey's conception of space-time compression (1999) or Massey's notion of time-space (2005). However, given this article's constraints, we are limited to acknowledging them and later in relation to relationship of time and spatiality to pointing to them as further directions for enquiry.

Our fundamental interest here is in the subjective experience of time and its relationship to learning mathematics. We devise two theoretical constructs - *regulated time* and *expansive time* - to support this. We are aware of the limits of positing binary and seemingly mutually exclusive categories but employ them here as an analytical heuristic rather than as phenomena found in "pure" form. The distinction serves to highlight the need for pedagogies which involve a relationship to time different from the one that generally occurs in schools, pedagogies that emphasise the 'whileness' that makes something worthwhile (Jardine 2012). Of the two polarised timescapes found in schools, the first timescape is one that dominates in state funded schools, certainly in England. It is the default one - *regulated time*. The second is one that is currently found rarely and perhaps only in fleeting moments and requires conscious effort by teachers and students to create and nurture - *expansive time*. We begin by articulating a modernist conception of time (*regulated time*) and link this to the pace and curricular fragmentation experienced in much primary mathematics. We argue that this default time is:

> the neutral, decontextualised empty time of calendars and clocks [which] remains the unquestioned medium and the parameter within which … activities are experienced, constructed, recorded and commodified. (Adam 2000, 126)

Regarding the time of learning, we consider this clock-time as 'certainly false … [concerning] the full, slow, extravagant, lucid and ever-changing emergence of children's capacities' (Malaguzzi 1998, 170). We describe how *regulated time* is rooted in neo-liberal schooling practices and offer an alternative understanding of and relationship to time (*expansive time*) which we argue opens up space for learning.

We introduce two projects *Mathematics in the Making* (*MiMa*) and the *Embodying Mathematics Project* (*EMP*) which in different ways interrupt prevailing practices with regard to time and pace in primary mathematics classrooms. We share short descriptions of enactments from these interruptions, exemplifying the explanatory power of the two time constructs, illustrating what is currently taken for granted in English primary classrooms and offering examples of what might be done differently. In offering these examples drawn from interruptions of practice, it is important to assert that not only do they offer examples of what could be, but also can sensitise us to recognise moments when *expansive time* is already found - all be it often in fleeting moments. For example, in one of the schools involved in the *EMP*, mathematics lessons did not have a fixed time period of an hour or similar as found in nearly all English primary schools. Rather, if pupils were engaged and productive mathematical activity was happening, then mathematics lessons might continue. Thus, mathematical activity, children's participation and engagement, and learning determined the length of a 'lesson' rather than having to fit within it.

Regulated time

Modernist notions of time and space separate these two aspects of experience from each other, in spite of their intimate relationship (Harvey 1999; Massey 2005; Matusov 2015). Modernist time (and, we note, space too) is subjected to rationalist, structured and structuring order, organisation and measurement and focuses on the external, the rational, the reckonable, the "objective" (Harvey, 1999). This time is mono-dimensional, its linearity created by and resulting from the ticking of the mechanical clock. Controlling, structured measuring then chops this continuum into ordered fragmented sections, thus making them available to be managed, made use of and "filled up". Time becomes commodified: it is something fixed, something which can be "saved" or "wasted", something that can be "invested", something that can be "used up" - and something which is always already running out (Jardine 2013).

Rooted in Newtonian conceptions of science and rationalist philosophy, the lived experience of this contemporary time is ratcheted up, accelerated, driven by ideas from the time and motion studies promulgated and enacted in the United States in the early decades of the last century by F. W. Taylor, an engineer with a mandate to improve efficiency (see Jardine 2013, 10-18 for an extended discussion). Based on a desire to make factories more "efficient" and to eliminate waste - "time is money" - all the analysed tasks become reduced to fractional, frictional, time-limited, ordered segments, any one of which is meaningless in itself. Indeed, seeking for meaning is to misunderstand what is required of oneself as a worker: this is simply to ask 'Who is in charge and what does that person want me to do?' The "efficiency movement" spread out from the factories to become a defining motif of the life of contemporary society. David Jardine (2012, 86) quotes Ellwood P. Cubberley who as Dean of the School of Education at Stanford University wrote in *Public School Administration* (1916):

> Our schools are, in a sense, factories in which raw products (children) are to be shaped and fashioned into products to meet the various demands of life. The specifications for manufacturing come from the demands of twentieth-century civilization, and it is the business of school to build its pupils according to the specifications laid down. This demands good tools, specialized machinery, continuous measurement of production to see if it is according to specifications, [and] the elimination of waste in manufacture.

Although such language would be unlikely to appear in twenty-first century education texts, the fundamental principles remain the same, particularly the 'continuous measurement of production' as the only indicator of worth in education. The "world-class benchmarks" to which we are told we must aspire, (for example, Andrews, Jerrim, and Perera 2017), are related not to whether or not our children are intellectually richer, more fulfilled, better able to think about the world, even happier but rather to how they perform in timed written tests. Teachers are charged to find "good tools" and "specialised machinery", to find "what works". (For example, in March 2013, the UK Westminster Government set up the *What Works Centre for Education*, comprising seven independent *What Works Centres* with two affiliate members. Together these centres cover policy areas which received public spending of more than £200 billion: '*What Works Centres* are different from standard research centres. They enable policy makers, commissioners and practitioners to make decisions based upon strong evidence of what works and to provide cost-efficient, useful services'. https://educationendowmentfoundation.org.uk/about/what-works-network/). They are

to understand their role to be that of technicist implementation thus guaranteeing success. This understanding of the nature and purposes of education is intimately connected to how contemporary education is lived and understood.

Thus, the first timescape, *regulated time*, is an industrial, Taylor-esque temporality (Jardine 2008, 2013), where both time and the curriculum are segmented and fragmented. Educational time is commodified and manipulated with the focus being on time management, time on task, progress over time and so on (Slattery 1995). The apportioning of time stands outside and beyond the educational focus; lessons are a fixed length, the curriculum content to be covered is specified. Teachers and students follow the times set and are judged to be slow (or fast) measured against external norms. For those children deemed to have "fallen behind" a range of measures has been introduced, aimed at helping them "catch up" (DfES 2001; DfE 2016).

The timescape of *regulated time* is integral to the contemporary logic of education, particularly in the context of performativity regimes. Space does not allow for a detailed discussion about the nature and impact of performativity: suffice it here to say that performative education systems are subject to constant reform; intense monitoring of school students, teachers and schools; and measurement, ranking and league tables. Education is recast as a consumer good rather than as a moral enterprise (see for example Ball 2003, Hall and McGinity 2015, Perryman, 2009).

Beyond discourses of performativity found in England, regulated time is also integral to the on-going colonial projects in which Eurocentric notions of time come to dominate (Shahjahan 2015). Post-colonial theory highlights how slowness and taking time is associated with laziness and inscribes only particular types of work and ways of working as being acceptable (Smith 1999).

The tick-tock of mechanical clock time asserts time's linearity and also frames time as an external measure with each segment having an exchange value (Adam 2000, 39). Part of the lived experience of both students and teachers is that "there is not enough time". In our experience as both instigators and researchers of innovations, an almost inevitable "barrier" to change is a sense of a lack of time (as can be seen in the remarks from teachers quoted below), involving a sense that time has run out (Jardine 2013).

Under *regulated time,* there is an expectation that learning can be pre-determined and can be "delivered" and successfully completed in pre-designated time-slots. This fundamentally shapes the nature of the tasks undertaken, as with factory production when compared with hand-crafting. Jardine notes that, with usual school tasks,

> there is nothing to hold memory and attention and experience in place, nothing to call it to collect itself or attend or return. Time speeds up … Many of the tasks asked of students in schools are not worthwhile in this very particular sense: they are not worth lingering over, meditating upon, remembering, and returning to. (2008, np)

The tasks adopted cannot be such as to require lingering over or meditating upon because the designated hour is "used up" and tomorrow has a new task ready to be completed.

In England, the propagation of *regulated time* has been mandated by policy, for example, through the emphasis on pace in the National Numeracy Strategy (DfEE 1998) and in an inspection regime in which maintaining 'a good pace' in lessons, even in nursery settings was frequently a commendation in inspection reports (Penn 2002, 879). The idea of pace has been a key influence on primary mathematics education and continues to be so in spite of the discontinuation of the National Strategies organisational framework and recent moves to adopt a "mastery" approach to learning (Boylan et al. 2019). Until very recently, the inspection regime in England focused not only on monitoring progress over time but on observing progress in single lessons (Ofsted 2015), often a twenty minute episode within a lesson, thus influencing school leaders' and teachers' beliefs about what is desirable - and therefore what is desired.

Despite recent policy developments, these ideas remain deeply rooted in many primary teachers' ideologies, formed by complex interactions between, first, the internalisation of the beliefs promoted through the policy and accountability mechanisms noted above and, second, through underlying beliefs about the nature of mathematics rooted in their own mathematical experiences (Bibby 2002). Further, given the continuing centrality of timed tests (see, for example, Weale 2018), assessment practices help to reinforce beliefs that mathematical success equates with being fast. This all despite the fact that extensive research, across different educational phases, has evidenced the negative consequences of fast paced lessons and moving through the curriculum quickly (see, for example, Brown, Brown, and Bibby 2008; Nardi and Steward 2003). Thus, pace and the phenomenology of time are important in what constitutes usual school mathematics (Boylan 2010).

Expansive time

An alternative timescape, *expansive time*, is one which in contrast celebrates the 'while of things' (Jardine 2008, 2012, 2013). Here the starting point is not an external time regime but twin foci on living disciplines and on learners. Tasks and the foci for learning are ones that are worth lingering over. Whiling may, and perhaps should, entail returning to content again and again. But here the returning is different from that found in spiral curricula in which topics are revisited because they have not previously been understood: often in mathematics lessons, for many, this spiralled return involves beginning anew as previous learning has been temporary or shallow. In contrast, not only does the hermeneutic process of return lead to deeper understanding and meaning making within a topic and the disciplines of which it is part; within such whiling

> things start to regard us and tell us about ourselves in ways we could not have experienced without such whiling. (Jardine 2008, 7)

There becomes time to let things strike us, intrigue us, provoke us, amuse us, startle us, to 'bowl us over, stop us in our tracks, make us catch our breath' (Jardine 2012, 101). Playing around with ideas, mulling things over perhaps for a long time, looking for patterns and connections, using intuition, making mistakes and using them to learn new things, asking yourself questions, having imaginative ideas, describing and explaining then discussing your work, conjecturing, visualising, getting stuck and keeping going, being willing to defend and justify your conclusions, changing your mind, conversing - all deeply mathematical practices - become possible. This can be likened to being in a state of flow:

> One of the most predominant characteristics of this flow state is concentration. An involved person narrows his attention to one limited circle. Involvement goes along with strong motivation, fascination and total implication; there is no distance between person and activity, no calculation of possible benefits. Furthermore there is an openness to (relevant) stimuli and the perceptual and cognitive functioning has an intensity which is lacking in other kinds of activity. The meanings of words and ideas are felt more strongly and deeply. Further analysis reveals a manifest feeling / of satisfaction and a stream of energy felt through the body. (Laevers 2000, 24/25)

Whileness, then, both supports things in themselves becoming worthwhile (Jardine 2012) and also makes our time worthwhile. Even in the context of prevailing regimes of practice of school mathematics (Boylan 2010) whileness can be found (for example, Angier and Povey 1999; Coles and Scott 2015; Jardine 2012; Watson, De Geest, and Prestage 2003). This expansive timescape supports qualities of spacious relationships to mathematics, between learners, between teacher and students and amongst teacher, students and mathematics itself (Angier and Povey 1999).

To understand further what whiling and worthwhileness might mean and how they might be experienced, in the following section as illustrative examples we describe moments of *expansive time* in contemporary primary classrooms, moments which came about through schools' engagement with two different curricular innovations.

Illustrating *expansive time*

Hilary and Gill worked together with international partners on the *Mathematics in the Making* (*MiMa*) project, a European funded transnational curriculum development project, involving mathematicians, mathematics educators and teachers from five European countries, which was informed by a commitment to hands-on, practical activities and the value of children explaining their mathematics to others. Hilary and Mark were part of the *Embodying Mathematics Project* (*EMP*) team - a collaboration between the Complicite Theatre Company, mathematics educators and teachers in which techniques and practices from drama and physical theatre, particularly that of ensemble, acted as interruptions to usual school mathematics. Both projects are premised on a commitment to a more spacious, agentic and collaborative curriculum (Angier and Povey 1999; Povey et al. 1999) and to the view that all learners can achieve mathematically (Povey 2014).

In discussing *MiMa*, we draw on qualitative data generated through interviews with teachers involved in the project. Our commentary on *EMP* draws on vignettes constructed following a school workshop. The longer data extracts are intended to encourage the reader to 'while' with us.

Mathematics in the Making (MiMa)

The *MiMa* project (Project no. 539872-LLP-1-2013-1-IT-COMENIUS–CMP http://www.mathematicsinthemaking.eu) was based on a primary school mathematics intervention in five EU countries - England, Germany, Hungary, Italy and Portugal. It had two distinct roots. First, it brought together two university mathematicians, Emanuela Ughi (Italy) and Albrecht Beutelspacher (Germany), who had each separately recognised that their undergraduate mathematics students had very limited mental images of mathematical objects. The undergraduate students found mathematical visualisation difficult and this impeded their understanding of the mathematical concepts they were studying. Emanuela and Albrecht separately decided to incorporate the building of physical mathematical models into their students' undergraduate studies, deepening the students' grasp of key mathematical ideas. Emanuela realised that the students had lacked concrete, hands-on practical experience of mathematical objects earlier in their lives and this provided the motivation for the *MiMa* intervention. Second, all the teams were aware that the problems that students of all ages have in learning mathematics are widespread (OECD 2009); that fear of and anxiety about the subject is common; and that these difficulties start early. Thus an intervention at primary level to combat them was required.

Theoretically the project (MiMa 2015a) drew on the ideas of Johann Heinrich Pestalozzi (1801) who argued that learning followed from *hand* to *heart* to *head*. Practical mathematical work with the hands gives deep pleasure to the heart of the learner and thus opens up a pathway to the thinking and articulating head. Connections were made to the work of Jerome Bruner (1966) who argued for the importance of recognising the relationship between *enactive*, *iconic* and *symbolic* thinking. These ways of understanding were viewed as acting more reciprocally than linearly and the project sought to promote an approach to teaching that would reflect this.

> Learners will … return to the enactive at all levels of mathematical thinking to scrutinise and deepen existing knowledge and to resolve uncertainties. Both the enactive and the iconic remain as metaphors in the mind to support symbolic thinking. (Povey et al. 2016, 1-2)

The practical, hands-on activities enabled learning to be *collective, reciprocal* and *supportive* (Alexander 2008). The children worked together on shared tasks, listening to each other's ideas and with space for creativity and openness, supporting the further intention of the project that the learning accord with a democratic way of life (Dewey 1949).

The *MiMa* partners produced ten sets of activities (MiMa 2015b). Participating teachers experienced the activities themselves through professional development workshops before working with a selection of the activities with their children in school. Pervading this experience was the knowledge shared by the teachers and the children that they were preparing for a public exhibition. The physical models the children had made and the practical activities they had devised would be presented and explained by them to parents and carers, children and teachers from other schools, distinguished guests and members of the general public passing through the exhibition space.

There were four ways in which engagement in the project opened up opportunities for teachers and students to experience *expansive time*. First, the very nature of practical, hands-on activities changes how we experience time from the "norm". As one uses one's hands to cut or paste or colour or construct or mould or … , the mind widens and frees itself from clock-time. In a space of deep satisfaction, clockwatching is abandoned, time stops still and the 'euphoria of flow' (Hughes 2012, p.160; see also Morrison 2017) takes over and opens the possibility for enchantment (Boylan 2018). One has the opportunity to become absorbed and thoughtful, to experience time as would an artisan at work - 'full-filled time' (Jardine 2012, 20) - rather than as the Taylor-esque machine time of the usual school mathematics classroom.

Second, project activities typically required a more extended engagement with a task than would be afforded by a single lesson-shaped fragment of time. We take as an example the way in which one of the German schools worked with the exploration of the solar system. Children were divided into small groups, one for each planet. They had to make their planet in *papier mâché* to a given, common scale; find out as much as they could about their planet and work out how to represent this to their peers; and then take their presentation and their planet with the rest of the class on a walk - out of the classroom where the metre-diameter 'sun' remained; out of the school grounds leaving behind them Mercury, Venus, Earth and a pea-sized Mars, with presentations at each station; and two miles out into the countryside finding a place for Neptune. It is worth noting that one of the English schools engaged with this task is a similarly rich and extended way but

> what's assessed … that's what gets done in maths … and lots of the *MiMa* stuff hasn't been done in maths lessons because I've not been able to *justify the time away from* the maths curriculum, so it's been kind of supplementary during afternoons. The kids know that it's maths, but unfortunately *I've not got or had the time* … So the scale thing, measuring the solar system, we could do out on the field, so we *spent quite a lot of time* on that during afternoons … I didn't feel I could really justify doing any of them during *my maths time* … I've got to do that because of where my kids are with their maths. You know, I'm not saying all schools would have to do that. Some schools might be able to do things in the morning. I suppose it depends what level their kids are at. I can't afford to *lose any curriculum time*. (Teacher, Broadriver School, emphasis added) (The school names are pseudonyms.)

Usual school mathematics precluded the engagement in such a whiling task.

Third, the exhibitions contributed to making time *expansive*. Because the children knew they were going to present and explain their mathematics to a wide variety of people, they worked hard, over time and revisiting their work repeatedly, to make sure they themselves understood it. In addition, the children were given the time and space to prepare for the exhibition.

> Planning something, thinking about it and then executing it, and adjusting as you go … it's something that they'd not really done before, so I think it was a unique opportunity for them. (Teacher, St Edmund's School)

Last, a recurrent theme from the project in England was the value that the teachers had attached to having time to work through the mathematics themselves in the professional development sessions. For example,

> … had I not had that opportunity to sort of practise … I probably wouldn't have done as much as I've done when I got back to school because, you know, in the *busyness and hectic-ness* of everything else that's going on it … So I think that was an absolute key to its being successful for me and without that I would have struggled, to be honest. (Teacher, Bluefield School, emphasis added)

We see these teachers as subject to machine time even more than the children they teach. As Jardine has it:

> But here is a school reality that is hard to admit: those sorts of work that fit the clockwork, one-thing-after-the-other, always accelerating rush of empty time bully themselves to the front of the line and provide a way to not just marginalize but humiliate those who might suggest that there is thoughtfulness, rigorousness, authenticity and good work to be had out from under this running-out panic. (2013, 9)

Taylor-esque time can rob teachers of the pleasure and fulfilment to which they are entitled in the execution of their work on their students behalf. Some of the teachers (though not all) were able to create spaces for themselves as well as their students for a richer experience of full-filled *expansive time* within the *MiMa* project.

Embodying Mathematics Project (EMP)

The *EMP* was a collaboration between the Complicite Theatre Company and mathematics educators. Complicite's theatre is rooted in ensemble and physical theatre practices. In 2015, Complicite worked with mathematics educators at Sheffield Hallam University to develop activities for schoolwork arising from a play - *A disappearing number* - which centred on Ramanujan, a mathematician. The curriculum and professional development project focused on primary mathematics in the 7-10 years old age range.

EMP explored how aspects of Complicite's ensemble practice could be interpolated with a strand of critical mathematics education that stresses relational pedagogy (Boylan 2018) and spacious mathematics (Angier and Povey 1999). Recently, steps have been taken to conceptualise an ensemble or rehearsal room pedagogy (Kitchen 2015; Neelands 2009) in the context of drama education. These conceptualisations emphasise the pro-social - the ensemble providing a sense of togetherness - and improvisation plus, linked to this, playfulness. Complicite's 'rehearsal room' practice has a very different timescape from the rhythms of school, requiring time for collaborative creativity. In usual school mathematics, the orientation is towards finishing, completion, and the end point. Whilst the production of a theatre play does orientate the creative process towards the future ahead - the opening night - this is not regarded as an endpoint by Complicite. The expectation is that a Complicite play will open unfinished and continue to develop as it is performed. There is an emphasis on a process of on-going becoming. This type of "not finishing" is very different from the experience of school mathematics students who are set exercises that they cannot finish in the *regulated time* allocated where the "not finishing" is regarded as failure.

Core *EMP* activities were designed for large open spaces in which the body is used to explore mathematical relationships. Like *MiMa*, a theoretical basis for this was found in the work of Bruner; in some of the embodied activities in *EMP*, the enactive and iconic fuse with, for example, learners both viscerally experiencing symmetrical relationships and seeing them. The activities emphasise the whole class working together and there being a time for everyone, thus drawing on the principles of ensemble.

Other theoretical influences are found in the philosophical conceptions of mathematics as embodied (Lakoff and Núñez 2000), enactivist theory (for example, Davis 1995) and conceptualisation of the relationship between learning and kinetic movement (Bautista, Roth, and Thom 2011). The emphasis on the body has a political intent to support an education project that, following Foucault, emphasises embodied passion and pleasure as legitimate educational concerns (Zembylas 2007) in contrast to a disembodied rationality often associated with mathematics (Mendick 2006;).

Teachers were supported through development days which emphasised their own participation in the activities and in mathematical thinking. In addition, Complicite practitioners visited participating schools and modelled activities with teachers' classes.

To illustrate *EMP* in practice and how its timescape differs from usual school mathematics, we present two vignettes from the same two hour workshop with a class of 7-8 year olds and their teacher, Ruth (a pseudonym), in a London school. The workshop was led by Victoria and Shane, Complicite practitioners, and Mark was a participant observer. The following is from Mark's account of the session.

Vignette 1: Making time to make a circle

At the start of the session with Ruth's class, Victoria, Shane and I are already in the Hall. The Y3 class arrive with Ruth. The class enter in a line and stand in a row. Victoria introduces herself, Shane and me. She says that she is looking forward to doing mathematics with them in a different way than in the classroom.

Victoria is holding a small soft ball. She places the ball on the ground in the centre of the hall. She asks the class to stand so they are all the same distance away from the ball. One child, followed by a few more, move to stand on a red line painted on the floor of the hall. The rest follow. The class are now all standing on the straight red line.

Victoria doesn't say anything. I reflect that in this moment, as a teacher, I might be tempted to ask a question, to direct attention to the different distances each child is standing from the ball. Instead, Victoria repeats the request to stand the same distance from the ball. Pause. Pupils begin to move to different places with no discernible pattern to the scattered bodies. This goes on for a few moments in silence. Then a group of boys go and stand closer to the ball. They begin to move closer and closer. Some are now standing so their feet are touching the ball, there is some gentle jostling and quiet laughter.

At this point, I wondered what I might do if the teacher. I notice the gendered positioning of the bodies of the pupils - would I point this out? Again there is an opportunity to ask questions that might scaffold the activity including addressing the gender issue.

Victoria picks up the ball and moves it to somewhere else in the hall and repeats the request to stand the same distance from the ball. The pupils move again, taking different positions. After some time some pupils - a mix of boys and girls - have formed *something that approximates to an arc of a circle. One of these boys begins to direct others, waving to where he thinks they should move. Other pupils join in. Soon a circle is formed. The adults join the circle. Once in the circle there is a pause as we stand and look at each other.*

Victoria asks what shape we have made and after "circle" is named she asks if it can be made more beautiful. There is some shuffling and adjusting of feet to form a more accurate representation. Questions follow about what makes a circle special and the responses mix the mathematical but also the social - how a circle is a good shape for being together and learning together.

This episode took around twenty minutes. There were many moments when the activity might have been speeded up. However, time was taken for the circle to become meaningful and a greater sense of ensemble emerged. Afterwards Ruth commented that her perception shifted of the boy who began to direct others to stand in a circle as she had considered him someone who found mathematics challenging and slower in the class. She also commented that the activity had made visible gendered patterns of engagement usual in this particular class.

Vignette 2: We need to wait for everyone

We are all standing in a circle. We go round the circle and jump in pairs. Because there is an odd number standing in the circle we go round again, this time jumping with a different partner. Then we explore jumping in threes. There is some speculation about what would happen if we jumped in fours and how many times we would need to go round, and how many times each person would jump to get back to the starting point. We are about to test by jumping the conjectures made. Someone needs to go to the toilet. Off they go. And we all wait, we cannot continue. We need everybody. Victoria *points this out - that we need everyone, otherwise we cannot continue. But mostly we wait until the missing person returns.*

In primary mathematics, we contend, teachers rarely wait for everyone. In ensemble pedagogy the aim is for everyone to matter and, when successful, everyone does matter. This means other timescapes may override clock time.

Looking across the two projects

We now look across the two projects and draw out some time-related features that they share. We note:

- the timescales on which they operate;
- the sense in which unfinishedness is permitted and experienced;
- the commitment to meaning-fullness.

In the conclusion we also begin to draw out their link to timespace (Adam 2000). Both projects recognise the reality of schools and school life, endeavouring to work within existing constraints whilst simultaneously pushing the boundaries, offering alternatives.

Different timescales

The *MiMa* project extended timescales across lessons, disrupting the idea that activities should be bound in a particular lesson, in the familiar patterns of usual school mathematics. Not only do the individual activities extend over several lessons, in working towards exhibiting their work, pupils and teachers also transcended the single lesson time boundaries as they continued to work on and with the mathematics in preparation for sharing. The exhibition provides a rationale for slowing things down. In England, these disruptions presented tensions in what teachers saw as possible or permissible; we noted earlier how one teacher felt unable to interrupt the school mathematics timescales: *MiMa* happened outside "curriculum time".

Whilst the design of the *EMP* included the aim of making time for 'spacious mathematics' (Angier and Povey 1999), the team accepted the constraints of the *regulated time* of lessons found in schools by offering activities that teachers can take up in the current contexts of English schools. However, it disrupted *regulated time* by seeking to create time - pauses - for meaning within that. It disrupted timescales by stressing that everyone matters - and this mattering is privileged over the smaller units of time of which a school mathematics lesson is comprised. In *Vignette 1: Making time to make a circle*, rather than an isolated task to be accomplished before moving on to another, we see Jardine's full-filled time 'the time of the work being done, the time belonging to the fullness of that work and its rich territoriality' (Jardine 2013, 20). By retuning again and again in lessons to creating a beautiful circle - as recommended in EMP materials - circle-making promoted a different kind of repetition, a new patterning where whileness could be experienced.

Unfinishedness

There is, in both projects, acceptance of unfinishedness, a tentativeness that leaves the mathematics open to revision, to being worked on further. Returning to an activity is made easier, not only by its shared history but also by its physicality: the act of walking out the solar system or of jumping in a circle. In usual school mathematics, unfinishedness is a sign of failure: failure of the teacher to "get through" the material at an appropriate speed and failure of the learners to produce the desired and desirable cut-and-dried finished product demanded.

Keeping things open, arriving from time to time at resting places but not regarding these as the end, supports transformative learning. Indeed it is argued that unfinishedness is

> essential to our human condition … [and] is integral to the phenomenon of life itself, which besides women and men includes the cherry trees in my garden and the birds that sing in their branches. (Freire 1998, 58-59)

In the *MiMa* exhibition it was note-worthy that many of the children were continuing to work on their mathematics, at the same time as sharing and explaining what they had already accomplished. In *EMP* the ensemble practices are never finished but always available to be improved, adapted and developed.

Meaning-fullness

In both projects there is a sense that meaning is made and made collectively. In working together and in making visible what others are working on, as in the practical, hands on activities in *MiMa* and through the ensemble work that is a key feature of *EMP*, time is made for meaning making, for meaning-full activity stimulated by observations of others and reflection on our own work. The crafting of their mathematics that the *MiMa* project allowed the children could generate the sense of 'the unity of thought and action, conception and execution, hand and mind' (Braverman 1998, 118) which occurs with work that is not alienated - meaning-full work. The pauses or stationary moments evident in the vignettes from *EMP* are examples of spaces created for meaning-full engagement, in this case for the attention and reflection that *expansive time* allows.

Inherent in this collaborative meaning-full activity is a concept of author/ity (Povey 1997), one which recognises 'each of us as the originator of knowledge' (332), which is characterised by dialogue and where meaning is co-constructed and contextual. This focus on authoritative co-construction necessarily moves us into *expansive time*. This may be contrasted with the alternative timescape of *regulated time* in which clock-time is followed and the job of the learner is to note who is in charge, find out what that person wants one to do and then to complete the designated tasks "on time".

Conclusion

Using the case of English primary mathematics education, we have pointed to the focus in contemporary schooling practices on speed, pace and demonstrating immediate progress. This despite the detrimental effects of fast-paced lessons, a crammed and time-pressured curriculum and continuing assumptions about the value of "accelerated learning". "Teaching for mastery" has been promoted by a government influenced by South-Asian mathematics education practices. A notable difference, and one pointed to by teachers, between, for example, Shanghai primary mathematics pedagogy and English practice relates to the amount of content addressed in a single lesson. Teachers adopting mastery approaches report a slowing down of the speed at which the curriculum is taught (Boylan et al. 2019). However, "teaching for mastery" continues to emphasise progressing through the curriculum in a predetermined way, albeit more slowly (and ideally together and with greater depth than common English primary mathematics education practice). Time is still *regulated*; the machinery running the conveyor belt has simply been slowed down.

We have argued that mathematics education needs pedagogies that involve a conceptually different "slower" relationship to learning mathematics, emphasising what Jardine (2012) describes as the 'whileness' that makes something worthwhile doing. We propose the constructs of *regulated* and *expansive* timescapes to understand the quality of time as lived and experienced in primary mathematics classrooms. These timescapes are implicated in how teachers and students construct learner identities and how they conceive the moral purposes of education:

> A timescape perspective … accepts that it makes a difference to … praxis whether time is valued as an economic commodity, a resource, or a gift of god(s) and loved ones. (Adam 2000, 141)

We have drawn on two primary mathematics curriculum intervention projects - *MiMa* and *EMP* - which, in their different ways, sought to slow down time in mathematics lessons and to expand it. Both projects provided the opportunity to operate on different timescales from usual school mathematics and have in common a different understanding of unfinishedness and meaning-fullness. Both offered opportunities to link time and space in ways that do not conform to standard expectations, seeking to generate *expansive time* and spacious mathematics and mathematics classrooms.

Both *MiMa* and *EMP*, through different timescapes, offered opportunities for identities to develop where the identification with mathematics is richer and stronger, offering a perspective different from usual school mathematics on learner agency. Whilst both projects link to and support the primary mathematics curriculum, they de-centre it and de-emphasise the rigid meeting of given outcomes within urgent time frames. *Expansive time* allows mathematics learning to be 'person- and socio-culturally, rather than discipline, driven' (Burton 2004, 27), with meaning making that is contingent, contextual and personal (Povey et al. 1999). Expansiveness creates time and spaces for co-agency and trust (Hart et al. 2004), for the unexpected (Coles and Scott 2015; Mason 2015): as Malaguzzi evocatively puts it 'if a child wants to be a Chagall character flying over houses' (Cagliari, et al. 2016, 399), then so be it. The importance of *expansive time* has also been connected to supporting 'rescaling the self' (Boylan 2018, 17) as part of de-centering from a human-centred world view that is counter to developing ecological awareness in mathematics. In both the projects we identified how expansive time can support and be supported by acceptance of unfinishedness in the service of meaning-fullness. Embracing the forms of unfinishedness found in the illustrative examples from the two projects may help to foster expansive time.

We have focused attention on time and the experience of time. However, there are hints in the narratives of and from these projects of ways in which time is inextricably linked with spatiality. Although we do not develop a discussion of this here, in both *MiMa* and *EMP* a different temporality is linked also with a refiguring of space, physically, experientially and metaphorically. In *MiMa*, the process of physical modelling provides a different centre for attention from the board (and teacher) at the front of the classroom. In the solar system walk and in the public exhibitions discussed above, the learning space extends beyond the classroom and indeed the school. The time needed for meaning making requires at least the time to walk out the solar system model and the space needed expands accordingly. Taking one's mathematics into a public exhibition space transforms that mathematics, reframing, energising and enriching it. In a similar way, core *EMP* lessons happen outside the classroom, in a hall in or in the playground, where there is space for learners to enact mathematical models and relationships. The embodied work which makes use of the whole body to experience and manifest mathematics needs room to move. The spacious mathematics invoked above is described as providing room to 'move one's elbows' (Angier and Povey 1999, 151). Adam's (2000) concept of timespace links the temporal with the spatial and offers the potential for addressing these relationships in further research, as do other theories that link time and space pointed to above (Harvey 1999; Massey 2005; Matusov 2015).

Thus, we support Malaguzzi's claim, that 'the question of time is a very strong question; it is enough on its own to overturn and revolutionise … pedagogy and schools' (Cagliari, et al. 2016, 399). There is an urgent need for time-sensitive social theory to enter the debate about mathematics education in particular and schooling more generally to deepen analysis of learners' experiences of performativity and resistive alternatives. This paper has addressed this need in mathematics education theory.

Attending to time allows a re-orientation in our understanding of human learning, refocusing attention on what is often ignored or unseen. Interrogating usual school mathematics using the new heuristic of *regulated* and *expansive time* allows both the uncovering of oppressive and de-humanising practices and a way of understanding the need for and possibility of enabling worthwhileness to enter the primary mathematics classroom. We anticipate that the constructs will be useful in interrogating contemporary schooling more broadly.

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