Designing Lesson Study for individual and collective learning: networking theoretical perspectives.

Journal:	*International Journal for Lesson and Learning Studies*
Manuscript ID	IJLLS-08-2022-0111.R3
Manuscript Type:	Research Paper
Keywords:	Lesson Study, Networking Theories, Cultural Historical Activity Theory, Communities of Practice, Professional Learning, Theories of change

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Abstract

Purpose
This article aims to explore, by drawing on, and coordinating and combining Cultural Historical Activity Theory and Community of Practice theoretical perspectives, what we might learn about how to design for Lesson Study that best supports both collective and individual learning.

Design/methodology approach
The article primarily makes a theoretical contribution. It does, however, draw on, and is informed, by the design of a large-scale study that sought to improve teaching and learning in mathematics with the particular aim of improving grades of post-16 learners in national examinations in England. Lesson Study was central to the designed intervention and such design is explored from the two theoretical perspectives.

Findings
Theoretical analysis suggests how the careful design of Lesson Study can facilitate both individual and collective learning in terms of the theories networked here. In particular, it is suggested that supporting collective learning requires careful attention to how 'disturbances' in activity systems need to be designed for rather than being left to chance and how architectures that can support individual learning in terms of identity development should pay attention to supporting emerging practices as well as defining what is non-negotiable.

Originality/value
The article takes a novel approach by coordinating and combining two different, and well established, theoretical approaches, which, significantly, are used quite widely in social science research. Together they provide a rich view of learning at both individual and collective levels and suggest ways in which we might better support design for Lesson Study.

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Lesson Study for individual and collective learning: theoretical perspectives

Introduction: Lesson Study as a mechanism of change

It has been claimed that Lesson Study (LS) is under-theorised (Widjaja *et al.*, 2017; Winslow *et al*., 2018; Hanfstingl *et al.,* 2019), although that is changing, if not rapidly, certainly substantially (for example see, Clivaz, 2018; Huang *et al.*, 2019; Wei, G., 2019; Wake and Selzynov, 2020). Here, I aim to add to this growing literature base to shed light on how theory might be deliberately designed to support professional learning. I do this by drawing on two theories that have been used, not only in educational research but also more widely, to provide insights into understanding both individual and collective activity and learning. My aim is to explore the professional learning of teachers through LS drawing on both Cultural Historical Activity Theory (CHAT) (Engeström, 2001) and Communities of Practice (CoP) (Wenger, 1998) social learning theories. Further to this I provide insight into how this networking was used to inform the design of a large-scale intervention and research study, in which LS was central, that sought to bring about change in teaching and learning.

The article is written from a point of view that fundamental to LS is that as a collective activity participants engage because of a desire to improve teacher professional knowledge both as individuals and as part of a community. It is these two different levels of scale that I wish to use theory to understand. I will draw on the CoP perspective to consider individual learning, albeit in a social space, and CHAT to consider more widely that of the LS collective. The article is primarily a theoretical contribution that I illustrate by referring to the design of a large-scale research project in which LS is fundamental.

In this context notions of *change theories* and *theories of change* are important (Rheinholz and Andrews, 2020). Here, I differentiate between *change theories* that apply generally across different settings and interventions and *theories of change* that are situated in specific circumstances. In this sense Lesson Study can be considered to have a role to play in both the wider applicability of a change theory, at a general level, and also in a theory of change, in relation to particular workable models of implementation of LS.

The purpose of a *theory of change* is to explicitly identify how an intervention is expected to bring about a desired change. The theory of change will consequently make explicit the moderators of the change process, that is, those factors that have the potential to slow it down or speed it up, act to affect quality, act to facilitate or act as a barrier, and so on (Rheinholz and Andrews, 2020). In any particular instantiation of a LS based model there will be a substantial number of such moderating factors: for example,

- the cultural context and setting in which the teacher(s) work that will affect a teacher's expectations in relation to, and notions of, professional learning and collaboration with others
- resources available such as time and funding (if necessary),
- expectations of LS and of classroom-based research at individual, and school levels;
- policy at local and national levels,
- frequency of involvement,
- support for knowledge exchange,
- teacher knowledge related to teaching, curriculum and subject

and so on.

There is no one model of LS that works in all instances: each needs to be designed as part of a particular *theory of change* that takes account of the social and cultural context and systemic structures in which it is situated. Each particular theory of change and LS model reflects the change theory that is derived from the particular instances of LS that are found to work (in the socio-cultural context of the LS models that have emerged). For example, LS in Japan and China, differ in some important features offering two different change theories because of the different intentions of outcomes in these jurisdictions. For example, in Japan, LS focuses on developing teacher knowledge generally in relation to approaches to teaching mathematics through problem solving (Takahashi, 2021), whereas in China LS is more focused on designing ideal lessons (Huang et al., 2017). Therefore, we might consider there being different change theories that guide different manifestations of LS in the two countries. In this article, I am concerned with teacher learning in the sense of the Japanese model, this model of LS underpins the change theory that guides the intervention introduced later in the article which I consider from CHAT and CoP perspectives. In the next section I consider why we might network these two theoretical approaches before considering the key features of each theory in the subsequent two sections. In the

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penultimate section I illustrate application of CHAT and CoP theoretical approaches in this context before drawing some general conclusions in the final section.

A rationale and strategy for networking CoP and CHAT theories.

An overview of, and rationale for, networking theories that frame empirical studies in mathematics education is given in detail by Prediger and colleagues (Prediger *et al*., 2008). After providing an overview of different notions of theory they suggest that there might be considered a spectrum of intentions in relation to the use of different theories. This has at one extreme, the aim of unifying all theories into a global grand theory of mathematics education through to, at the other extreme, privileging just one theory that ignores all others. They suggest that bringing together two or more theories can have a range of different intentions along this spectrum and here I declare my intention as to using the two theories I have identified. In my research in mathematics education, I have used both independently at different times, when analysing collective activity. For example, I have drawn extensively on CHAT (Engeström, 1987), as a conceptual framework for understanding the factors that mediate human activity as a collective endeavour (Wake et al., 2013; Wake et al., 2016; Wake et al,.2020). In other studies, I have as an alternative drawn on the CoP perspective, where my concern has been more focused on the learning of the individual, rather than the structural setting in which they are situated (Ponte and Wake, 2019).

Although both of these theoretical approaches were developed from concern about, and consideration of, the individual, in later iterations they have both been expanded and developed to take account of the collective endeavour in which individuals act/participate. My concern is to understand both these aspects (individual and collective) in relation to professional learning that involves LS and use this understanding to inform the design of a theory of change for professional learning communities. My intention, therefore, is to use a coordinating and combining strategy as described by Prediger and colleagues (2008). Whilst both theories have a number of (at least potential) connections and compatibility in terms of focus and intentions, they also have distinctive aspects so that a strategy of coordinating and combining the two has much to recommend. As Prediger and colleagues suggest this brings advantages and benefits above and beyond use of a single theory (Prediger *et al*., 2008).

Cultural Historical Activity Theory and learning

Fundamental to CHAT, that considers the collective activity of individuals when they come together in a joint endeavour, is the Vygotskian notion of goal-directed actions of the individual (Vygotsky,1978). This considers how the actions of individuals are mediated by “instruments” (the upper triangle in Figure 1). Here, I distinguish carefully between the terms “artefacts” and “instruments” as the former indicates something that the subject may or may not make instrumental in use depending both on the action that they wish to perform, and additionally their understanding of the potential of the artefact to help them realise this. For example, in the case where the object of an individual’s actions is the learning of mathematics this may be mediated by a range of artefacts that might assist them, such as advice from their teacher, discussion with peers, a YouTube video and so on.

The notion of individual goal-directed action was expanded by Leont’ev (1981) in second generation activity theory to include the community in which individual actions are aggregated in pursuit of joint activity (the whole of Figure 1). This is represented by the lower triangles in Engström’s schema (Engström, 1987) which highlights the additional mediating nodes as considered by Leont’ev. These indicate how factors of *community*, *division of labour* and *rules* mediate the actions of the subject as an individual in relation to the object of activity of the collective. For example, in the mathematics classroom considered as an activity system focused on the joint enterprise of learning mathematics the teacher and students form a *community* with a clear *division of labour*.

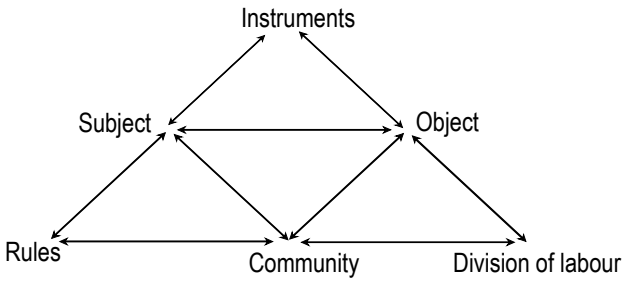

Fig. 1. Engström’s Cultural-Historical Activity Theory .

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There are many *rules* that impact on the behaviour of the individuals (pupils and teachers) in pursuit of the learning of mathematics: these include rules that are both explicit and implicit. For example, there are curriculum expectations that may be made explicit in curriculum specification documents, official assessments and textbooks. There are also many implicit rules including those that relate to, for example, societal expectations in relation to teaching and learning as well as more locally derived expectations such as how students are expected to engage in learning in an individual teacher's classrooms.

Third generation Activity Theory (Engeström, 2001) considers as a minimum two interacting activity systems and raises issues of individuals as boundary crossers engaging in boundary crossing supported by boundary objects (Star and Griesemer, 1989) such as when teachers are active in both the activity systems of their classrooms in pursuit of the learning of students and in lesson study groups in pursuit of their own professional learning. Here we conceptualise boundaries as Akkerman and Bakker (2011, p. 133) suggest in their review of such ideas, "as a socio-cultural difference leading to a discontinuity in action or interaction". Engeström also draws attention to how contradictions understood as historically accumulating structural tensions within and between activity systems have a central role as sources of change and development. He writes,

"when an activity system adopts a new element from the outside (for example, a new technology or a new object), it often leads to an aggravated secondary contradiction where some old element (for example, the rules or division of labour) collides with the new one. Such contradictions generate disturbances and conflicts, but also innovate attempts to change the activity" (Engeström, 2001, 137).

In this way contradictions give rise to collective effort either within or between multiple activities that can give rise to revisioning or expansion of the object of the activity system and institutional change or learning. Engeström terms this expansive learning (Engeström, 2001; Engeström, 2016), which "produces culturally new patterns of activity" (Engeström, 2001, p. 139). As I illustrate later this view of learning from an activity theoretic perspective provides insights into designing the research and intervention we worked on in introducing a change in the enacted curriculum that emphasised a new model of teaching.

As well as the activity system of the classroom LS participants work collectively in the LS group which can be considered as another activity system with its joint endeavour focused on an object of teacher learning of the group. This system has rules that are bespoke to the group but which follow a general cyclical model of LS (e.g. Lewis and Hurd, 2011) and develops a sense of community with a division of labour which is more or less formal in operation. As I, and colleagues, have explicated elsewhere (Wake et al., 2016) the interaction at the boundaries of classroom and LS group activity systems supports the learning of the group, facilitated by boundary artefacts such as the research lesson plan and student tasks.

The Communities of Practice perspective of learning

From the CoP perspective I particularly call on Wenger's social theory/model of learning (Wenger, 1988) to consider how individuals are supported in LS communities in their:

- developing practice,
- their identity development (that is a sense of participants becoming someone),
- making meaning (sense) of the practice,
- becoming a member of the community (participating in collaborative activity with others who have and develop a shared understanding and sense of direction).

In his seminal work Wenger (1998) explicates his theoretical stance and goes on to consider designing for learning and as a result provides much insight into the features to which we need attend for learning to be supported. He is clear that learning can't be designed, but infrastructures that support learning *can* be designed. Important in this regard are a number of principles that apply to Wenger's social theory of learning. These help give more insight into the four features of learning bulleted above and involve learning as:

- being inherent in human nature
- being first and foremost the ability to negotiate new meaning and involving individuals in a dynamic interplay of participation and reification
- creating emergent social structures
- fundamentally experienced and fundamentally social

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- transforming individuals' identities
- constituting trajectories of participation
- dealing with boundaries that arise in our participation in multiple communities of practice
- a matter of social energy and power
- a matter of engagement
- a matter of imagination in ways that provide understanding of an individual's identities and practices in a broader context
- a matter of alignment (with the community)
- involving an interplay with the local and the global. (ibid, pp 226-228.)

A brief moment of reflection on these features of learning suggests that learning to become a LS participant, and the ongoing professional learning that LS affords involves us in all of these features of learning in ways that deeply affect our identities: our ways of being in our professional lives. Wenger considers how we might design architectures for such learning and points to four dualities that should be considered when providing an infrastructure that supports learning:

i. Participation and reification
Participation, as indicated above, is a lived experience: it cannot be designed. However, it can be supported by designed artefacts that become *reified* by participants in the community, e.g. schedules, procedures, templates for shared documents, and so on. There is a constant interplay between participation and reification. This is a fundamental dynamic in communities of practice as learning communities.

ii. The designed and emergent
Practice can be designed for but is in reality a response to this design. We need to have core principles carefully designed but also allow for adaptability supporting features of the lived practice to *emerge*.

iii. The local and the global
A distinction needs to be drawn between the practice as a *global* endeavour and how that is manifested at the *local* level. This allows for distinct local practices to emerge in pursuit of a more widely agreed and accepted 'common' global practice.

iv. Identification and negotiability.
A framework needs to be designed that gives structure to an *emerging* community and designed so as to support participation in ways that allow the development of individual participants' emergent *identities* as well as allowing negotiation of these.

It is probably obvious to those who have participated in one, or maybe more than one, LS community that they provide just such an architecture of learning:

i. Participation is supported by reified artefacts such as research themes and research questions, observation protocols, lesson plans that act as in-class research proposals as well as guides for post-lesson discussions (Wake et al., 2016) schedules and patterns of engagement (when, how frequently, and so on).

ii. Expectations of how a community will enact its particular manifestation of LS can be designed (often conforming with well-known, and respected models of LS) but ultimately the model that emerges and continues to dynamically develop will depend on how the community responds to and emerges from this design.

iii. In this way LS practices become localised to meet the needs of the participants at any moment in time. In doing so each LS group conceptualized as a particular (local) manifestation of a community of practice that is operational in the wider, global, sense of LS. This allows for LS participants to have a sense of being part of an endeavour that has multiple participating groups.

iv. In LS communities professional modes of operation are developed that prioritise collaborative professional learning focused on the day-to-day classroom practice of teaching and student learning. Questions about teaching and learning are agreed and explored by teachers in ways that involve them in close-to-practice classroom research. New identities are negotiated and forged which re-position *teachers as learners*.

Further, to having identified the dualities described above, Wenger (ibid, p.174) points to how these dimensions need to articulate with three distinct and important components of 'belonging' a sense of which is essential for an individual to develop an identity as part of a community of practice. These components, to quote Wenger (ibid., p/173), are:

1) engagement – active involvement in mutual processes of negotiation of meaning

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2) imagination – creating images of the world and seeing connections through time and space by extrapolating from our own experience
3) alignment – coordinating our energy and activities in order to fit within broader structures and contribute to broader enterprises.

Theory informed design of learning in a large-scale intervention

An important question in the design of an intervention that seeks to improve teaching and learning, then, is how can networking these (CHAT and CoP) theories of learning effectively inform this design at the level of both individual and collective. Here I reflect on the design of a large-scale intervention in England. This sought to change and research teaching to improve attainment outcomes of students who fail to achieve a sufficiently high enough grade in the sitting of the national GCSE qualification for students aged 16. A student who does this, and stays in full-time education post-16, is required to undertake further study of mathematics and work towards obtaining a higher grade. In total just over 130 teachers took part in the study in two periods of research over 2017-2018 (30 teachers) and 2018-19 (100+ teachers). All teachers in the first phase, and half of the teachers in the second phase, took part in a modified form of LS as part of the theory of change model. The whole study was informed by a theory of change in which LS was central (Nelson et al., 2020). The LS process was modified from typical cycles (Lewis and Hurd, 2011) in that the research team provided the research theme, in this case dialogic learning, the research question(s) for each lesson, the lesson plan and accompanying classroom materials for students to work with. Key elements of LS were retained: (i) developing a shared understanding of the lesson in a group meeting a few weeks before the research lesson, (ii) collective observation of student learning in a lesson taught by one of the LS group, and (iii) post-lesson discussion of the lesson and student learning in relation to the research questions of the lesson.

In each of the two intervention periods, in five windows of time from November through to March/April, just prior to the next round of national assessment, intervention teachers took part in cycles of LS which involved them in teaching five exploratory research lessons that were designed to focus on five key areas of the GCSE curriculum. These can be seen in the outer layer of the Maths-for-Life Pentagon (Figure 2), along with our focus on the five key indicators of dialogic talk (the inner layer) and five 'signature' pedagogies (the middle layer).

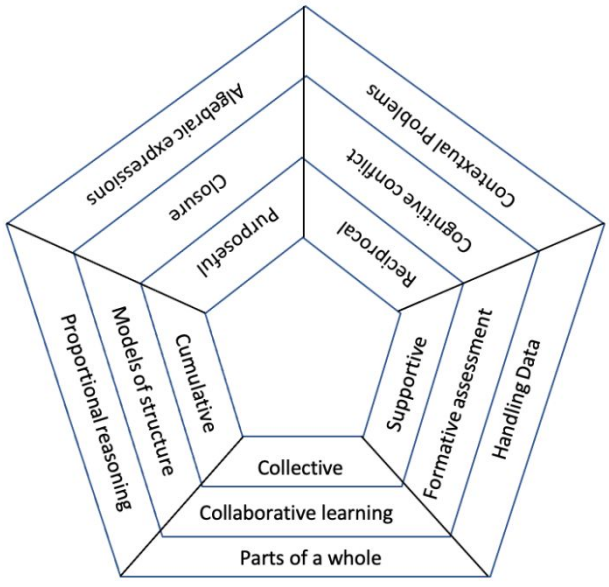

Fig. 2. The focus of lesson design in the intervention project.

In the first round of the intervention the research team worked closely with the teachers working in six geographically spread groups. These were to become the Lead Teachers of the full intervention which was evaluated by a randomised controlled trial in phase 2. The LS typically brought together 4, 5 or 6 teachers from different colleges. Each teacher typically taught multiple classes of students so that they were often able to teach the research lesson to their own students, perhaps multiple times, before

coming together with other teachers to observe one of them teach the *research lesson* at that teacher's college. This observation was immediately followed by a post-lesson discussion in typical lesson study practice (Lewis and Hurd, 2011).

Prior to each of the research periods the research/design team worked to develop the artefacts that embodied the theory informed principles for learning that I discuss in the next section. These artefacts included for teacher use:

- the lesson plans with each including a research question(s);
- task materials for distribution to students;
- powerpoint slides that sequenced aspects of the lesson such as when students worked in pairs/groups and engaged in whole-class discussion;
- observation forms for when observing the research lesson.

These materials are now all available at the project's website: https://www.nottingham.ac.uk/maths-for-life/about/index.aspx In addition we developed a substantial number of short video sequences that provide teachers with insight into classroom implementation of lessons. These prove important in providing images of our design intentions.

Networking theories and informing designing for learning

Here I coordinate and combine CHAT and CoP theories to shed light on factors that are significant when designing learning of both individuals and collectives when using LS. I primarily use CHAT to focus on the endeavour of the collective and CoP theory to focus more substantially on the learning of the individual. Because of the fundamental basis of each theory being concerned with the individual in symbiotic relationship with the collective this coordinating and combining strategy seems potentially rich in providing suitable insights into, and the design of lesson study within the Theory of Change.

As I indicated previously, according to CHAT, Engeström suggests that learning of the collective occurs when there is an expansion of the object of the activity of an Activity System. This expansion is brought about by a contradiction caused by a disturbance to old patterns of activity (Engeström and Sannino, 2010). Conceived of in this way, it seems that LS set within a clearly defined research theme (Lewis and Hurd, 2010) and with an intention to bring about substantial change to practice will, by its very nature, lead to learning of the collective. Bringing disturbance to the classroom is at the heart of LS activity as part of any change theory.

In our research project's LS design, we sought to introduce disturbances in patterns of activity by our design of artefacts, rules, division of labour together with community (the nodes of the framework in Figure 1). Each LS cycle introduced research questions that we designed alongside lesson plans and student tasks. For example, research questions such as "How do models of structure help to facilitate cumulative dialogue and insight into mathematical structure?" (Lesson 2). It was our intention that the mediating artefacts (research questions, lesson plans, tasks and so on) we designed both provided disturbance to usual practice *and* supported teachers, both individually and collectively, in activity in both their lessons and newly established LS groups. In this way the modified LS format of the intervention ensured that the collective was able to engage in expansive learning with each group working collaboratively to discuss and transform teaching practices in ways that could resolve the disturbances that we introduced. Our introduction of Lead Teachers who were able to facilitate and support the LS groups in the second phase of the research provided issues of division of labour and the inevitable accompanying issues of power relations. However, these Lead Teachers were drawn from those teachers who had taken part in the first phase of research, using initial drafts of the five research lessons, and ensured that there was a strong sense of equity in terms of learning of the teacher collective in phase 2.

The introduction of dialogic teaching and practices required teachers to establish new *rules and norms* to establish new modes of working in their classrooms. We designed for, and indeed in classrooms noted, a significant shift in the division of labour with students co-constructing knowledge with peers as opposed to the traditional model of previous teaching where teachers had worked to 'transmit' effective rules and procedures for solving problems. In the LS post-lesson discussions new shared models of, and underlying values in relation to, what constitutes learning for these students were explored and agreed. In this way the collective was supported in developing a new shared discourse that they used to talk about student learning through dialogue. This was developed from their observations of students

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who, with peers, discussed, exploring and building on each other's understanding of important concepts: for example, their understanding of proportionality. Examples of such working can be viewed at https://www.nottingham.ac.uk/maths-for-life/resources/lesson-2.aspx . As the LS cycles of the intervention progressed the LS groups lived the disturbances that we had introduced and developed.

A further disturbance was introduced by forming the LS (cluster) groups in a way that brought together teachers from across a number of colleges (in practice 4 or 5). This deliberate design feature ensured that the teachers in the LS group brought to the collective activity their different culturally and historically evolved models of teaching and learning that they developed in the different settings in which they work. For example, even though all students in each of the colleges were working towards the same assessment at the end of the course, each college plans and resources the patterns of learning of their students differently. They schedule mathematics lessons to different structures. Such differences in the *rules* that mediate the activity of the different teachers provide for further potential sources of disturbance which help to ensure a rich variety of experiences to inform the discussions of the collective as they consider 'what works' in relation to the research question under consideration.

In these different ways the design of our LS model intended to support collective learning in multiple activity systems working to realise new models of activity focused on expanded objects of activity. In terms of CHAT, in general, we sought to introduce disturbances leading to contradictions in the activity systems that the participating teachers experienced in their different colleges. The role of the LS community and their post-lesson discussions played a crucial role in providing a learning space in which these new modes of working could be discussed, developed and reflected upon collectively.

CoP theory (Wenger, 1998; Farnsworth and Kleanthous, 2016) is a social learning theory where the focus is more clearly on a sense of identity development as the *individual* works to become a member of a *community* engaged in a particular practice. In Wenger's terms, teachers who regularly engage in cycles of LS form a community of practice so that *professional learning is central to what it means to be a teacher*. Through their active involvement in the community, newcomers move from initial legitimate peripheral participation to more firmly established patterns of participation. In this way they develop their practice, develop an identity as someone who engages in, and learns from LS, make meaning of the practice and their role in this as they develop shared understanding and behaviours as part of the community. Even where and when LS is firmly established culturally and historically, this does not happen without support and an 'architecture' that supports this.

To further explore this theory of learning, in relation to the design of LS as part of our Theory of Change, I return to consider the four dualities that Wenger (1998, p.232) points to. Here I consider how these relate to the participation of individuals involved in the LS practices at the heart of our research study.

i. reification < -- > participation
ii. designed < -- > emergent
iii. global < -- > local
iv. identification < -- > negotiability

Each of these points to what we, as designers, can control, in our design of the intervention, and what we should acknowledge as needing to support. Fundamental to individual teachers is participation which we aimed to support by the reified artefacts we provided such as research themes and research questions, observation protocols, lesson plans that act as in-class research proposals, as well as guides for post-lesson discussions (https://www.nottingham.ac.uk/maths-for-life/about/index.aspx), schedules and patterns of engagement (when, how frequently, and so on). These were designed to support individual teachers in both their participation in their well-established classroom communities in ways that facilitate them in changing their practice as well as in the newly developing LS community in which they participate with others to explore new ways of working.

Expectations in relation to both classroom and LS practices are carefully *designed* and communicated not only in the artefacts we designed to support Lead Teachers, participant teachers as well as LS communities, but also communicated in the professional development sessions we ran to set up the intervention. These aimed to ensure practices could become *localised* to meet the needs of the individual participating teachers at any moment in time. In doing so each LS participant (and community) developed a localised response to expectations of classroom and LS practices that were conceptualised and designed as a global intervention operating with fidelity to the key principles that

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informed it. This allowed for individuals (and communities) both as teachers in their classrooms and in their localised LS groups to have a sense of being part of a global endeavour with a strong sense of involvement in a programme of research and change.

Importantly we allowed individual teachers to negotiate and forge new identities as *learners* in relation to their professional practice. Our design was cognisant of, and sympathetic to, the dualities that Wenger identifies in ways that supported individual teachers to develop new practices, identities and make meaning of these.

We took control of how participation in the LS groups was expected to be structured by providing guidance about how to organise LS research lesson meetings, conduct lesson observations, research questions to stimulate discussion, and so on. Thus, we outlined a model of intentions to inform reification of practice by each LS group, but also allowed for different practices to develop across the groups so that over time their own bespoke practices emerged. This ensured that some important features of the research, for example, the phasing of lessons and associated research questions were fixed at a *global* level whilst other parts of a community's practice, such as where and when they met and agendas, were developed *locally* in ways that supported individuals' trajectories of participation to be taken into account. In certain aspects of the design of the LS practices central to the research we were uncompromising: we required as much uniformity and fidelity to our model of implementation as possible across the different LS groups that were part of the research, around issues such as the number of LS cycles, their phasing during the research and so on (Nelson et al., 2020).

In general, to support learning of individual teachers in seeking to introduce a new teaching approach we introduced a new practice to go alongside exemplar lessons and student tasks, that of LS, and we provided an architecture for learning guided by the ideas put forward by Wenger.

Conclusion

To effect a change in teaching practice, professional learning needs to be addressed in terms of both the collective and the individual. In this article I have networked, according to a strategy of coordinating, both CHAT and CoP theories to consider professional learning with respect to these different constituencies respectively. I used the design of a particular *theory of change* to reflect on, and illustrate, what we can learn from application of these theoretical approaches about such design. Here I draw some conclusions about what we can learn from networking of these theories when LS is central to theories of change.

Learning of a collective is facilitated by providing a disturbance(s) (leading to contradictions in activity systems) in Engeström's terms. This leads to expansive learning where the object of the activity of the collective is expanded to have a new focus. In interventions designed to bring about professional learning the incorporation of a LS model can facilitate such a disturbance(s) by identifying and working within a research theme that challenges socially and culturally accepted norms. It helps if this overarching theme is well defined and if it is clear about how this will challenge existing practice. It will be helpful to clarify how the intervention will disturb different aspects of classroom rules, the balance of power between teacher and students and how this might have implications for the sense of community that is developed in the classroom. Disturbance in the LS group can also be provided by ensuring diversity in its composition by including contributors with experiences from different socio-cultural contexts. This can be achieved by including teachers who work across diverse institutions. Such design requires knowledge of, and sensitivity to the socio-cultural context of activity system participants and might be best achieved through careful development work undertaken over a relatively substantial length of time. In the design and research referred to here this was achieved by running two studies within a programme with a time span of over more than two years.

At a different scale the learning of individuals can be supported by designing and providing an architecture of learning that supports learning viewed as participation in which practice, identity, meaning and becoming a member of a community are developed, recognised and supported. Such an architecture needs to be cognisant of what it aims to control, by its global design and reification, and what it aims to support in its emergence and diversity. Important in this is the design of artefacts that support the work of the individual, often by providing structure that also informs the work of the community. For example, observation protocols are often used that support individual reflection on both issues of classroom learning of students, and also reflection on participation in the community.

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As Wenger (1998) points out our design work, in respect of supporting individual learning, needs to allow for their *engagement* in ways that involves their ongoing *negotiation of meaning*. In LS this is reflected in both the *trajectories of individuals as participants* move from peripheral participation to become established and potentially 'leaders' of the community and trajectories of the community as a whole. This involves initially supporting a potential and tentative group trying to establish workable practices in the local context to becoming a well-established part of the institution(s) of which it is a part. In this way socially constructed and shared "images" emerge and develop that allow participants insight into what they might become.

As designers of theories of change in which LS is central, then, as we consider and design for learning of both collectives and individuals, we need to consider carefully how we do this in the systems and structures and the accompanying artefacts that we produce. Importantly, artefacts such as lesson plans need to be sensitive to how they might support both aspects of learning. In each artefact we can ensure that we address both collective and individual learning. For example, lesson plans can facilitate individual teachers as 'scripts' for working in their classrooms and also for LS groups in collectively exploring the designed disturbance embodied in the LS plans' intentions. Ultimately, the artefacts we design and produce need to have dual learning intentions.

This suggests that the design of each of the elements we produce should not be left to chance. It is important to say, however, this design is not, by necessity, the preserve of an outside agency (although that was the case in the research I describe here). The design can be a co-construction of participants in the group: as is the case in Japan where in elementary schools the research theme for the year, for example, is often determined by a committee of teachers. However, wherever responsibility for the design lies, theoretical exploration such as I present here, can provide beneficial insight. The two theoretical approaches I draw on provide different lenses that highlight important and different views of learning. They suggest different but complementary features of design for professional learning that require attention, and importantly can be realised in artefacts with dual intentions.

Further networking of theories in this way has the potential to provide new insights for designers of theories of change that incorporate LS. However, there are a number of challenges in such networking. First, theories such as CHAT and CoP, are well-established because they provide comprehensive frameworks that have traction with researchers due to the insights they can provide into complex phenomena. Each on its own tends to be complex with interacting and interlocking constructs that attempt to provide ways of seeing and making sense of learning. As Prediger and colleagues (2008) point out each of these might be categorised as belonging to a particular research paradigm as well as being of different scope and focus. Consequently, a question we have to ask is, which theories can we effectively network and what potential is there for doing so in ways which will provide new insights that will be helpful in our work? In this article, I have called upon two theories that are particularly well-established and used widely by researchers with each taking a distinctive view of learning. Both take a social view of learning that seeks to consider learning beyond relatively narrowly conceived, but nonetheless, complex, cognitive viewpoints. A challenge has been to focus each to a particular purpose: that of giving insight into the learning of the collective (in the case of CHAT) and the individual (in the case of CoP). It would have been easy to be distracted by each theory to consider both collective and individual at the same time and in doing so perhaps having lost the two distinct strands of thinking that the two different theories afford. Whilst encouraging researchers to consider the networking of theories that can inform their work, I suggest careful thought needs to be given as to which theories, to what purpose, and how this might best serve the design and ultimately analysis of their research.

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