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The potential of lesson study

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Embracing Complex Adaptive Practice: The Potential of Lesson Study

The current neoliberal political climate in education has narrowed the focus of teachers' professional development and reduced their work in the classroom to a simple and predictable process. In this article, we challenge this view by deploying a range of complexity thinking concepts to present an account of teachers as self-organising, inquiring, and emergent professionals, whose classroom practice is constantly evolving as they negotiate different boundaries and make connections across the nested layers of the education system. Lesson Study is recognised as a collaborative, school-based, and long-term form of professional development that appears to have the potential to foster these complex and adaptive features of classroom practice. To this end, in the closing stages of this article, we present examples from our involvement in two longitudinal research projects in Scotland. The project leaders have set up appropriate contexts for Lesson Study that are ripe for a focus on complex adaptive practice in the future. We share our next steps in these two projects but remain realistic about the implications of developing complex adaptive practice through Lesson Study in the current political climate.

Keywords: complexity thinking, classroom practice, professional learning, Lesson Study

Introduction

With neo-liberal developments dominating the educational landscape for much of the last 30 years, accounts of the complex nature of teachers' classroom practice have tended to fade from view (Delamont 2012). With politicians inclined to regard education as 'a pretty simple business' (Smith 1996, p. 195), teachers have increasingly been positioned as mere technicians (Zeichner 2014), expected to teach in a similar manner regardless of context (Gale 2018). Market-driven education policies are now commonplace and create competitive arenas for school effectiveness within and between countries. Locked within this adversarial environment, school systems have become progressively risk-averse as they seek to minimise harmful influences on their

performance metrics by heightening teacher surveillance, controlling classroom practice and delivering ‘quick-fix’ professional development solutions (Page 2017). While we recognise the constraints imposed by neo-liberalism, we argue that teachers’ classroom practice is more complex than it is often portrayed by policy makers and, in agreement with Biesta (2017), we propose that it is time to recapture the art of teaching.

In this article, we make the case for Lesson Study as a professional development approach that has the potential to help teachers embrace the complexity of their classroom practice. To build our case, we begin by discussing how the neo-liberal turn has created a narrow perspective on education that positions teachers’ professional development and classroom practice as reasonably simple and straightforward phenomena. We then draw on principles from complexity thinking to sketch out how classroom practice is in fact a complex and adaptive endeavour. We deploy a range of complexity concepts to present an original view of teachers as self-organising, inquiring and emergent professionals whose practice is constantly evolving as they negotiate different boundaries and make connections across the nested layers of the education system. We, subsequently, present Lesson Study as a collaborative, school-based and data-driven form of professional development that appears to have the potential to foster the complex and adaptive nature of teachers’ classroom practice.

These two research areas – Lesson Study and complex adaptive practice – have been central, but separate, streams of our own research interests over the past five years. We plan to bring them together for the first time in our future work. The latter stages of this article presents examples from two longitudinal research projects in Scotland where the

project leaders have set up appropriate contexts for Lesson Study to focus on complex adaptive practice in the future.

Neo-liberalism and Teachers' Classroom Practice

Currently, the education landscape in most countries is dominated by neo-liberal policies grounded in 'the normative assumptions and prescriptions of economism' (Lingard et al. 1998, p. 84); thereby creating conditions that have enabled politicians to present education as a straightforward phenomenon whereby central policy directives are translated into practice through a process of 'conception, consultation, development, implementation and evaluation' (Humes 2008, p. 77). In this context, politicians have adopted a mantra – improve teacher quality to improve student outcomes – and, consequently, government agencies have adopted a simplistic approach to teachers' professional development (Day and Smethem 2009). Teachers are increasingly attending one-off, off-site, short courses delivered by 'experts' (Darling-Hammond et al. 2009). Rather than prioritise the personal learning requirements of teachers, this form of professional development tends to privilege the demands of national curricula and the improvement plans of schools (Jones and O'Brien 2014). Thus, professional development has been steered towards short-term solutions to perceived weaknesses or problems, which is viewed by politicians as a route to enhance education and contribute to a country's economic competitiveness (Loomis et al. 2008).

Critically for teachers' classroom practice, this neo-liberal agenda has motivated efforts to quantify the relationship between effective teaching and student achievement through large-scale, government funded, and often process-product research projects (Rex et al. 2006). These quantitative studies aim to identify the key elements of effective teaching, and accordingly, present government agencies with the evidence of practices *all* teachers should deploy, regardless of social and cultural context (Gale 2018). In

addition, various surveillance measures have been progressively embedded in school systems (Page 2017). With competition across education systems becoming the norm, the aim of schools is to avoid ‘poor inspection, poor exam results, poor league table ranking, negative parental attention, bad press in the media’ (Page 2017, p. 2) by *eliminating* risk. For example, checklists have been developed in countries to observe ‘effective’ teaching and are being used by school leaders and other agencies to track whether a teacher can synthesise the key elements of a lesson to create a clearly defined whole (Page 2017). Framing teaching against pre-specified elements detailed in observation schedules highlights a simplistic understanding of teaching. It places constraints on teachers’ professional judgement and overlooks the adaptive forms of practice required to meet the demands of diverse student populations.

The scenario outlined in preceding paragraphs is not the same in all countries. Darling-Hammond et al. (2009) present several exceptions to the rule (e.g. Denmark, Finland, Hungary, Italy and Norway) where governments have managed to resist the appeal of neo-liberalism and acknowledge education as a far more complex phenomenon.

Scotland, where this article is set, could be added to this reasonably short list. Key policy documents shaping teacher professionalism in Scotland (Scottish Government 2011; Scottish Government 2017) have painted an extended picture of teacher autonomy and positioned inquiry as central to the educational landscape. This policy rhetoric could be viewed in a positive light, although there is potential for it to be twisted to serve priorities other than teacher learning (e.g. Jones and O’Brien 2014). With this background in place, we now present a different account of classroom practice, which begins by providing a short overview of systems thinking and then moves to sketch a detailed view from a complexity perspective.

A Complex Adaptive View of Teachers' Classroom Practice

Systems Thinking: the starting point for adaptive practice

In seeking to develop our case for a complexity-informed view of classroom practice, we propose that concepts from systems thinking are a useful starting point for drawing attention to the limitations of the neo-liberal approach to teacher learning and developing – and introducing – complexity to re-frame the way we regard teachers' classroom practice. Systems are a key feature of the world in which we live and have been defined as 'an interconnected set of elements...coherently organised in a way that achieves something' (Meadows 2008, p. 11). In line with Osberg et al. (2009), we take the view that there is a difference between complicated and complex systems; an idea that is central to our understanding of the complex nature of how the human social world functions.

On the one hand, complicated systems are a common and important feature of our daily lives: including, traffic lights, cars and televisions. The key to the complicated system is that the interaction between the different parts within each system has been pre-programmed to function in a linear and closed-loop fashion. Complicated systems, due to their closed nature, have little, if any, relationship with the environment in which they operate. Hence, complicated systems generate outcomes that are predictable, or even certain, and that are repeated time after time. In a neo-liberal approach to education, the implications we discussed earlier for teachers' professional development and classroom practice share many features of a tightly bound complicated system. On the other hand, complex systems are different from complicated systems. While complex systems may have the capacity to be ordered and predictable, they also possess a key self-organising capacity. Self-organisation enables different elements within the system to interact with

each other *and* with the external environment (Prigogine 1976). Unlike the predetermined functioning of the complicated system, complex systems can generate ‘rich interactions’ (Cilliers 1998, p. 3), which produce emergent behaviours that may be predictable and unpredictable. Complex systems are, therefore, ‘dynamic and transformational’ (Byrne 1998, p. 51) with the capacity to be ordered and structured while concurrently having the potential to change the overall structure and ways of functioning. In this way, most living systems, particularly humans, can be viewed as complex because of the way they are able to interact and behave.

Education systems are a human creation and as such, they are complex (Davis and Sumara 2010). Politicians, policy makers, academics, teacher educators, school staff, students, classrooms and lessons all function as complex systems in that they are self-organising, interrelated, emergent, nested and transformational. Therefore, while some may find it convenient to view education from the perspective of the complicated system, we are beginning to witness an increasing number of authors viewing elements of the education system through a complexity lens (e.g. Mason 2008, Morrison 2010, Osberg and Biesta 2010, Ovens et al. 2013, Keay, Carse and Jess 2019). In line with a number of authors (e.g. Burns and Knox 2011, Davis et al. 2015, O’Leary and Wood 2017), we turn this complexity lens on teachers’ classroom practice as a complex and adaptive process.

Complexity Thinking: the concepts of adaptive practice

Acknowledging the complex nature of the classroom environment, Le Fevre et al. (2016, p. 312) have highlighted how adaptive practitioners need to develop:

...flexible knowledge and performance in order to respond effectively and efficiently in novel situations...[and] deep conceptual understanding to enable

the creation of new solutions to existing problems and innovative solutions to new ones.

Adaptive classroom practice is a complex process that requires teachers to move beyond the simplistic transmission of knowledge by developing the ability to respond to, and influence, the dynamic and ever-changing environment in which they work. From this complex perspective, developing adaptive practice is not a ‘quick fix’, but a recursive process that is non-linear and long term (see Figure 1). We now discuss how several interrelated concepts can collectively frame and support the evolving nature of complex adaptive classroom practice.

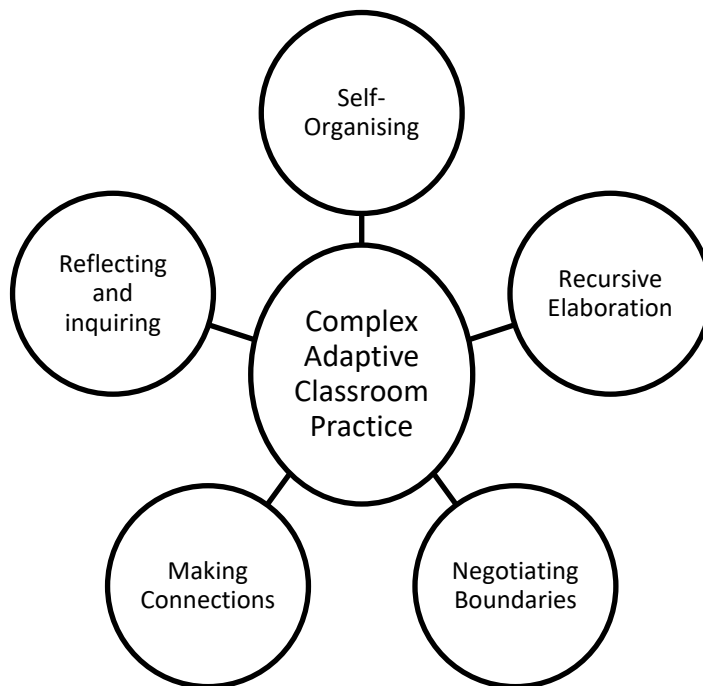


Figure 1: Complexity Concepts Framing Teachers’ Adaptive Classroom Practice (Adapted from Keay et al. 2019). *Self-Organisation and Recursive Elaboration*

The development of teachers’ complex adaptive practice is long-term: a recursive process that needs teachers to use their self-organising abilities to respond to and influence the uncertain environments in which they work. Pivotal to this self-organising

process are the different personal visions for education that each teacher holds.

Hammerness (2001, pp. 3-4) advises that:

...[vision] consists of images of what teachers hope could be or might be in their classrooms, their schools, their community and, in some cases, even society...vision can provide a sense of 'reach' that inspires and motivates them, and invites them to reflect upon their work.

A vision for education relates to a teacher's classroom practice and also how they influence, and are influenced by, the wider school, community and societal domains (Shulman and Shulman 2004). Each teacher, however, will not have the same vision for education. They will have had different personal and professional histories, will be at different phases of their teaching careers and will work in contexts that differ from each other. Hence, personal visions are not simply 'taken down from the shelf' or copied from policy makers or the school hierarchy, but rather are always evolving as a 'work in progress'. Personal visions are significant drivers for teachers' classroom practice and support them to 'take a stand for a preferred future' (Block 1987, p. 102), give meaning to their teaching and are a key feature in their long-term professional development (Senge 1990). Vision has recently been mooted as a potential tool to help the teaching profession 'speak back' (Vaughn and Faircloth 2013, p. 1), and may even act as the 'antidote' (Hara and Sherbine 2018, p. 686), to the increasing neo-liberal attempts by governments to control teacher professional development and classroom practice.

The recursive and long-term nature of this self-organising vision-making process is key to a teacher's complex adaptive practice. Over time, teachers introduce, revisit, consolidate, elaborate and reflect on topics, ideas and issues as part of their ongoing work in the classroom. Through a process of recursive elaboration, teachers organise their knowledge, understanding and skills into a conceptual framework that can be

applied and transferred across different classroom contexts (Bransford et al. 2000). This deep learning (Marton et al. 2005) is critical to their development as adaptive practitioners and ‘unfolds recursively by constantly invoking and elaborating established associations’ (Davis and Sumara 2010, p. 201). Consequently, developing teachers’ adaptive practice is not a simple, linear ‘quick fix’ controlled by the school management and narrowly focussed professional development courses. Rather, it is a complex process that evolves through a long-term capacity building exercise. As we will discuss, this self-organising process does not take place in a vacuum; instead, it is constrained and enabled by a multitude of boundaries that teachers need to interact with and negotiate on an ongoing basis.

Complex Adaptive Classroom Practice: Negotiating boundaries

What do we mean by boundaries?

For some years, the concept of boundaries has been a feature within the social sciences (e.g. Lamont and Molnar 2002) and education (e.g. Alsup 2006). While a specific definition of boundaries may remain elusive, there is some agreement that “all learning involves boundaries” (Akkerman and Bakker 2011, p 132) that either act to hinder learning or to facilitate learning potential (Wenger 1998). In the context of this article, we take the view that boundaries are complex devices that specify the limit of a space or social grouping and are found in the physical, conceptual, functional, behavioural and communicational factors teachers meet in lessons (Khalil and Boulding 1996). Using this definition, we focus on the place of boundaries within teachers’ classroom practices by highlighting that, while teachers need to self-organise, they are constantly involved in an ongoing process of identifying and negotiating the different boundaries they meet across the school day. This relationship between teachers and boundaries over time is key to their development as adaptive practitioners.

The boundaries teachers meet and negotiate in their classroom settings are limitless but can be framed within three interrelated ecological categories (see Table 1). Ecological thinking offers a helpful way to frame boundaries because, consistent with complexity thinking, it takes a relational view of human behaviour. Specifically, across the literature ecological thinking highlights how different factors within the individual, the environment and the task being attempted act as boundaries that influence an individual's behavioural efforts e.g. health, (Stokols 1992), physical activity (Welk 1999), psychology (Gibson 1979), sport (Davids et al. 2013), physical education (Rovegno 2006), family studies (Bronfenbrenner 1979) and social settings (Rogoff and Lave 1984). Human behaviour, therefore, emerges as individuals negotiate their personal boundaries, the boundaries within the environment and also the boundaries inherent within any task being attempted. Critically, while there will be many boundaries within the immediate environment, many authors recognise the multiple layers across the broader environmental context and propose that a 'ripple' effect sees each nested layer influencing the other (e.g. Bronfenbrenner 1979). As we now discuss in more detail, these three interrelated ecological factors can be used as a device to frame the many boundaries that teachers need to identify and negotiate as they develop their adaptive classroom practice over time (see Table 1).

Table 1: Boundaries in the Classroom Setting

Individual Boundaries	The teacher's cognitive, social, emotional and physical characteristics
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Environmental Boundaries	Factors within the immediate classroom (including the students) and the broader school, community and national settings
Task-related Boundaries	The cognitive, social, emotional and physical aspects of the activities being attempted

Table 1 presents the array of ecological boundaries that teachers need to negotiate as they teach lessons over time. In most individual lessons, task-related boundaries include the learning intentions the teacher has designed for the lesson, the series of learning activities planned for the students, and the relationship the teacher has with the students in the class. The individual factors include: the knowledge the teacher has about the topic being taught, their range of teaching skills, how they feel physically or emotionally at that time, and their knowledge about the students in the class. In addition, the environmental boundaries include: the space in which they are teaching, the equipment they have at their disposal, the time allotted for the lesson, the school ethos and national policies influencing the topic being taught. Other boundaries, some unexpected, will need to be negotiated during the lesson (e.g. the time of day, poor weather or illness). As teachers self-organise and negotiate the multitude of boundaries they meet in a lesson, they recognise that some boundaries remain constant throughout the lesson (e.g. the teaching space), while other boundaries are more dynamic and open-ended (e.g. students' behaviour).

To be adaptive in their practice, teachers will, therefore, need to identify the boundaries they are able to influence and manage while also acknowledging there are some

boundaries they are unlikely to have any impact upon, particularly in the short term. Understanding the difference between these boundaries could influence how a teacher approaches their teaching and help them identify the knowledge, teaching skills and relationships they will need to apply to further develop their adaptive capabilities. Additionally, because teachers do not share the same personal visions, teaching experiences and current work environments, they often respond differently to boundaries that appear to be the same. For one teacher, a particular boundary (e.g. knowledge about a topic) could limit or even halt their negotiation process, while for another teacher the same boundary opens the negotiation process and leads to creative interactions. For this reason, boundaries can be considered as ambiguous because they can be perceived differently by different teachers. The ambiguous nature of boundaries is important to the learning process because it highlights how different individuals' self-organising capacity is demonstrated as they respond to the same boundary in different ways (Akkerman and Bakker 2011). For example, if a group of learners are given clear instructions on how to present information about a topic to their peers (the boundaries of the task), some may become nervous and constrained, others may be motivated and enthusiastically engage, while a third group may switch off completely and disengage. While acknowledging that boundaries may be a barrier to learning, several learning theories posit that boundaries can be resources for learning as they have the potential to help individuals reconsider assumptions, look beyond what is known and familiar, and avoid intransigence and routine (e.g. Engestrom et al. 1995; Wenger 1998).

How do teachers negotiate boundaries?

As teachers move to develop their adaptive classroom practice they shift beyond the straightforward transmission of 'set' forms of knowledge: an approach that usually leads to segmented forms of learning that are "strongly bounded from other knowledges

and contexts” (Maton 2011, p. 128). As teachers’ adaptive practice evolves, they become more focussed on helping students develop the cumulative learning that is characterised by integrated progression and transfer across different contexts (Maton 2011). While this focus on cumulative learning may begin with clear learning intentions for students, these intentions will become increasingly flexible as teachers begin to identify and negotiate the different individual, environmental and task-related boundaries they meet as a series of lessons progress. Crucially, as time passes, this complex process sees the adaptive teacher return to similar learning contexts in which they revisit existing boundaries and meet new ones. This revisiting process is called recursive elaboration (Morrison 2003) and enables teachers the opportunity to negotiate the different boundaries to support students’ cumulative learning.

As we now discuss, in these efforts to build this cumulative learning capacity in their students, teachers use their professional judgement to negotiate the many ecological boundaries that will support a complex mix of learning tasks and help students consolidate key learning, challenge their existing learning and also open the possibility for creative learning. This negotiation process unfolds over time and fluctuates as teachers work inside, around and outside different boundaries (see Table 2). This interweaving and interactive process is likely to be messy as teachers make successful and unsuccessful efforts to consolidate, challenge and support creativity. ‘Playing safe’ inside, ‘pushing’ around and ‘exploring’ beyond boundaries highlight the non-linear, cumulative and emergent nature of this boundary negotiation process (Jess 2020).

Table 2: Negotiating boundaries to build adaptive practice

Supporting Learning	Hindering Learning
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'Playing safe' inside the Boundaries	<i>Consolidating</i>	<i>Boring</i>
'Pushing' around the Boundaries	<i>Challenging</i>	<i>Stressful</i>
'Exploring' beyond the Boundaries	<i>Creative</i>	<i>Chaotic</i>

(1) 'Playing safe' inside the Boundaries

When 'playing safe' *inside* the boundaries, teachers are seeking to stay inside the different boundaries they meet during lessons. This could include repeating the behaviour rules they expect the students to comply with, presenting knowledge they have regularly included in a lesson, or using a specific student activity they used often. Over time, repeating these tasks will help consolidate and reinforce key features of their practice, which, in neoliberal times, may be attractive for schools that are eager to control any risks to performance and reputation. While teachers may not be taking any risks, they will not be challenged in their thinking and practice to any significant degree. A teacher will play safe when they use teaching methods that they use often and believe are important. However, while 'playing safe' may help consolidate practice, it can also reinforce misunderstandings or can be boring if it repeats what the students already know.

(2) 'Pushing' around the boundaries

'Pushing' *around* the boundaries is also an important feature of a teacher's development because it challenges their current practice and the students they are teaching. For

example, a teacher may ‘push’ the boundaries by presenting a more controversial view of the content they are discussing with students. In this scenario, they may attempt to make the learning activities more challenging for the students. If the argument they present is well-constructed, they will challenge their own thinking and the thinking of students. However, if teachers challenge themselves and the students by adding too many controversial points, it is possible they will ‘push’ the boundaries too far and begin to overload their presentation, lose the thread of their argument and probably confuse themselves and the students. For teachers, deciding when, and how, to challenge themselves and their students by ‘pushing’ different boundaries is a key feature of becoming adaptive in their classroom practice.

(3) ‘Exploring’ beyond the Boundaries

‘Exploring’ *beyond* the boundaries may be daunting, particularly in the risk-averse contexts in which many teachers find themselves. This is, however, an important feature of teachers becoming adaptive practitioners. Teachers can intentionally move outside the boundaries they meet to explore different possibilities by trying out ideas that are novel and unpredictable. For example, a teacher can move outside the boundaries by taking a different approach to the way they teach a lesson. By moving outside their normal knowledge and relationship boundaries, the teacher may become involved in uncomfortable discussions, as the students offer unexpected and potentially contentious responses. As their discussions continue, the teacher may have the opportunity to explore a wide range of possibilities and could end up creating a lesson that is different and unexpected. This experience can become highly motivating and exciting, although, it is possible that the students remain quiet and unresponsive.

These three examples highlight how teachers can identify and negotiate the boundaries they meet on a regular basis. This negotiating capacity builds as teachers consolidate inside, challenge around and explore beyond the different boundaries and develop as efficient, adaptable and creative practitioners who can engage effectively across a range of contexts. However, as we now discuss, building the capacity to become this adaptive practitioner would also require teachers to make and sustain connections across and beyond their school context.

Complex Adaptive Classroom Practice: Making connections

As teachers self-organise and negotiate boundaries in their classrooms, making connections becomes a key part of their adaptive classroom practice. That is, teachers seek to build the knowledge base and teaching skills that help them make connections within subject areas, across the school community and beyond the school gates. Contextualising and integrating their knowledge and teaching is unlikely to materialise without working collaboratively and collegially with colleagues beyond their own classroom walls. Teachers, therefore, should be supported to work together consistently to collectively identify and develop the steps that will lead towards more integrated forms of adaptive classroom practice. From this perspective, teachers need to recognise that their classroom practice is embedded within a nested education system that is ‘simultaneously a unity, a collection of unities and a component of a greater unity’ (Davis and Sumara 2001, p. 85).

The classroom is connected to, and influenced by, the ever-changing school, local authority and national policy trajectories. A complexity perspective recognises that the relationship between the nested boundaries of education systems do not solely function in a top-down, linear fashion. The smaller classroom and school systems feed into the

larger education system, which, in turn, exerts influence back into the smaller parts of the system (Morrison 2003). While some policy makers view the implementation of policy as a straightforward process, the reality is non-linear and messy. Due to the different personal visions teachers hold, policies are viewed differently by different teachers and so will, consequently, be enacted, not implemented, in different ways and to different degrees (Ball et al. 2012). Collaborating with colleagues helps teachers connect with different policies and, crucially, negotiate a pathway through the different boundaries these initiatives generate. We are not suggesting that governments abandon policy creation, but rather that teachers should be supported to integrate their personal visions and classroom practices with the different policy initiatives that emerge on an increasingly regular basis. To do this, as teachers self-organise, negotiate boundaries, and make connections, reflection and inquiry play an important role in keeping their adaptive classroom practice in perspective.

Complex Adaptive Classroom Practice: Reflecting and Inquiring

Reflection and inquiry will not be new concepts for most teachers (e.g. Schön 1983). These are critical features of adaptive practice because they help sustain the ongoing development of their capacity to self-organise, negotiate boundaries and make connections. In addition, reflection and inquiry can help with the ongoing development of teachers' visions, knowledge bases, teaching skills and relationships, while also helping them to contemplate and respond to feedback. Without ongoing reflection and inquiry, there is a possibility that teachers' classroom practice will remain static (Lamb and Aldous 2016) and they may begin to lack the confidence or commitment to engage with the on-going development process (Borko et al. 2002). However, to develop their reflection and inquiry skills, teachers need support to assume the actor/critic role that will help them analyse their own and others practice honestly and recognise how

practice is informed by the different visions that drive teachers' actions (Osterman and Kottkamp 1993). Reflecting and inquiring represent an integrated, capacity building process focused on the cognitive, social, emotional and applied aspects of teachers' classroom practice, together with supporting their on-going negotiation of externally driven agendas. Therefore, as teachers' shift towards more adaptive practice, the role of reflection cannot be overemphasised as it can help feed into the inquiry process (Ertsas and Irgens 2017); it can focus on the knowledge, teaching skills and relationships required, alongside identifying more creative ideas that become part of their adaptive practice.

Thus far, we have presented the case that the neo-liberal view of education does not adequately capture the complex nature of teachers' classroom practice. We have argued that complex adaptive classroom practice requires teachers to move beyond a linear transmission approach to teaching and develop the ability to negotiate and influence the dynamic and ever-changing environment in which they work. However, and critically, we recognise that developing complex adaptive practice is not a product of the 'quick fix' professional development course, but instead is a long-term, recursive and non-linear process. Therefore, we now introduce Lesson Study as a long-term professional development approach that we believe has the potential to support the development of teachers' complex adaptive classroom practice.

Introducing Lesson Study

Lesson Study is a professional development approach that involves teachers collaborating over time to investigate classroom practice. It was initially introduced in Japan in the late nineteenth century as a teacher-led approach to professional development and spread to the U.S. and elsewhere from 1999 (Stigler and Hiebert

1999). While Lesson Study has to date not been extensively theorised (Xu and Pedder 2016), there are encouraging signs that participants can exhibit positive and significant changes in their teaching behaviour, professional beliefs, pedagogical skills and content knowledge (Willems and Van den Bossche 2019). However, it is from the perspective of teachers' complex adaptive classroom practice that we believe Lesson Study has considerable potential. Lesson Study is intended to be an on-going and long-term process (Dudley 2016) and, according to Jones (2020), is an approach that could be used to share 'fresh perspectives on familiar themes' (p. 1) and offer scope for 'local interpretations' (p. 3). As a long term collaborative venture, Lesson Study, therefore, offers teachers a 'safe space' in which they can explore the practical potential of their personal visions, identify different boundaries to be negotiated and make connections in a context that aligns the rhythms of school life with their professional lives.

The specifics of Lesson Study help clarify its potential role in the development of teachers' complex adaptive practice. The focal points of teacher collaboration during Lesson Study, often in groups of three, are to plan, conduct and evaluate a 'research lesson' (RL) that is taught to their own students (Stigler and Hiebert 1999). Lewis and Tsuchida (1998) highlight how RLs involve a number of key elements:

- A focus on specific, real life issues identified by the teachers;
- Detailed planning of the RL by all teachers involved in the project;
- Observation of RLs together with follow-up student interviews by the teachers involved in the project;
- A post-lesson colloquium involving lesson study group members, other colleagues, administrators, and/or invited individuals to reflect on data gathered and (re)plan further lessons.

Dudley (2016) explains that Lesson Study is best viewed as cyclic to capture the integrated, on-going and long-term nature of the process. He identifies five main stages of the Lesson Study cycle, which are summarised in Figure 2.

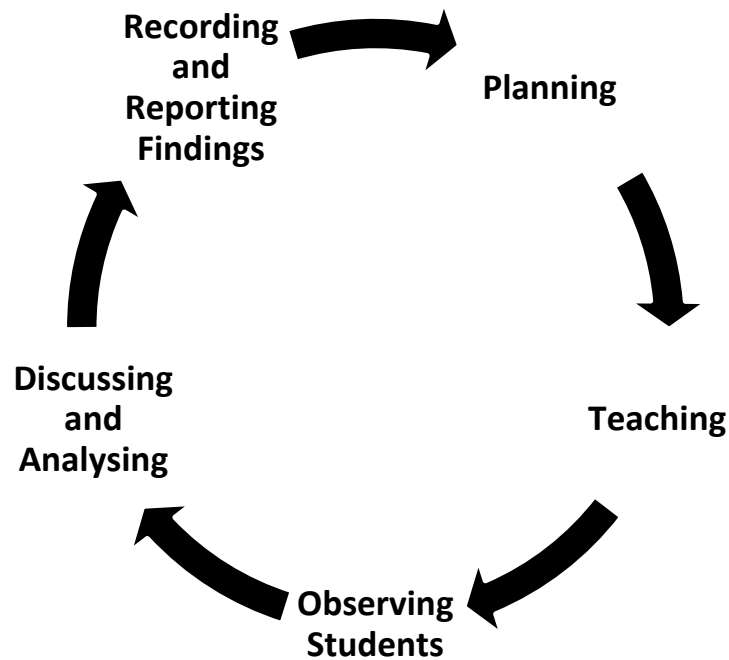


Figure 2: Lesson Study as a 'cycle' (adapted from Dudley, 2016)

While the process in Figure 2 is illustrated as cyclical, in reality, the general progress of participants within and between each stage is messy and non-linear. Hervas and Medina (2020), in their application of complexity thinking to Lesson Study, explain one part of the challenge is the unpredictable nature of classrooms. Given that a RL is unlikely to be enacted as predicted during the planning stage, they claim that, if resources were available, the Lesson Study cycle “would be infinite, since teachers could always return to observe the RL, reflect on it, reformulate it and teach it again” (Hervas and Medina 2020, p. 120). The other part of the messiness and nonlinearity is that, as they battle to comprehend classroom practice, teachers individually engage and experience the Lesson Study process in different ways. The factors contributing to this diversity

include, but are not limited to, an individual participant's understanding of teaching and learning (Hervas and Medina 2020), levels of teaching expertise and familiarity with Lesson Study (Bocala, 2015), and the support received at classroom, school and system levels (Dudley et al. 2019). Therefore, progress during Lesson Study can adopt different "lines and intensities of movement" (Ovens, Garbett and Hutchinson 2016, p. 357), where participants individually and collectively grapple to make sense of the process as they shift between various stages of the cycle.

There is latitude then, for integration within and between participants as they work collaboratively to accumulate insights into a chosen aspect of teaching to improve classroom practice (Dudley 2016). A series of cycles would enable a balance between on-going and long-term practitioner inquiry efforts in general and the day-to-day demands of school life. During the planning stage, a Lesson Study group meets to discuss the focus of the project and 'plan together having done some research' (Dudley 2016, p. 7). Alongside the collective experiences and knowledge of the teachers in the Lesson Study group, the expectation is that there will be further access to research articles, theoretical frameworks, curriculum policy guidelines and other materials. This important point counters concerns that the process can become trapped within the practice domain or constrained by the extant experience and knowledge of group members. This stage also involves 'plan[ning] each RL with three particular pupils in mind. These are 'case pupils'' (Dudley 2016, p. 7) who will be the focus for the later observations and pupil interviews that will help reveal insights about the chosen topic.

Turning to the teaching and observation stages, while the RL is being taught, 'one member will lead the teaching while the others act as observers' (Dudley 2016, p. 8). It

could be expected that, having planned the lesson together, different members will lead different parts of it. The emphasis, however, is not about the observation of each teacher, but rather how the collective lesson plan translates into practice. Thus, the focus is about how: ‘they [the observing members] instead compare what pupil learning they had predicted...with what they observed did happen’ (Dudley 2016, p. 10). In other words, the observers are observing the learners (not the teacher) to understand the teaching on display and this differs markedly from traditional observation and surveillance practices discussed earlier.

The discussing and analysing stage involves conducting the case pupil interviews about their experiences together with the later teacher discussions about the lesson observation notes and case pupil data. Dudley (2016, p. 11) asserts that efforts to discuss and analyse the lesson should maintain a ‘focus on the pupils’ learning and away from aspects of the teaching’. The post-lesson discussion, or colloquium, appears to furnish participants with the most ‘teacher learning’ (Dudley 2016, p. 12). In line with complex adaptive practice, reflection is recognised as a crucial part of this learning during the colloquia, where group members foster a deeper understanding of learning, a shared sense making of the findings, opportunities to reframe existing ideas and the prospect of challenging misconceptions (Dudley 2016).

Finally, the recording and reporting of findings is an important part of the process, which is viewed as ‘giving back’ to the teaching community. Disseminating findings breaks the isolated nature of the teaching profession, contributes to a collective effort to investigate the complexity of classroom practice and assists the learning of other teachers in the school community (Dudley 2016). Therefore, as an ongoing and

collaborative feature of their professional development, Lesson Study has the potential to engage teachers in a self-organising, recursive and non-linear process focussed on the development of their complex adaptive classroom practice.

Discussing the future integration of Lesson Study and complex adaptive practice

In the final section of this article, we focus on how we plan to integrate Lesson Study and complex adaptive practice within our research work in the immediate future. To do this, we share reflections on our ongoing involvement in two longitudinal Lesson Study projects that recognise the complex nature of teachers' classroom practice. While these two projects acknowledge that practice is complex, the leaders and participants have grappled to comprehend their experiences. The main issue is that neither project has managed to locate in the literature a framework or common language to work effectively with the complexity of classrooms. The complex adaptive account of practice presented earlier has built a lens from complexity thinking concepts, providing an original frame and terminology to embrace the self-organising, recursive and non-linearity of teachers' work. Accordingly, as we now discuss, we take the view that both these Lesson Study projects offer an attractive and appropriate context in which to introduce and develop these key features of complex adaptive classroom practice.

The first is the Lesson Study-Initial Teacher Education (LS-ITE) project, set within the context of the four-year MA (Honours) in Physical Education at the University of Edinburgh (Irvine and Jess 2018); this is an undergraduate programme that primarily prepares secondary school physical education teachers. In each year of this programme, the student teachers participate in a core course: Physical Education Curriculum and Pedagogy (PECP). While micro-teaching experiences, where students practice the

technical aspects of teaching with each other, have traditionally been included in each PECP course, we have been able to gradually introduce Lesson Study as a cohesive thread running through each of the four PECP courses. We have started to include key aspects of complex adaptive practice in each of these Lesson Study experiences.

Although this has taken a number of years to enact, PECP 1 and 2 currently investigate the flexible use of learning intentions and how these translate into practice across several cycles; PECP 3 delineates the enactment and interpretation of curriculum policy in practice across three cycles; while PECP 4 explores the personal visions of each student teacher and considers the teaching repertoires required to bring these visions to life through Lesson Study.

As the student teachers journey from years 1-4, Lesson Study, subsequently, recurs across ten interlinked cycles and sets the context for gradually building their adaptive capabilities. One feature of complex adaptive practice that appears constantly across these ten cycles is the identification and negotiation of boundaries. It is not that one feature is privileged over others, but rather that our ecological frame adopts such a broad conceptual span – individual, environment and task – that students require extended support to negotiate these different boundaries. While the interrelated nature of boundaries means we cannot completely isolate these in practice, we do aim to focus on different boundaries at different points of the PECP journey. For example, PECP 1 and 2 place emphasis on how the physical activities pursued, and the evolving relationships with students in classes, are central tenets that underpin the negotiation of learning intentions (task boundaries); one aspect of PECP 3 involves a critique of national education policy to demonstrate how teacher agency is required for curriculum to be enacted in line with the local demands of school contexts (environment

boundaries); and PECP 4 incorporates the individual characteristics of the student teachers, including personal visions, to plan the short-to-medium term professional development required to achieve their future teaching ambitions (individual boundaries). Therefore, although we recognise that the student teachers may be at an early stage in their career, the LS-ITE project introduces them to the complex adaptive nature of practice as a long-term professional development experience.

The second longitudinal Lesson Study project at Alba Academy (pseudonym) is a whole school project at a high school in the west of Scotland (Smedley et al. 2019). This project was instigated by the head teacher in 2016 and our direct involvement started in late 2018. In line with Scottish Government guidance on practitioner inquiry (Scottish Government 2017), the school leadership team introduced Lesson Study as a proposed teacher-led, collaborative and long-term professional development initiative focussed on the complexity of teachers' classroom practice. Conscious that most of the teachers in the school were used to a top-down, short course approach to professional development, the introduction of Lesson Study was a gradual process. In the early stages of the project, interested teachers signed up to participate in a pilot project, where they collaboratively selected different topics as the focus of their RLs. Over the next two years, individual subject departments became involved in the project and selected their own topics for the different Lesson Study cycles and, when completed, shared the findings across the school. Subsequently, Lesson Study has become a constant feature of the school's professional development programme and teachers are beginning to engage in inter-departmental projects that focus on generic topics related to the complexity of classroom practice.

There is potential in this next phase, as this form of inter-departmental Lesson Study begins, for the teachers to use the complex adaptive practice concepts to develop a collective understanding of the scenes that unfold across classrooms from different subject areas. For example, self-organisation and recursive elaboration will be key features to navigate planning meetings. For the majority of teachers, the sharing of subject knowledge bases and personal visions with other participants for the first time, could be a daunting experience. Working together in small groups, self-organisation around extant visions could support and recognise the different professional journeys and priorities of each group member. Recursive elaboration, supported by reflection and inquiry, provides opportunity to further explore the visions of group members. These features of complex adaptive practice could deepen understanding, facilitate a sense of affiliation, and shape a focus for inter-departmental Lesson Study that coalesces around group members. Alongside the priorities of group members, the making connections feature is important so the focus of inquiry is not ‘anything goes’, but rather acknowledges, engages and challenges the wider priorities for education across Alba Academy and beyond.

Consequently, we believe that the early phases of both the LS-ITE and Alba Academy Lesson Study projects have created appropriate contexts to now develop, investigate and track the complex adaptive practice of the student teachers and teachers. While we argue that our proposal for complex adaptive practice and Lesson Study is more principled than the status quo in neoliberal times, there are major implications of introducing these two approaches within the current climate. One major implication is the introduction of not one, but two, largely unfamiliar areas of research. Our project work, which could be viewed as the teachers in the school volunteering and the students

at university being introduced to a top-down initiative, has witnessed a range of responses: many engage wholeheartedly, some see little value or are afraid of it, and others are in-between these polarised starting points. Thus, our encounters with students and practicing teachers have been, for many, an emotional experience that must be managed sensitively to the requirements of the participants and the demanding cadence of local contexts. Another major implication is the danger, principally in countries where neoliberalism has a strong foothold, that Lesson Study is twisted to serve other ends. In other words, while Lesson Study is a long-term, participative and collaborative venture that locates teachers at the centre of their own professional development (Dudley 2016), there is scope for it to be re- or mis-interpreted in contexts as a route to surveil teachers and boost school effectiveness.

Over and above these challenges of teacher engagement and neoliberal policy directives, we suggest that one core feature of our complex adaptive practice framework could be fostered within Lesson Study to provide a sense of optimism for the future. Teacher vision has been identified as one specific way to combat the restrictive measures placed upon teachers and their learning (Vaughn and Faircloth 2013, Hara and Sherbine 2018). The integration of Lesson Study and complex adaptive practice appears to provide a site for these teacher vision calls to come to fruition, thereby providing teachers with some political tools to speak up for their professional work in neoliberal times.

Conclusion

In conclusion, this article began by conceding that the art of teaching has been lost amidst the rise of neoliberal thinking in education systems (Biesta 2017). This economically oriented mindset has increased competitiveness within and between

schools in national and international domains, contributing to strategies in schools aimed at risk management. The response, in a broad range of education systems, has focused on school improvement agendas, which have narrowed professional development to a short-term, off-site, 'quick-fix' format (Darling-Hammond et al. 2009) while reducing teachers' professional work to a simple and predictable process (Page 2017). While acknowledging the scale of the task, we presented complex adaptive classroom practice and Lesson Study as a dual response to the constraints that exist within contemporary education systems. Drawing upon systems thinking and complexity theory, several key concepts – self-organisation, negotiating boundaries, recursive elaboration, making connections, reflecting and inquiring – were presented as a frame for complex adaptive classroom practice. We provided examples from our experiences of working with the LS-ITE and Alba Academy projects to exemplify how this complexity-informed view of classroom practice could be advanced through the Lesson Study model of professional development. While there is a degree of hope, against the strength of the current political backcloth in many countries, there is clearly much research and teacher activism required to advance complex adaptive classroom practice in the future.

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