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Enabling collaborative lesson research

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Abstract

In this paper, we interrogate and justify the design of a local project that used collaborative design research in a secondary school in England. As authors, we represent teachers and teacher educators engaged in design research, whereby we acknowledge the difficulties implicit to university and school collaborations within a performative culture. Our analysis recognises the struggle for research-informed professional judgement in the decision-making and actions of educators that are situated in schools. A professional learning project is analysed to position teachers and teacher educators as practitioner researchers. In this respect, Stenhouse's work provides an analytical framework that is both a lens through which to interpret the nature of collaborations, as well as a methodology that allows us to understand the way in which we navigate the gap between educators' aspirations and the curriculum design and teaching within the project. The collaborative design research project was stimulated by an aspiration to make trigonometry accessible to low prior attaining pupils in a secondary mathematics classroom. This provides a stimulus for understanding the conditions that enable collaborative lesson inquiry and to question whether it can provoke raised aspirations for young people in inclusive classrooms. This allows us to understand the work of teachers as researchers and research users in an increasingly messy teacher education context. We interrogate the potentially problematic connection between

All projects discussed in the paper were conducted in Chester, UK.

research and practice within collaborative inquiry, as we understand how we enable research that is "held accountable for its relevance to practice" because "that relevance can only be validated by practitioners" (Stenhouse, 1988, p. 49).

KEYWORDS
collaboration, curriculum inquiry, research-informed, Stenhouse

INTRODUCTION

Within this paper, we will use Stenhouse's theory to help us to understand the way we position and use collaborative lesson inquiry in order to understand our professional knowledge and practice as teachers and teacher educators. As with the majority of educators operating in the current climate of performativity, post-performativity and marketisation, we are aware of the discontinuities experienced when fostering local, collaborative research projects in schools, not least because of the way in which meaning is imposed upon educators through normalised practices, mirroring narrow and standardised expectations of teacher behaviour, as well as increased surveillance within a perception of high-stakes accountability (Ball & Olmedo, 2013; Fuller & Stevenson, 2019). It is within this backdrop that we explore the relevance of Stenhouse's notion of realistic curriculum planning; planning that recognises the uncertainty of teachers' aspirations in the design of a lesson amid the situated variables of any classroom. Stenhouse claimed:

> Rational curriculum planning consists in the exercise of cautious judgement in making inevitably precarious decisions as one attempts to achieve some sort of co-ordinated curriculum in the presence of so many variables and uncertainties. (Stenhouse, 1970, p. 82).

Although all of the authors of this paper agree with the need for risk associated with "precarious decisions" in design research, we also recognise that a performative culture is restrictive: demanding that educators have a sense of certainty in what will work in any classroom because it relies on a normalised practice that is somehow believed to be evidence-informed (Biesta, 2007b, 2019; Daly et al., 2020).

Stenhouse (1988) recognised the influences from domains such as social psychology on his own contribution to education, acknowledging that "while they serve to stimulate educational imagination and to define the conditions of educational action, [they] do not serve to guide such action. They provide for education […] a context in which to plan intelligent action, but they do not tell us how to act" (p. 43). In the current context of English schools, much of what is intended as evidence-informed education policy relies on a narrow interpretation of research (Ellis et al., 2019). The practices that are normalised within this narrow framework report to close the education outcome gap between those who are most privileged and those who are not, but instead these policies result in a deterioration in teacher autonomy (Benn & Downs, 2016; Ellis, 2023; Ellis et al., 2019; Wilkins, 2015). Education policies founded on selection of particular aspects of research are unlikely to "stimulate educational imagination" nor guide intelligent action (Biesta, 2007a). These limitations strengthen the need for more authentic action research, stimulating the research analysed in this paper. In England, the tightly controlled reaccreditation of initial teacher education (ITE) programmes exemplifies government control in education that reports to raise standards in education,

but instead creates a highly prescriptive and constrained interpretation of what teacher educators should teach and what beginning teachers must know and do, contributing to what Ellis (2023) describes as teacher education in crisis. Even though such policies deform what it means to exercise professional judgement as a teacher, positioning policy interpretations as stimuli for teachers to explore what their aspirations for lesson design might be, could allow teachers to recognise what intelligent action is and what it is not in their own lesson inquiries. This means that projects, such as the one we will present here, need to consider the conditions in which teachers can exercise their professional judgement; conditions that might allow them to foreground their knowledge of their learners, their knowledge of how to adapt to the needs of their learners, their understanding of their existing situated curriculum and their capacity to challenge existing assumptions in their own actions and the actions of others at the site of learning (Darling-Hammond, 2017).

Opportunities for collaboration are increasingly undermined in models of teacher professional learning that are premised on performativity and governmentality (Perryman et al., 2018). The tension between the principles behind a Global Education Reform Movement (GERM) and the nature of authentic professional learning are well documented (Ellis et al., 2019; Fuller & Stevenson, 2019; Nelson & Campbell, 2017). This paper will address this tension by interrogating a model of professional learning that integrates collaborative lesson research in a university and school design research project (Bakker, 2018). As teachers and teacher educators engaged in design research, we acknowledge and often live the difficulties implicit to university and school collaborations within a performative culture (Perryman et al., 2018). We are aware, through our own experiences, of potential barriers and contradictions in attempts to foster authentic lesson research that provides a space to question our own assumptions about practice and our professional beliefs; a space for resistance against structural barriers that marginalise professional dialogue and autonomy (Ball & Olmedo, 2013). This awareness informs our aspirations for a better, more democratic classroom that is founded on the belief that all pupils can thrive and that this can be enabled by teachers (Stenhouse, 1970, 1975). We recognise the struggle for research-informed professional judgement (Biesta, 2007b, 2019) represented in the decision-making and actions of educators that are situated in schools. Educators frequently understand the paradox that performativity normalises notions of what-works research as the gold standard of evidence informed practice, despite consensus that it is the activity of the school and those that teachers work with that influence how they act and what they believe (Ellis et al., 2011; Nelson & Campbell, 2017).

Within this political and cultural context, the collaborative lesson research analysed in this paper positions teachers and teacher educators as practitioner researchers. In this respect, Stenhouse's work provides an analytical framework that is both a lens through which to interpret the nature of local collaborations (Stenhouse, 1985), as well as a methodology that allows us to understand the way in which we navigate the gap between each educator's aspiration and the curriculum design and teaching within the project (Stenhouse, 1975).

As authors, we represent secondary school teachers and curriculum leaders, experienced teacher educators and design researchers and those making a transition from classroom to university teacher. These roles illuminate the difficult position that university-based teacher education holds in England (Ellis et al., 2011) and the complex relationships between school and university education settings. Recognising that any research collaboration between a school and university is situated in the current political landscape that informs and constrains research, we will present an account of this landscape, before presenting and analysing a school and university research collaboration so that we can better understand the conditions under which such collaborations are possible.

POLITICAL LANDSCAPE

Over the last few decades, state education in England has become increasingly shaped by economic rather than egalitarian aims. Indeed, successive Conservative (1979–1987), New Labour (1997–2010), Conservative-Liberal Democrat Coalition (2010–2015) and Conservative (2015–present) governments have perpetuated and escalated the neoliberalisation of educational institutions, policy and practice (Hill et al., 2015). The infiltration of neoliberalism has ultimately refined the purpose of education in terms of competition and choice rather than community and commonality (Beckmann et al., 2009). This has resulted in schools becoming competitors rather than collaborators as they are placed into league tables and monitored, audited and judged on many aspects of their provision (Ball, 2016). While market-orientated reformers argue that applying market rationality to state education improves outcomes for all children and young people, education inequalities seem to persist (Benn & Downs, 2016; Hill et al., 2015; Wilkins, 2015). Ultimately, the quasi-privatisation and marketisation of state education in England is de-democratising educational provision and entrenching elitism and inequality (Beckmann et al., 2009; Hill et al., 2015), influencing all educators, not least teachers in school.

On a worldwide scale, the GERM is founded on an enticing argument that only increased marketisation can remedy failing public education across the world (Benn & Downs, 2016). This has resulted in an increase in 'policy borrowing' where policy is created in one country and then adopted by policy-makers in another (Ball, 2016). This has been notable between the UK and the USA where policy borrowing has been commonplace for many years and yet their respective educational systems remain largely unchanged in terms of equitable outcomes for young people (Ball, 2016; Benn & Downs, 2016). This is reflected in the growth of academies and free schools—based, in part, on US Charter Schools—increasing the number of state-funded schools that are no longer funded and controlled by local authorities. Concerns that the academisation programme could cement social segregation are mirrored in widening inequality as students may have less access to qualified teachers, raising questions about the value placed on the professional knowledge of teachers (Martindale, 2019; Wilkins, 2015). Policy borrowing is also seen in the recent interest in the Teacher Research Group (TRG) adopted by Maths Hubs in England that are influenced by teacher education practices in Shanghai (Boylan et al., 2018). Whilst these models share some characteristics of the research in this study, integrating a cyclical model of mathematics teacher development, there are important differences. Our study is a partnership between a school and a university, rather than state funded Maths Hub trained Mastery Specialists, using a structured approach to teaching known as Teaching for Mastery designed by the National Centre for Excellent in the Teaching of Mathematics (NCETM), who are in the role of expert teacher within the TRG. Boylan et al. (2018) query the ambiguous position of research within the TRG model, which questions the role of the teacher as an inquirer and the nature of the research that informs, structures and possibly restricts the inquiry to the reproduction of normalised practices within the state-imposed model.

In this neoliberal landscape, the role of the teacher has been transformed by performative mechanisms which employ modes of judgement and regulation to control normalised practices (Hill et al., 2015). Performative culture has led to a weakening of teachers' autonomy and agency and an attack on their professional identity and integrity (Wilkins, 2015). As such, teachers' work is increasingly shaped by accountability, monitoring and surveillance (Beckmann et al., 2009). Here, pupils are routinely audited to ensure they meet targets, with teachers scrutinised for their effectiveness in delivering an instrumentalist curriculum (Foreman-Peck & Heilbronn, 2018). Within this context, policy decisions can alter teacher's relationship with what constitutes research, such as selective findings from cognitive science informing policy, without the associated commitment to research that demonstrates

the benefits of applied cognitive science in different subjects and with different age groups (Perry et al., 2021). This has resulted in a greater focus on decontextualised restrictive pedagogies built on the premise that to learn is to know more and remember more (Foreman-Peck & Heilbronn, 2018; Turvey et al., 2019). Performativity creates school cultures that undermine teachers' critically reflective practice in favour of authoritarian principles where compliance with performative mechanisms becomes normalised (Wilkins, 2015). As such, it is important that we understand how teachers find spaces to reclaim agency and autonomy through professional growth.

Opportunities for collaboration between and with teachers have been increasingly eroded over the last two decades. A teacher's capacity to engage with research has been significantly reduced, altering what it means to develop professionally and limiting opportunities for teachers to critically interrogate their own practice (Ball, 2016). Centralised, reductive and restrictive government policy, performativity and accountability regimes undermine teachers' professional judgement and agency, many of whom become teachers in order to educate all young people regardless of background or attainment. Teachers are increasingly judged on their capacity to perform and meet performance targets, creating insecurity about what is right and important. Too often in education "we come to know and value others by their outputs rather than their individuality and humanity" (Ball, 2016, p. 1054). Conforming to leadership demands which have been influenced by the Office for Standards in Education, Children's Services and Skills (Ofsted; Perryman et al., 2018) have resulted in limited time and opportunity for engagement in research and professional collaborations, eroding teacher agency that would allow them to act intentionally in order to shape their own practice. Teachers remain incredibly busy, but the nature of that work calls into question their capacity to inquire, control and research their own practice.

THE CONDITIONS FOR COLLABORATIVE DESIGN RESEARCH

School and university collaborations have the potential to stimulate opportunities for educators to engage in research that could influence all participants' practice. Professional learning projects such as the one described in this paper situate teachers at the centre of the research leading to "professional satisfaction" (Stenhouse, 1988, p. 50) because educators are able to take control of a development focus in their own classrooms, whilst supporting teachers themselves to identify as research-informed practitioners (Darling-Hammond, 2017). However, the relationship between teacher research and the teachers' perceptions of themselves as researchers is not straightforward because research is not viewed as an integral part of the professional identity of the teacher and, as such, teachers may not feel fully equipped to conduct research themselves (Ellis et al., 2011). There is a danger that the teachers' role could be reduced to no more than technicians, providing access to school students that would enable academic researchers to implement their own studies (Winch, 2017). Stenhouse (1967) saw the role of the teacher as much more than that, understanding that the teacher and university researcher should be partners in collaborative inquiry that makes the link between teaching and curriculum explicit (Stenhouse, 1975). The school researcher, viewed as the internal researcher, provides the axis through which any classroom research can become possible; the validity of curriculum research outcomes can only be realised through the activity of the school researcher who elicits responses from learners, to be interrogated through systematic inquiry. Meanwhile, the university researcher, external to the site of learning brings insight into research informed lesson design that can be configured away from the culturally reproduced practices of the school. The discontinuities brought about by the insider school researcher and outsider university researcher views

have the potential to lead to expansive professional learning (Daly et al., 2020; Engeström & Sannino, 2010). Although the messy relationship between university education research and the authentic practice of schools has changed in the 50 years since Stenhouse proposed a model for teacher research (Ellis et al., 2019), it is possible that collaborative work could allow teachers to challenge assumptions and increase aspirations for what learners can achieve in a classroom that enables systematic and critical scrutiny.

Stenhouse and his contemporaries developed their theory of teacher research at a time when evidence- and research-based practices had a place in educational discourse (Elliott, 2001). Contesting what-works conceptions of evidence informed practice is not a new phenomenon. However, the difficulties associated with challenging the supposed certainty of what-works research in education becomes increasingly challenging within a performative context characterised by uniformity and the perception of surveillance, especially when those with greatest power promote a model of research that is far removed from teachers as inquirers of their own practice. Nelson and Campbell (2017) recognise the persuasive nature of teacher's experience at the site of learning:

> [E]vidence constitutes a range of types and sources of knowledge and information, including professional expertise and judgement, as well as data and research. Indeed, despite the considerable debate about 'gold standards' of research methodologies, the most frequently used sources of 'evidence' are often derived from professional experiences and colleagues rather than original research studies. (p. 128)

This highlights a dilemma for school and university collaborative lesson researchers because the outsider, university researcher is seen to represent knowledge that resides in original research studies and is also a collaborator rather than a legitimate partner sharing professional experiences that the school researcher is immersed in. This difficulty raises questions about how research is used within a collaborative lesson research project and how that research might provide a catalyst for authentic classroom inquiry.

The design research used in the project presented here invokes Biesta (2007a) criticism of what-works research because:

> [R]esearch cannot supply us with rules for action but only with hypotheses for intelligent problem solving. Research can only tell us what has worked in a particular situation, not what will work in any future situation. The role of the educational professional in this process is not to translate general rules into particular lines of action. It is rather to use research findings to make one's problem-solving more intelligent. (p. 20)

Alongside our desire to make our problem-solving better informed, we applied a model of design research influenced by Swan (2011) that focuses on a mathematics classroom that is transformational because "it challenges the status quo, through the design and implementation of novel experiences and materials […] it goes on to study how designs function and mutate in the hands of teachers with contrasting styles, beliefs and commitment." (p. 54) The knowledge and practice of the teacher is central to both of these perspectives on research in education.

Collaborative lesson research is enmeshed with the day-to-day practices of teachers and teacher educators (Swan, 2011), demanding the authenticity of alignment with the culture of the setting where the intervention takes place, whilst maintaining the rigour associated with systematically researching the stimulus for the study as well as the design, implementation and evaluation of the collaborative lesson research (Bakker, 2018). An iterative cycle allowed us to capture the inquiry through the interrogation of field notes,

artefacts such as teachers' design notes and pupils' work and transcripts of dialogue before, during and after the lessons, alongside pupils' assessments and recorded conversations in presentations at conferences or teacher seminars. The excerpts presented in this paper are derived from two stages of research implemented in 2019–2020 and 2023 that gained ethical consent from the University of Chester School of Education Ethics committee in June 2018 and April 2023. The systematic review of the collaborative lesson research relies on participants sensitivity to both the setting and the phenomenon studied. We valued the professional knowledge and judgement of all of those involved in the study (Biesta, 2019), and tried to be sensitive to our position within the study because we are the designers who had imagined a hypothetical lesson trajectory using both our knowledge of the culture and context of the school and research that informed the design (Bakker, 2018). This meant that we needed to be sensitised to the students' responses and aware of our own beliefs, decisions and actions before, during and after the study. Sensitivity to critical incidents that illuminate students' emotional and cognitive responses was enhanced by professional knowledge and experience—as teachers, teacher educators and researchers—whereby the research was "held accountable for its relevance to practice" because "that relevance can only be validated by practitioners" (Stenhouse, 1988, p. 49). This includes knowledge and experience of the systematic design research project that enhanced the researchers' responsiveness, criticality and reflexivity beyond the day-to-day expectations of teachers in school. Sensitivity to critical incidents that had a meaningful representation within the context of the study allowed us to act intentionally.

Stenhouse (1975) understood the iterative process required for intelligent inquiry, enabling critical scrutiny of the classroom within his process model for designing and developing the curriculum. The features of the design process used in this study are part of the iterative cycle of collaborative lesson research described elsewhere (author's paper, 2018), but with similarities to the process model attributed to Stenhouse (Rudduck, 1988). Some of the distinctive features of the cycle include the relationship between the school and university researcher, which is not premised on recruitment of participants to a proposed study, but is about seeking authentic solutions to a problem that has arisen in practice. We identified authenticity in our study because the stimulus for the study addresses an issue encountered by teachers and the school researcher, whilst claiming authenticity in the implementation of the inquiry because it was situated within the culture and context where the issue arose. The activity designed in response to the issue was in the hands of the person in the role of both teacher and school researcher. The model is designed to be expansive (Engeström & Sannino, 2010) so that the insider (school researcher) and outsider (university researcher) take risks and share accountability for students' responses to the designed lesson. The nature of the collaborative design research respects the professional judgement of both researchers, with the outsider university researcher using knowledge of how existing research might inform solutions to the problem and the insider school researcher bringing expertise in the culture and context of the school, the existing curriculum and its relationship to how they teach their class. The cyclical process uses the teacher's students' responses as the stimulus for questioning and inquiring, being centred on interrogation of students' responses to the designed lesson, using the researcher's intelligent interpretation to inform action.

In order to illuminate the significance of the school researcher's words, allowing us to understand the way in which research is modified through the iterative process of classroom inquiry, we have largely used verbatim quotations derived from field notes, project meetings and presentations where the school and university researchers have disseminated the project. However, the insights of the university researcher and other authors have been integrated into the narrative analysis that follows, allowing the words of the insider, school researcher to be amplified so that they illuminate the study (Brannick & Coghlan, 2007).

OVERVIEW OF THE CURRICULUM PROPOSAL

To Stenhouse, a curriculum was an attempt to communicate a proposal, a proposal for what teachers aspire to for the actions and knowledge of their learners through "the essential principles and features" (Stenhouse, 1975, p. 4) of what might be done, said and, ideally, learned. In essence, the curriculum should be proposed "in such a form that it is open to critical scrutiny and capable of effective translation into practice" (p. 4). For the two researchers designing the project translation of a hypothetical lesson design into practice was the guiding principal: what should they do in their lessons and how might their learners respond. However, to be in the position to ask those questions implies that the two researchers had already challenged some assumption about practice. In the case of this project, a school-university partnership was already in place because of ITE collaborations, as well as interventions and enrichment activities that had been shared for several years. The project that we focus on here disturbed the assumption that pupils with low prior attainment would find learning trigonometry too difficult; that the complexity of solving triangles using trigonometric ratios would fail to align with their existing understanding, would contain too many substages and would use symbols and notation that was alien to the pupils in the project class.

The school researcher acknowledged that "maybe that was not the best class to try the project with" because of the high number of students who had gaps in their knowledge due to disruption to formal education, specific learning difficulties that might limit working memory, students demonstrating the characteristics of maths anxiety or general anxiety and access to language being difficult for those students not learning through the language that they use most frequently. The school researcher's aspiration was to question assumptions about low prior attainment students' capacity to learn trigonometry because "for me, it might give the students the accessibility to concepts that traditionally I might have said, oh don't teach them that, they won't get it, let's see how they go with the easier stuff first and then think about trig" (School Researcher, field notes from second research cycle). Teacher's and researcher's concerns about the appropriateness of teaching concepts such as trigonometry to low prior attainment pupils as a watered-down version of what is aspired for their highest prior attaining peers are not new. Hodgen et al. (2022) argued that there is no justification in English education policy for "why students who struggle with basic concepts and skills to get a Grade 4 at GCSE are at the same time currently expected to learn trigonometry" (p. 23). In this way, trigonometry is often used to represent the tension between the statutory curriculum for all students in English maintained schools and the needs of students that face the difficulties and potential barriers already mentioned. Within this context, the school and university researcher recognised that changing national policy was beyond any attempts at critical scrutiny and so considered how access to a potentially complex concept might be realised by designing lessons that could be translated into practice because, as the school researcher acknowledged "we have to have a go because we cannot put ceilings on students' potential".

The experience of the individual student within an education system driven by performative measures is often overlooked. A pupil's response to the curriculum enacted by the teacher will depend upon and be influenced by, many factors, not least a student's socio-economic background, anxiety, specific difficulties, language and prior experience will have an impact on their educational experience and, ultimately, their academic outcomes (Smyth & Privalko, 2022). This project was centred on the experience of the student because the methodology privileges the students' responses to the lesson and requires the school and university researchers to interrogate the consequences of their decisions through the students' lens. Low prior attaining 14- to 16-year-olds who are approaching their GCSEs do not always gain insight into rich aspects of mathematics such as trigonometry in school

(Hodgen et al., 2022). The school and university researchers both believed that the project design should foster socially just outcomes for GCSE students because the pupils are not assumed to be found wanting when they are not able to make connections with predominantly symbolic, and frequently abstract ideas, typical of a transmission approach to teaching (Swan & Burkhardt, 2014).

Learning to solve triangles requires prior understanding of the structure of triangles and what the lengths and angles within the triangle represent. Low prior attaining students might not understand angle as an abstract idea and may rely on more intuitive angle contexts such as slopes, as well as a misconception that angles are always measured from a horizontal line, configured as a 'base' of a triangle or slope (Mitchelmore & White, 2000). The starting point for the project design was to work with the powers that the pupils bring to the classroom so that they might experience success quickly. The project was designed using realisable contexts and used concrete and visual representations of triangles, with the aim of providing pupils with a logical foundation on which to base the more abstract ideas associated with trigonometry. Constructing diagrams that produced images that were roughly to scale was not seen as a failing for 'weak' students but as a way for the students to realise what more traditional representations seen in school textbooks meant. The project design built on the logic of the experience of constructing triangles that are orientated to that they have a base length and height that students would recognise in their everyday uses of the terms base and height. Understanding the properties of orientation and space in geometry is part of mastering trigonometry. However, students who do not have deep prior knowledge of these aspects of geometric reasoning may hold on to horizontal and vertical orientations of shapes because they are part of the stable spatial environment that most students experience in the early stages of learning about geometry (Bryant, 2009). Stenhouse recognised that "the problems selected for inquiry are selected because of their importance as educational problems. That is, for their significance in the context of professional practice" (Stenhouse, 1983, p. 19). The agreed project design did not see the tendency to rely on the stability of horizontal and vertical orientations as a deficit in the students, but as a potential power that they bring to the lessons that could be used as a starting point for making sense of relationships between sides and angles of triangles.

The project required teachers to challenge their existing practice and perception of the curriculum for teaching trigonometry. There was a tacit agreement amongst teachers at the start of the project that trigonometry was demanding and possibly beyond the reach of the low prior attaining students. The disturbance that the inquiry created initially altered the teachers' expectations of the lowest attaining pupils, as the school researcher described "[the university researcher] had an idea and we just thought we never teach that to these children so I thought why don't we teach the trigonometry just as another idea about ratio". This disrupted the tacit agreement that teaching trigonometry through the transmission of discrete rules, followed by worked examples and practice of pre-determined exercises (Swan & Burkhardt, 2014) would be inaccessible to some students, so that imagining another way to teach trigonometry could be considered. When returning to the justification for designing the project, the school researcher acknowledged that the inquiry was appealing because it offered an alternative approach "rather than it being this dry worst-case scenario- these are the ratios- use them. But the students don't get it". As the teacher and the school researcher, this exposed the aspiration that all students should have access to the content of the trigonometry curriculum because "those that were in the highest attaining sets were going into it in more depth, but in the foundation sets it was a lot more formulaic. Just literally use [the procedural method] then work it out that way. The maths was correct but is there a better way" (School Researcher, Evaluation Phase Field Notes). Stenhouse taught that the site of learning, the teacher's classroom, is in the command of the teacher and not the researcher so that "[t]he research act much conform to the obligations of the professional

context […] the teacher cannot learn by inquiry without undertaking that the pupils learn too" (Stenhouse, 1983, p. 20). Thus, the focus of this inquiry was not how to create the conditions necessary for inclusive classroom, nor to embark on a detailed review of theoretical positions that relate to teaching trigonometry, but to understand what conditions are necessary to design lessons that enable low prior attaining pupils to learn to use trigonometry to solve triangles. Consequently, the starting point for the inquiry was the students' experience and knowledge, followed by the school researcher's understanding of the students, recognising the teacher's professional obligation.

WERE ASPIRATIONS REALISED

For professional learning to be expansive, practitioners need to acknowledge that the first time we do anything new in the classroom, generally, we are not entirely successful (Daly et al., 2020; Engeström & Sannino, 2010). Collaborative research lessons should be taught to a class where researchers can inquire within a safe space to challenge assumptions and to allow for the conditional nature of teaching. Classroom inquiry requires risk, values professional judgement and embraces the uncertainty of action research. Stenhouse argued that:

> Such a view of educational research declares that the theory or insights created in collaboration by professional researchers and professional teachers, is always provisional, always to be taught in the spirit of inquiry, and always to be tested and modified by professional practice (Stenhouse, 1983, p. 20)

For the school researcher, testing and modifying the lesson design was central because "you think that didn't work last time so I'm going to try that in a different way and that's a cyclical process that we are trying to go through with most of the things that we teach. It can take ages but it's a nice journey and its fed into other things we've done" (School Researcher, Teacher Conference Presentation). This project recognised the role that the two researchers brought to the study, one as a school researcher, taking an inquiry stance within the professional context of the school where they are immersed and the other as a university researcher concerned with collaborative design research and teachers' professional learning. However, both researchers' contributions to the study centred on a shared aspiration and an awareness of the provisional and situated nature on the collaborative inquiry. The researchers understood that a research lesson put in the hands of a teacher responding to a class of students on any particular day will be different to the one that existed in the imagination of the researchers as they set about designing a hypothetical lesson trajectory (Bakker, 2018). This ambiguity was expected, but the design started with a structured, research-informed collaboratively designed lesson.

The school researcher articulated their thoughts about the project demonstrating that they understood the uncertainty associated with the inquiry:

> For the initial group it took quite a few lessons and it took a chunk of teaching time out. Which you've got to take the risk and think, I've got to spend three weeks on this and they might get the question in the exam and its only worth two or three marks. But it was something that we wanted to try and we're very fortunate here that we've got leadership that allows us to take those risks to try to improve the outcomes for students. (School Researcher, Mathematics Subject Leaders Forum Presentation)

Within the acknowledgement of risk and uncertainty, the school researcher is aware that exam performance is a potential threat to classroom research, but also acknowledged the safety of having support from school leaders, suggesting that the uncertainty of the inquiry would be valued. This suggests that the performative culture that influences school context (Ball, 2003, 2016) and could restrict collaborative inquiry was not a barrier because of the trust of school leaders.

The iterative inquiry allowed both researchers to study students' responses to the designed lesson, using field notes and artefacts that represent students' knowledge and understanding. Critical incidents from the lessons were recorded so that the researchers could later account for their significance by interrogating the response in relation to the designed lesson (Swan, 2011). The school researcher articulated what was noticed:

> For that particular group, knowing the students, they really struggle with maths, attendance and behaviour was poor at times… for them doing something like that gave them an opportunity to build their resilience, where they were trying things out and working things out themselves. [One student] was getting things right every time and he had never had that success before. At that moment at that time, he could work it out, he was really excited to be getting things right because that didn't always happen.

And that:

> [Another student] was almost completely silent in lessons. He had a bad experience of maths and came to us at the beginning of year ten. He came up [to the whiteboard] and wanted to get involved and got stuck in. They couldn't get it wrong because they were [scale] drawing and measuring initially. It was a safe environment that we created. They were helping each other and they did work quite well together, which was not their normal behaviour. (School Researcher, Mathematics Subject Leaders Forum Presentation)

The pupils described would often exhibit behaviours similar to students who are at risk of underperforming in school, such as low attention to tasks, impulsive and unplanned approaches to problems or difficulties in problems that require multiple steps (Russo et al., 2023) as well as traits associated with mathematics anxiety (Carey et al., 2016). The school researcher was able to articulate how the students' behaviour improved in the inquiry lesson. Many of the students in the project class were known to all of the teachers within the mathematics department of the school. Positive responses from students had the potential to persuade other teachers that low prior attaining students could demonstrate some understanding of a concept that might otherwise have been deemed beyond their grasp.

The initial project was expanded and adapted for all mathematics teachers in the school. The school researcher was aware of how the ongoing process of inquiry was influencing professional practice:

> The initial group, it was about three weeks. With my [middle prior attaining class] it took say, three lessons and then lots of problem solving with it. It's that process of the teacher making themselves comfortable with it and working out how you want to do it for the students. It completely depends on the group of students in front of you, but the more we've done it the more we've refined it. It's that process of you making yourself comfortable with the content and how you want to teach it to your students. (School Researcher, Teacher Conference Presentation)

The use of the term comfortable suggests confidence in the teacher's own professional knowledge as well as an awareness of how the curriculum design aligns with their professional judgement about what 'the students in front of you' know and how they should be taught. Awareness of the need for all teachers to develop their own inquiry focus was also apparent:

> Just because we have collaboratively designed lessons, I don't want to take teacher's freedom away. I don't want them to feel that they have to do it exactly this way. It's evolved from where we originally started. We don't use all the [stages] that we initially did. I've left the teachers to choose what is appropriate. (School Researcher, Mathematics Subject Leaders Forum Presentation)

This approach acknowledges and respects the need for intelligent action (Stenhouse, 1988) for all teachers. The school researcher's commitment to ongoing inquiry after the project ended was apparent:

> We had a new colleague this year who is reasonably experienced who had never used [the designed approach] before and he absolutely loved it. [the teacher] came to work in this school because he knew that we worked with the university and was quite keen to see how we're doing it here. We co-planned a few lessons and then looked at the reactions from the students. (School Researcher, Mathematics Subject Leaders Forum Presentation)

When disseminating the research through conferences and teacher networks, educators frequently question how other teachers in the mathematics department engage in a culture of inquiry. Mathematics curriculum leaders want to know how teachers who are reluctant to participate in collaborative activity respond:

> I invite teachers to co-plan, trying [the project lessons] with me teaching it, saying come and watch me, come and [review] my lesson, team teaching and giving [teachers] support. It was fine, we all went through it together, there was no hiding. The rest of the team bought in, they want to do projects with the university, but one particular colleague [would revert to procedural tricks] and the students kind of knew that this was not how you were supposed to teach it, so that almost embedded the idea that you had to know why you were doing it. That was challenging but little by little- come and watch me and I'll watch you- tweaking their practice and not telling them that everything they were doing was wrong. (School Researcher, Mathematics Teacher Education Conference Presentation)

Teachers are naturally sceptical of blanket change and resist the top-down imposition of change that Stenhouse (1975) was critical of. The school researcher was aware of this, adopting a more democratic and collaborative approach to the changes associated with classroom inquiry (Darling-Hammond, 2017; Swan, 2011).

DISCUSSION AND CONCLUSION

Stenhouse contended that teaching is inquiry. Some operating in the current performative culture of schools might struggle to recognise teaching as inquiry when they experience diminishing professionalism in their roles and encounter a narrowing experience of what teacher agency could be. Meanwhile those operating in a post-performative culture (Perryman et al., 2018) might not recognise limitations at all, embracing the normalised,

managerial practices of their school in a manner that aligns with their beliefs. Perhaps Stenhouse's notion of teaching as inquiry assumes that an inquiring stance is both possible and desirable. This study has not presented a model for how collaborative inquiry should be, because the structural barriers to the sort of collaboration described here resist widespread application of meaningful school and university research partnerships. However, despite these limitations, this study has interrogated the conditions under which local collaborative lesson research could represent a more democratic and relational model of professional learning, whereby the knowledge and role of the teacher as a researcher of their own practice is dominant.

Stenhouse (1988) claimed that research provides teachers with a way in "which to plan intelligent action" (p. 43), but not be told how to act. This raises questions about how the partnership between a school researcher and a university researcher works. If the role of the school researcher dominates collaborative lesson research, this could become problematic when considering the need to question and disturb existing assumptions in order to stimulate inquiry. University and school research collaborations have the potential to disrupt practice in a manner that can catalyse questioning, as well as potential solutions to a problem. Studies into professional learning experiences that transform outcomes for students frequently identify the need for external expertise to enable assumptions about practice to be challenged (Elliot, 2015). However, any inquiry in a classroom can only be validated by the teacher (Stenhouse, 1985), raising questions about what the nature of the external expertise should be. For the school researcher's practice to be privileged in the inquiry, classroom research needs to be tested and modified by both researchers at the site of learning. The school researcher acknowledged that they felt fortunate that school leaders supported the collaboration, suggesting that the mathematics teachers recognised that this would not be possible for some of the other mathematics departments that they were familiar with (Perryman et al., 2018). Curriculum development collaborations are unlikely to influence practice in a meaningful way without alignment with the school improvement strategies of senior leaders, implying that success depends on the culture of inquiry within the school and constraints on or imposed by school leaders.

Understanding how the school researcher had the trust of school leaders would rely on data beyond this study, especially examining how the relationship between other curriculum leaders and school leaders influences change. However, we know that collaborative lesson inquiry, such as the one discussed here, is entangled with the activity imposed on teachers irrespective of how the teachers' professional knowledge and experience informs their judgement about how young people learn within their discipline. In the study school "the rest of the team bought in", suggesting that the trust that the school researcher recognised from leadership is apparent throughout the mathematics department. Stenhouses's notion of "cautious judgement in making inevitably precarious decisions" (Stenhouse, 1970, p. 82) applies to all aspects of this study, the design, the implementation and the interrogation of what has been done differently and why teaching has changed. The school researcher recognised the precarious nature of decisions that lead to change; "that didn't work last time so I'm going to try that in a different way" because inquiry is "a cyclical process that we are trying to go through with most of the things that we teach". This suggests a professional responsibility for the students' responses to lessons that challenges the teacher to change; an alternative to a perspective that finds the students wanting because they fail to learn the first time. Probably most significantly, the school researcher knew that "it can take ages" to embed the changes to the culture and practices of a team of teachers. The school researcher understood that the specialists in the mathematics department had good knowledge of their curriculum and their pupils and that leaders were "confident that we know what we're doing" and that "our head teacher wants staff to have CPD that is subject based. It's not that an idea just sprang to mind, it's all research based, it comes through the research.

It's properly done and I think that gives it more credibility- they're understanding of what I'm trying to do" (School Researcher, mathematics subject leaders forum presentation). These conditions seem to have enabled the collaborative research; the changes were credible, coming through research, because judgement was cautious and responsive.

Aside from external stimulation that might disrupt the existing practices in a school, the role of the university researcher provided access to research sources and international practices that the busy teacher has limited access to in terms of desirable, accessible and useful sources (Nelson & Campbell, 2017). Stenhouse's criticism of education research that positions teachers as technicians in the university researcher's study is justified because the teacher should be empowered to make decisions that are more intelligent (Biesta, 2007a) in that research is used to inform their professional judgement and their action. This does not mean that we shun large scale research projects, but implies that the outcomes of experiments and trials are only of any value if they can be used in the intelligent action of teachers in classrooms characterised by many variables and situated features. Rudduck aligned Stenhouse's concern for teachers with that of student's:

> Stenhouse's concern to liberate students from the disempowering dependence on authority figures in school runs parallel to his interest in liberating teachers from dependence on "academic" researchers and from a view of themselves as mere practitioners. (Rudduck, 1988, p. 31)

The nature of "academic" research that is imposed on schools by policy makers and leaders' interpretations of policy has changed in the period since Stenhouse was writing. Current interest in selective readings from cognitive science (Perry et al., 2021) and presentation of randomised controlled trials as the key source of evidence to inform school's development (Nelson & Campbell, 2017) dominates current policy in a way that did not exist in the 1970s. Stenhouse's approach was seen by some as a response to his perception of weaknesses in the objectives model of curriculum that was gaining popularity in the 1970s (Rudduck, 1988; Stenhouse, 1970). If teacher research responds to an imposed version of the curriculum or imposed practices in the name of cognitive science, it is a way of resisting impositions that reduce the significance of the teacher's role in changing their own classrooms. Such impositions reduce the significance of the teacher's professional judgement (Ball & Olmedo, 2013) and constrain teachers' capacity to research their own design and implementation of curriculum through teacher inquiry, either individually or collaboratively. This study offers an alternative view because teachers' capacity to inquire and the specialist content knowledge that informs curriculum inquiry is not ignored. Collaborations that allow teachers to seek research to inform their decision-making and actions can support more equitable outcomes for young people (Burkhardt, 2014; Christianakis, 2010), which is the same outcome that the GERM movement and followers of narrow interpretations of evidence-based practice claim to support (Ellis et al., 2019). The school researcher understood how the collaborative lesson research sat within a wider culture of collaboration through mathematics leadership networks, using evidence from several sources to improve outcomes for students because "I think it's tried and tested and the GCSE results are improving". This demonstrates that although, as Nelson and Campbell (2017) claim, "the most frequently used sources of 'evidence' are often derived from professional experiences and colleagues rather than original research studies" (p. 128) those professional experiences include collaborative research that enables problem-solving to be more intelligent (Biesta, 2007a).

The school researcher's words in this study illuminate awareness of the conditions necessary for meaningful inquiry in school. Inquiry into how the students learn mathematics is central, resisting watered down general approaches that ignore domain differences in the school curriculum (Darling-Hammond, 2017). These insights are independent of the research sources that are used to explain the project in this paper; the "academic"

sources. However, this collaborative study enables these conditions to be captured so that they can become recognisable outside of the activity of the project in one school. The university researcher was not in school to translate research into practice for the school researcher, as though such a partnership might fix teachers whose professional judgement is somehow starved of criticality. Research exists in the collaboration as a way of working systematically to understand the relationship between the curriculum, the teachers and the students. The role of the university researcher is to enable alternative solutions to the problems identified by the teacher, so that the inquiry focus is challenging—embracing contradictions in the concerns of both researchers—but centred on the work of teachers as researchers in school. As the school researcher described, "what we do with the university is empowering for the students and empowering for the staff, for their development".

Confidence in the validity of teachers', leaders' and school researchers' intelligent professional judgement enabled the collaborative research in this study. This confidence is influenced by the security that stems from school leaders' support for collaborative research with a university researcher. The professional relationship between researchers enabled the contribution that both researchers made to the inquiry to be equally valued, predominantly because they shared aspirations for more equitable outcomes for all young people, alongside beliefs that value a democratic model of professional learning. This blurred the boundaries between the insider and outsider view of research in a manner that is provisional during the cycles of inquiry, yet demonstrated the scope for sustained change on a local scale. The relationship between the researchers in this study originated in a typical ITE partnership between a school and a university. This study has offered an insight into a way of fostering an authentic research relationship that can empower and enhance the professional learning of everyone involved because it privileges the activity of teachers and their students in the classroom.

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CONFLICT OF INTEREST STATEMENT

There are no conflicts of interest associated with the publication of this paper.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

The research conforms to BERA's Ethical Guidelines for Educational Research (4th Edition). Ethical approval was sought and granted from the University of Chester School of Education Ethics Committee on 14/06/2018 and 23/04/2023 for the Design Research Project analysed in this paper.

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