Teachers in transition: The challenges of facilitating student-led PBL. A study of teachers of year 9 students adopting a hybrid of PBL and teacher-led mathematics pedagogies in England

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In secondary school mathematics classrooms in the UK, students are typically taught mathematics through teacher-led pedagogies that focus on students passing Mathematics GCSE. The school where this study was conducted is transitioning to teach with a hybrid of project based learning (PBL) and teacher-led pedagogies, with the year nine mathematics students. There is limited research that looks at utilising a hybrid such as this or the challenges teachers face in this transition. The study adopted a qualitative approach and found that the biggest challenge to teachers was facilitating student-led learning. The study explores why teachers found this demanding, highlights the particular challenges they encountered and reports on the strategies they developed.

Key Words: Project Based Learning; PBL; student-led learning

Introduction

There is a huge pressure on teachers in the UK to ensure that students get a good grade in their Mathematics GCSE, the assessment taken by nearly all students at age 16. This demand for grades often leaves teachers feeling a lack of control, de-professionalised and uncreative (Perryman, Ball, Maguire, & Braun, 2011) and often focusing on disparate skills that do not equip students with skills for life (Ofsted, 2012).

The mathematics department I teach in, and where this study was conducted, typically performs in the top 20% of schools nationally for student progress. One of the benefits that Perryman et al. (2011) identify for being a high performing department is an 'earned autonomy'. Because of this earned autonomy the mathematics department were able to move towards a hybrid curriculum in year 9: the students are taught through a mix of project based learning (PBL) and more teacher-led pedagogies. Teachers in department meetings voiced a desire to teach students in a way that developed skills that equipped them for life, as much as ensuring that they succeeded in their exams. This was felt to be imperative in the school context as although measurable educational outcomes have risen, local youth unemployment is one of the highest in the country at 24.6% (East End Community Foundation, 2017). One of the department's reasons for teaching through a hybrid model rather than purely PBL is the belief that "there is no single teaching strategy that guarantees the improvement of educational outcomes. Instead, it is the combination of techniques and practices that seems to be the best approach for instructional quality" (OECD, 2016, p. 17).

Teacher-led pedagogies

In this study, teacher-led pedagogies are defined as classroom activity where the teacher is central to what happens in the classroom. Hodgen, Foster, Marks, and Brown (2018, p.48) found that "structured teacher-led approaches can raise mathematics attainment by a sizeable amount". The teacher-led pedagogies utilised by the mathematics department in this study include strategies that can be viewed as having a 'collaborative orientation', such as small group work and whole class discussions.

Project based learning (PBL)

This study uses the term 'project based learning' (PBL) to encompass a number of pedagogical approaches that put students at the centre of their learning, including problem based learning and inquiry based learning. The definition adopted is based on Thomas' (2000) seminal work. Thomas defines a number of key characteristics: centrality to the curriculum, authenticity, student-led, construction of knowledge through the project. More recent research has suggested that both formative assessment (Condliffe, 2016) and scaffolding (Lazonder & Harmsen, 2016) are critical elements of PBL hence they are included in our definition; assessment should be embedded within each project and the projects should be structured so that they scaffold the students' learning.

Recent literature suggests that when learning through PBL, students perform as well or better on standardised tests as in a more traditional classroom, but have a greater conceptual understanding of material. Studies of discrete PBL projects in the mathematics classroom have found that teaching through a PBL approach can help students think more positively about mathematics, increase mathematical literacy, help students integrate and apply their knowledge, develop intrinsic motivation, increase problem solving skills and promote the long term retention of knowledge and skills. PBL has been found to develop '21st century skills' such as reasoning, problem solving and communication (Condliffe, 2016; Thomas, 2000), which are all key aims of the national curriculum for mathematics.

Kirschner et al. (2006), however, highlight a series of concerns with PBL. Notably, they think that the burden on working memory and cognitive load is too high. They suggest teaching strategies that reduce this burden on working memory, such as worked examples and process worksheets. Hembree's (1992) study considered the effects of different instructional methods on students' performance when problem solving. He found that 'explicit training' in heuristics and sub skills such as drawing diagrams was essential for developing students' problem solving skills.

Researchers have also identified many challenges for teachers when teaching with PBL. To be able to teach with PBL successfully, teachers need extensive professional development, time to plan, to adjust how they teach and to believe that teaching is about more than helping students get good exam results.

The study and methodological framework

RQ1: What are the main challenges for teachers in transitioning to teach through a hybrid of PBL and more teacher-led pedagogies?
RQ2: What have teachers found particularly supportive in attempting to adopt this model?

The data I collected can be viewed as being co-constructed by me with the participants in the study through my interactions with the participants in the field. I made simultaneous use of: theoretical sampling, categorising and coding, constant comparative analysis, memo writing and theory generation (Charmaz, 2014). The data was gathered from six teacher participants at my school using: reflective diaries, semi structured interviews, a focus group and an observation of a team meeting. Where I had to choose between potential participants, I used purposive sampling: I selected participants whom I thought would generate deep and rich data. Grounded analysis resulted in the key findings reported below.

The study is insider research: I was head of mathematics at the time this research was conducted. The findings that I have made from this study are limited to the context of the school in which the study took place.

Key findings - challenges for teachers

Data suggests the teachers in this study struggled most with allowing the learning to be student-led. I did not expect this to be the most challenging aspect, however this is consistent with other research which claims that changing practice from being someone who provides knowledge to someone who facilitates learning is a significant challenge for teachers (e.g. Savery, 2006).

> The challenge I found was… to try to balance… letting the students do the work themselves, giving them free rein. But you also need to keep them on task. So that was the most challenging because… sometimes students would coast and sometimes they might find something difficult, so you need to try to balance… how much [of a] hint do I give them on something, before it becomes teacher-led again which… goes against the whole thing, the point of the PBL (Shazidul, focus group)

This comment illustrates how challenging Shazidul found it to support students during the projects whilst not losing the student-led element. My study found that despite most teachers claiming espousal of allowing the learning to be student-led, they did not always let this happen. This could be attributed to the huge pressure that teachers feel to get students good exam results (Perryman et al., 2011) and therefore ensuring that students make good progress is more important due to external pressures on their *hierarchy* of beliefs.

Analysis identified three specific aspects which appeared to contribute to teachers' difficulties in facilitating student-led learning: anxiety about giving up control, having less professional experience, and working with lower attaining pupils, although these suggestions derive from only a small sample. In this study, teachers with less classroom experience, as well as those with limited experience of facilitating student-led learning, found it more challenging to teach with this pedagogy.

> I think there is a sense of letting go a bit with a project and if you haven't experienced that you're worried about, "Well I let go and they might do this, or they might not do that." You're thinking about all the negatives as opposed to the positives. (Thamid, interview 1)

All of the participants made similar comments about being anxious about giving control to the students.

Teachers who had more overall classroom experience, more experience of facilitating student-led learning, or who had taught the same project previously were

in general more likely to feel confident and therefore able to allow the learning to be student-led.

Some participants seemed to find it more complex to allow low attaining students to lead their own learning; they felt that the students lacked the required learning skills.

> The other thing is if you have a low attainer then, I find that you have to scaffold a lot… Giving them autonomy is actually much more overwhelming for them because they have a problem and… [they don't] know where to start. So, you start giving them a scaffold and then it becomes like how much is it me, how much is it of my solution, how much is it of their solution? (Tash, focus group)

In this study there are instances with lower attaining students where it appears the teacher provided so much support and scaffold that the students were essentially solving contextualised problems and were not leading their own learning. This is in contrast to some of the literature on PBL which suggests that PBL can be useful for lower attaining students (Speckels, 2012). Understanding how lower attaining students can lead their own learning requires further exploration.

Key findings – supporting elements

A further three elements were identified as supporting student-led learning in the classroom: planning, intervention and students working collaboratively.

Planning that included consideration of pitch and accessibility as well as how to create student interest in a project, often through the use of an authentic context, resulted in perceptions of increased student ownership of their learning. The participants found it particularly challenging to pitch the projects appropriately and often looked to colleagues who had previously taught a project to help support them. This challenge, of pitching projects effectively, could be explained by the complexities of teaching through problem solving. As highlighted by Verschaffel et al. (1999), as well as needing to consider whether the content was appropriately pitched, the teachers would also have to consider whether the students have the required problem solving skills (such as strategies and heuristics), beliefs about mathematics and the metacognitive and self-regulatory skills. The participants also highlighted how a project's accessibility often relied on students being able to identify and recall the prior knowledge needed.

All of the participants in the study spoke about the importance to them of planning together and getting advice from more experienced colleagues.

> I also found it helpful, because you're trying not to intervene as much as possible, to ask for help [from] people that have a bit more experience and have taught it before, to see, okay what happened in this -- when you came across this, how did you deal with it? Whereas with the normal lesson…, with the slides and everything it's already there. It's trying to address the misconceptions in the slides. But with this one you need to maybe ask someone who has taught it before to see (Shazidul, focus group).

The participants in the study met weekly, alternately discussing the projects as a department and planning new projects in pairs. The participants all spoke positively about working collaboratively in this way.

In this study, the teachers highlighted how they believed it was imperative to intervene to support and guide the students. The participants intervened when students needed to engage with the project, to focus more closely on the mathematics or when they needed support with the mathematics itself. This is consistent with the wider

literature on PBL which stresses that scaffolding students' learning is intrinsic to PBL (Hmelo-Silver, Duncan, & Chinn, 2007). The teachers in this study used a range of different strategies to intervene, including: whole class modelling, questioning of individuals or small groups, using tables and written scaffolds and exemplars. All of these were seen by the participants as aiding the students' learning, however some of the teachers stressed it was important to ensure that the interventions still allowed the learning to be student-led,

> Most of what we should be saying to them is, "What do you think?" You know, "What's your plan? What would you do if?" Those sorts of questions. So, it's all about them, not I suggest you do this (Thamid, interview 2).

This study did not explore how teachers judged the degree of support they should provide, or how teachers chose which type of support to provide. Further exploration of this area would be useful.

The study found that students working collaboratively aided student-led learning as this allowed students to support each other and develop and challenge each other's ideas. The teacher could take a less authoritative role and intervene less as,

> You can use the power of some children to get others involved… It also stops them relying on you (Thamid, interview 1).

The participants in this study, who were transitioning to use PBL, found that it helped to have small groups carefully chosen by the teacher of two or three students. They found also that seating groups separately also helped to support student engagement in the task.

Conclusion

This study adds to the existing research on student-led learning. The study reported that teachers found it particularly difficult to facilitate student-led learning if they were inexperienced, became anxious about the work rate of the students, or were teaching lower attaining pupils.

The study also reports on a number of strategies that the participants used to help support the learning being student-led. Firstly, they planned carefully and often collaboratively to create an appropriately pitched project that was easy to access, interesting and engaging. Secondly, they set up small groups of two or three carefully selected students who would provide mutual support and challenge within the project. Lastly, they carefully monitored the students' progress and regularly intervened to ensure that students were accessing the project and engaging mathematically at a correct level of challenge. The teachers intervened through small group and individual questioning by using exemplars, tables and scaffolds, as well as conducting whole class discussions. The nature and timing of effective interventions is ripe for further study.

This study would be complemented by further exploration of the elements raised in this study through a student lens. There is limited student voice on both PBL and student-led learning and there is a need to better understand the differences that these pedagogies make to student skills, knowledge and affect.

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