EDUCATION & TRAINING FOUNDATION

OUTSTANDING TEACHING, LEARNING AND ASSESSMENT

TECHNICAL SKILLS NATIONAL PROGRAMME

Case study by**: Derby College**

Created by**: Melanie Lanser: Project Lead**

Date**: January 2019**

Managed by:

ASSOCIATION OF COLLEGES

EDUCATION & TRAINING FOUNDATION

CONTENTS

PROBLEM-BASED LEARNING: FURTHER EXPLORATION OF THIS PEDAGOGICAL APPROACH IN CURRICULUM DESIGN AND DELIVERY

DERBY college

New College Stamford
All round excellence

GATESHEAD COLLEGE
EDUCATION WITH EMPLOYMENT EDGE

Lakes College
West Cumbria

EDUCATION & TRAINING FOUNDATION

PROBLEM-BASED LEARNING: FURTHER EXPLORATION OF THIS PEDAGOGICAL APPROACH IN CURRICULUM DESIGN AND DELIVERY

PROJECT OVERVIEW

Following a successful OTLA project (Beyond Competency: A Paradigm Shift in Educating Engineers or the Future[1]), our project aimed to extend our practical research on the merits of problem-based learning as a pedagogical approach to creating a future workforce with higher-level skills, knowledge and behaviours.

Problem-based learning has a resolute focus on real world learning and aims to develop students holistically, which prepares students for future job roles and lifelong learning. Designing a curriculum and using teaching and learning approaches focused on scenarios aligned to industry workplaces develops a range of behaviours, attitudes and transferable and practical skills. These skills are identified as the skills that will be in demand for employment in the future, such as interpersonal, problem-solving, systems analytics, leadership and management skills and creative and critical thinking (Nesta 2018). Following our initial trials in Engineering and Construction, we concluded there were sufficient "green shoots" to extend our action research. The aim in this project was to deepen the understanding of the approach to learning beyond qualification and to develop a critical evidence-base for the benefits and limitations of this pedagogical approach in developing technical skills, knowledge and behaviours. We also wanted to trial it with lower level students studying Functional Skills Mathematics to assess its potential as a pedagogy for academic learning, specifically learning Maths.

The approach aligns firmly with the Post-16 Skills Plan (2016) and the absolute need for high quality technical education. It is potentially, a pedagogical approach for preparing T Level students to be "threshold ready"; it can be used a framework for valuable learning in work placements; it involves employers in co-design and delivery of the

> *"This new concept will allow us to redevelop our curriculum to support the progress of our students. Having the opportunity to collaborate with various learning providers and employers enabled us to share ideas and work together to formulate problems for our students"*
>
> **A TEACHER INVOLVED IN THE FIRST PROJECT**

1 https://www.aoc.co.uk/sites/default/files/Derby%20Case%20OTLA%20project%20case%20study%20-%20December%202017.pdf

technical curriculum, and it has a firm focus on the “quality of education”

(Ofsted, 2018). Problem-based learning has the potential to provide a clear line of sight to employment and higher-level learning.

In this project, we set out to design and roll out a technical curriculum design with problem-based learning (PBL) at its heart (BTEC Extended Diploma in Construction and the Built Environment), to trial PBL in different technical routes (Business and Computing), and to investigate whether it could be transferred to academic learning (Functional Skills Maths).

Hypotheses

We aimed to test three hypotheses in this project:

1. Problem-based learning needs to be adapted in different technical routes to develop excellent technical professionals
2. There is a process that can lead to effective problem-based learning curriculum design
3. Problem-based learning is an effective pedagogical approach to learning Maths

Partners

At Derby College, we trialled PBL with 197 Functional Skills Maths students and 36 Level 3 Construction and the Built Environment students. We also created a whole Year 1 curriculum and assessment strategy using PBL as the pedagogical approach.

We worked with three core partners during this project who helped to deliver and review the PBL episodes and outcomes and peer review our curriculum design. They were:

Gateshead College who trialled PBL in Business and Computing with 60 Year 1 Level 3 students involving one employer who created a design brief so that Business and Computing students could work together

New College Stamford who were part of our original project, and in this project they peer-reviewed our curriculum design for the BTEC Level 3 Construction and the Built Environment

The Lakes College who compared our PBL approach with their own trials of Experiential Learning in Maths to determine similarities and differences in impact on students, learning, teaching and employer involvement.

Aim

In growing the evidence-base for PBL as a pedagogical approach to developing excellent technical professionals, we aimed to trial it outside of Engineering. We wanted to trial PBL in FS Maths to equip students with transferable skills and mind-set for T Level learning and in a different Level 3 technical route. We were also keen to deepen the approach in Construction, devising a curriculum for putting PBL at its heart. We aimed to engage a greater range of employers to broaden its use and uptake and strengthen our tentative conclusions from our previous project, increasing rigor and evidence across technical and academic pathways.

WHAT WE DID (METHODS)

We facilitated tailored professional development workshops with teachers to explore the features of problem-based learning, the educational values underpinning the approach and the skills-set required for effective development and facilitation of problem-based learning. The workshops encouraged teachers to consider how the professional standards could be used as a tool to think about practitioners' skills development to facilitate this new way of learning. The workshops were highly collaborative and stimulated teachers' thinking on potential effects of conducting problem-based learning with students in their specialist subject. The workshop enabled teachers to develop induction and extended problem-based learning scenarios, and employers attended part of the workshop to assist teachers to co-construct these.

Several mini-PBL scenarios were created in Maths, Business and Construction and the Built Environment, to be rolled out during induction, in order to build students' confidence, collaborative skills and problem-solving skills. Additionally, the Maths teachers created some extended PBL scenarios with a range of local employers intended for use in October/November. The Business and Computing teachers

worked with a local employer to design a PBL brief that required cross-curriculum collaboration between teachers and students and the Construction and Built Environment teachers worked with a local architect to create an extended PBL brief and mapped this to the BTEC qualification (see Output 4).

Our Construction and Built Environment teachers also worked with a consultant who specialises in PBL learning in higher education settings to design a curriculum plan and assessment plan using PBL scenarios

L3 Construction and Built Environment students presenting their solution

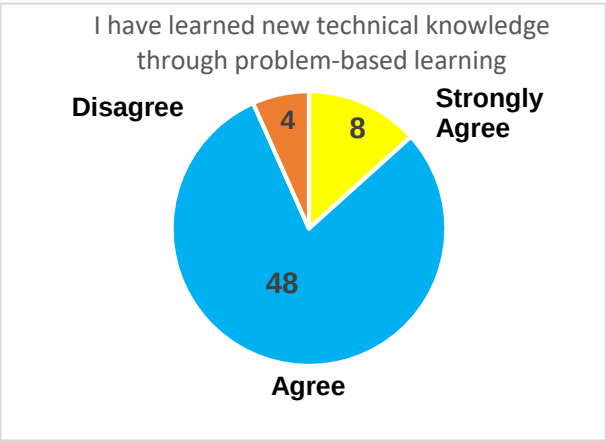
The Maths Induction PBL scenarios were delivered during Induction by 15 teachers to 197 students on Functional Skills Maths. The extended Maths PBL scenarios were delivered to significantly less students (33). In Business and Computing, 60 Y1 BTEC students undertook the extended PBL task facilitated by two Business Studies and one Computing teacher. In Construction and the Built Environment, four teachers facilitated the mini and extended PBL tasks with 21 full-time Year 1 Level 3 study programme students and 14 apprentices. In all trials, student feedback and practitioner reflections were collected (see Output 11 in relation to reflections on the Computing and Business trial). We asked students to complete a questionnaire and we also ran focus groups to further probe student reflection.

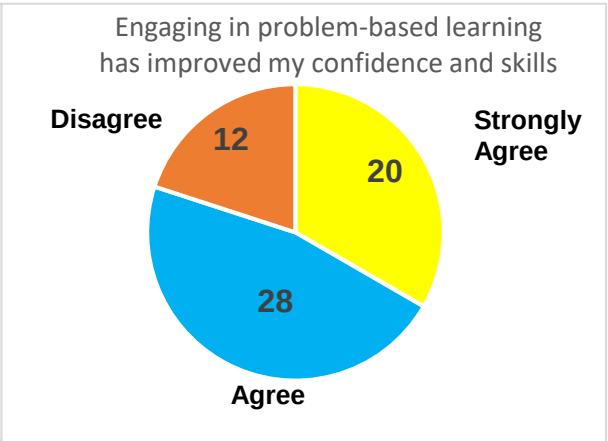
WHAT WE FOUND

Feedback from both students and teachers differed considerably depending on whether they were teaching technical routes or Maths.

Student Feedback: Technical students

Most students were positive about the learning approach. We asked them if they had developed their confidence and skills, and if PBL had





enabled them to improve their technical knowledge. Amalgamating student feedback across Business, Computing and Construction and the Built Environment, the results were:

Students reported that they enjoyed the themed and industry-relevant approach and were able to connect it to "being in the workplace". Most enjoyed the freedom and trust and recognised that they had developed transferable and practical skills. Students reported:

> **"Learning has not been handed to us on a plate: this will help us when we go into industry. Our teachers haven't just told us, they have only told us what to look for, a few hints. We have to go out and do our own research. Group work has been great and I have made good friendships"**
>
> **"I don't want to go back to the traditional way of learning; I want to do this again. I've really enjoyed it"**
>
> **"I have like working on a project in our locality; we have driven past this sit so often, and now I know so much more about it. I really valued the industry expert input too"**

"In two- or three-years' time we are going to be doing this, and we've already practised. We can put this on our CVs and in our UCAS personal statements and it's only November in Y1"

A STUDENT INVOLVED IN THE PROJECT

However, not all students were positive:

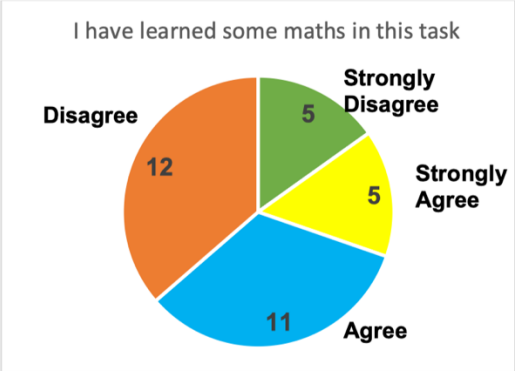
> **"I haven't enjoyed it at all. I just want to learn in the traditional way. It's much easier. I don't think I have learned anything so far"**
>
> **"I would appreciate some teaching!"**

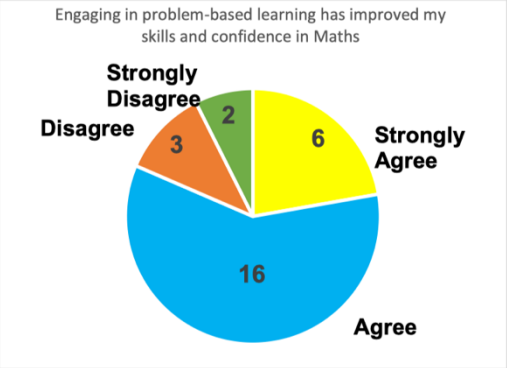
The differing views may be attributed to different mind-sets of students. For those coming straight from school, particularly those who have achieved well in high-stakes assessments, they may have a fixed mind-set and struggle to shift from the primary responsibility of learning the content to a host of new responsibilities, including responsibility to their group members (Dweck 1991). Students' role change in the learning process can conflict with habits and expectations of learning. They may not be able to identify what is wrong, only that they feel confused, disorientated and resentful (Boyd and Felleti, 1991). Moreover, PBL focuses on the processes of learning rather than the product of knowledge acquisition and this has not been the experience

of students in Key Stage 4, taking them out of their comfort zone, and for some, into a panic zone (Vygotsky).

Student Feedback: Functional Skills Maths students

Feedback from maths students differed considerably. For those who worked on the extended PBL scenario, quite a few did not think they had used or learned any Maths, although more felt that it had developed their confidence:





Students reported:

> **"It was fun to redesign the car park and solve problems"**
>
> **"I liked working with other people I didn't know and doing things together"**

STUDENTS GETTING READY TO PRESENT

However, a common theme in the feedback was:

> **"I did not understand this task at all and I did not use any maths**
>
> **I didn't really know what was happening, or how it was Maths related. This didn't help me"**

It seemed that the emphasis on skills and employability developed through this learning had not been absorbed by the participating students.

Practitioner Feedback

Practitioners involved in the trials stated that PBL is a way of bringing real-world learning into the classroom and can be effective in involving employers in co-constructing these scenarios. Learning and

assessment goes beyond the confines of the qualification outcomes and as its heart is learning for capability rather than for the sake of acquiring knowledge. Our Business and Computing teachers elected to use PBL to develop skills and positive attitudes to learning only. They regularly required

students to rate their development of skills using a Reflective Diary and Skills Tracker. The teachers also rated individual students using the same methods, and where there were significant discrepancies in judgements, the teacher would talk to the student. These teachers connected the process to Broadwell's conscious competence" model (1969):

> **"Technical students move from 'unconscious competence to conscious competence' as they progress through the problem and reflect on their developing skills"**

Because PBL was used purely as a 'learning experience' they did not focus at all on specialist knowledge learned, although on reflection, they advocate mapping the knowledge/skills developed to the qualification criteria wherever possible, even if this is not shared upfront with students, so that both students and teachers feel they are making progress with the qualification.

Our Construction and Built Environment teachers developed a curriculum around PBL tasks aligned with the qualification outcomes for the whole of Year 1 around a series of PBL scenarios (based on the design of a development of land near to College – the land was also a bird sanctuary). They themed the unit assessments around the scenarios and in doing so, reduced assessment burden by 66% (compared to the previous Y1). The teachers commented:

> **"It's a combination of learning and assessment activity through a real-life scenario, integrating different units in the scenario. Students have been a lot more positive with it. Giving them something real-life, rather than fitting assessments around individual units has really motivated them"**

> **"It gives us more flexibility to go in a different direction based on students' needs and curiosity, and it is a lot more**

"

"Students need about seven weeks of deprogramming (from their school education experience before they are ready to successfully tackle problems that are assessed"

A TEACHER INVOLVED IN THE PROJECT

"

"Instead of me deciding what to teach, my students indicate what teaching they need through their questions, and through my observations. So, they tell me what to teach, when and how"

A TEACHER INVOLVED IN THE PROJECT

interesting. Ultimately, it has changed my relationship with students."

"It's boosting their confidence; they now feel they can have a go at real life problems and some of the questions that they are asking go way beyond what we expected at this point in the course. They are thinking creatively and the way they approached the task has been very professional for 16-year olds."

However, during the first trial, our Construction and Built Environment teachers did perceive some barriers:

"Using PBL as an assessment tool is challenging as we are confined by the criteria set by BTEC. We can't ask them something that's not in line with the real-life scenario just because it is in the assessment criteria. So, we might need to do some mop-up assessment possibly"

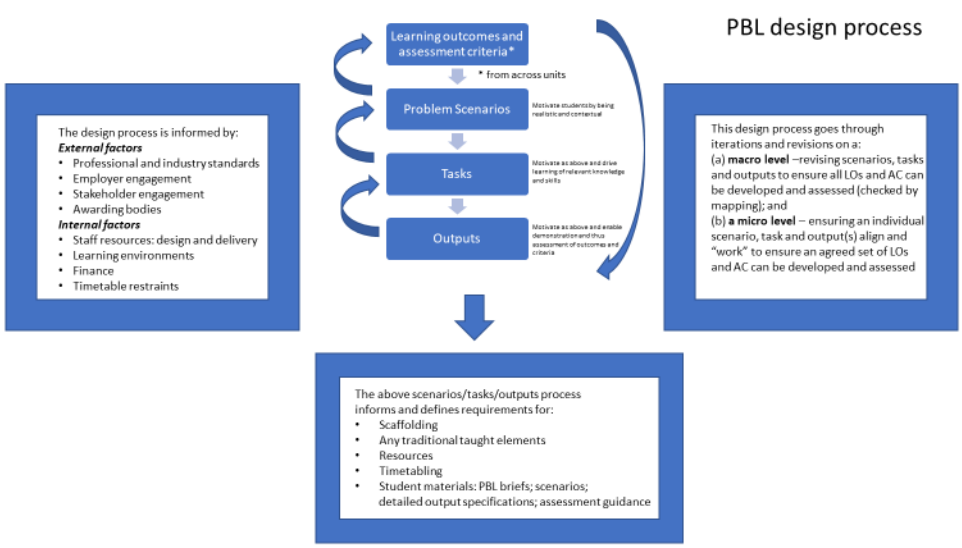
"

"We need to be doing more of it (PBL) in terms of developing skills and behaviours that employers want. The qualification may secure an interview. Behaviours and attitudes secure the job"

A TEACHER INVOLVED IN THE PROJECT

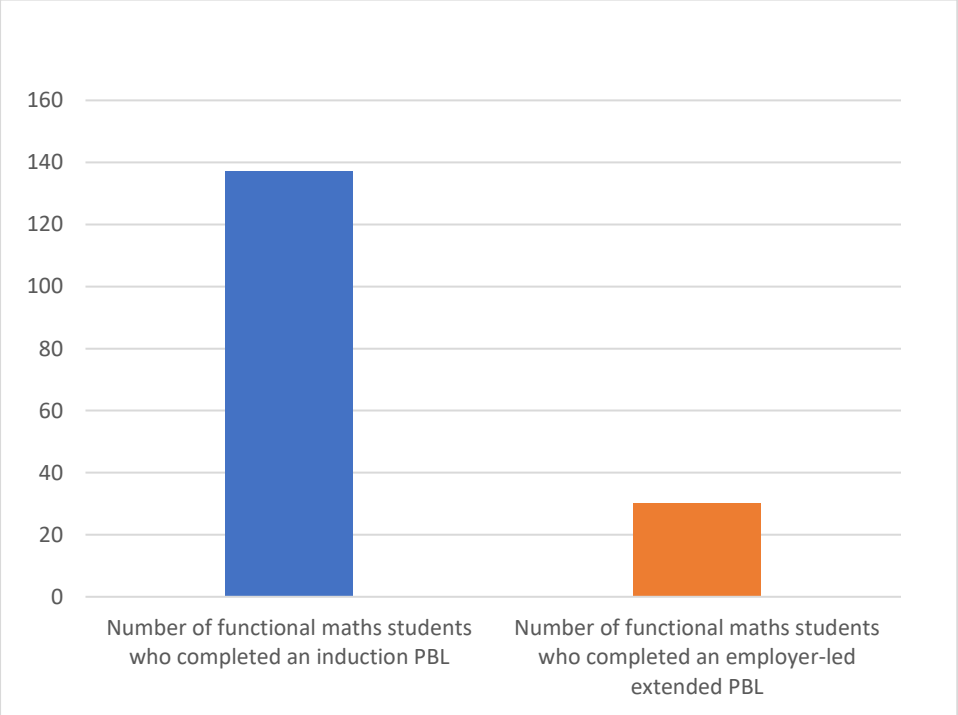
However, their concerns seem to be unfounded. When students submitted their first PBL task for assessment, there was a significant increase in achievement at first submission (compared to the previous year), and more high grades. Only one group had to produce additional evidence towards the assessment criteria.

Curriculum design continues after each problem-based learning episode. Teachers will review and evaluate impact on learning and will make complex decisions on types of scaffolding and its gradual removal as students make progress with their skills in problem-based learning. Teachers will reflect on the concept of assessment mapping to qualification and the assessment of skills and behaviour development. This can be represented as a process below (Slorach, 2018):



Our maths teachers had a less positive experience in their PBL trials. Whilst Functional Skills Maths students enjoyed their PBL tasks, they tended to avoid Maths when solving the carefully-crafted problems, although mathematical and problem-solving thinking skills are developed. However, with an assessment by standardised testing, teachers were concerned that the approach may not adequately prepare students for success in the exam. This resulted in a significant decrease in teachers using PBL after the initial induction of PBL:

It became apparent that standardised assessment by examination and the risk to teachers and organisations of poor "exam results" impacted on willingness of teachers to take risks and continue with the



> *"How do we enthuse our Functional Skills students? Do we just shout louder? We need to do something different, but I am not convinced PBL is the solution"*
>
> **A TEACHER INVOLVED IN THE PROJECT**

approach. Schemes of work are tailored to meet and fulfil the needs of an exam specification, aiming to include enough 'content teaching' to provide students with the best chance of success in their examination. PBL does not foster linear progression and success is shown at the 'last-minute' when the task is completed. Teachers reflected and concluded that PBL must form part of a combined teaching strategy, using PBL in sessions in conjunction with traditional taught lessons, to develop mastery in mathematics alongside problem-solving, confidence and collaborative skills.

In all our trials, it is evident that teachers 'go on a journey' when using PBL pedagogies. Reflective practice is at the heart of effective PBL. Our practitioners confirmed that they are not helping students as much in traditional learning sessions, asking questions instead of telling and encouraging students to develop resilience, independent learning skills and critical thinking. Teachers confirmed that planning of learning often took place after the classroom-based learning session, emerging from teacher and student reflection. Teachers planned interventions such as the delivery of a masterclass, or scaffolding cards or reflective conversations with groups of students or coaching techniques. The approach enabled sophisticated and responsive differentiation and redefined relationships with students. However, 'intervention teaching' requires teachers who are reflective practitioners, confident with their subject-knowledge AND pedagogical practice, and who feel trusted in their professional judgements.

Employer Engagement and Feedback

In all our trials, employers and practitioners reported they were able to work together in a meaningful way. Employers were keen to offer contextualised and realistic ideas for problem-briefs. Most were keen to host student visits. For example, our Functional Skills Maths students were able to visit McDonalds to observe the use and importance of Maths in all business functions. Our Construction and Built Environment students were able to visit a development built on a Nature Reserve, to see how the architect had designed a sympathetic and sustainable housing development. Business and Computing students have visited the employer's premises to present their solutions (in a Dragon's Den style).

> "We have thoroughly enjoyed engaging with the students as they worked through various problem-based learning tasks that we set; when they came to visit us they were so curious and exhibited professional behaviours. We are happy to continue to support this way of learning and foster employability skills"
>
> **AN EMPLOYER INVOLVED IN THE PROJECT**

When done well, it adds authenticity in preparing students for a role in industry and contributes to developing a genuine "two-way street". Our employers connected with how the curriculum content can be selected from industry standards and practices, innovatively integrating topics and holistically developing knowledge, skills and behaviours.

Impact on Organisations

During our Project, it became apparent that the traditional way of judging the quality of teaching, learning and assessment in observations of "lesson snapshots" and focusing on 'progress' in that lesson did not fully align with the emphasis on skills, behavioural and attitudinal development. In our pilots, the observation team have had an introductory session on PBL and have required teachers to construct lesson outcomes in terms of skills/behaviours and how these might be evidenced in the session. Crucially, observers revisit the observed lesson at the end to make a judgement on progress.

> *"This approach makes our students more employable and it is our duty as an educational organisation to develop students this way"*
>
> **A COLLEGE LEADER INVOLVED IN THE PROJECT**

The contribution of employers in co-writing problems and in meeting and talking to students (at College and/or in the workplace) has implicitly exposed both teachers and students to different careers and roles in the industry; it has also enabled teachers and students to connect their studies to employment. Teachers have engaged with employers and this has supported them to connect with the purpose of technical learning in developing a skilled workforce for the future, bringing relevancy and currency to curriculum content and introducing methods of developing students' skills and behaviors.

The style of delivery in PBL has naturally aligned College-based studies with future employment. This has fostered confident practitioners in supporting students to make informed choices and achieve their goals and next steps.

However, problem-based learning pedagogies present many challenges within the current educational climate. Assessment has a massive effect on curriculum design. PBL presents a dichotomy between the policy and practice of judging short-term gain, and the longer-term outcomes of attitudinal change and holistic skills development, such as critical appraisal, self-evaluation, communication and life-long learning. Our findings suggest that for sustainability, changing the way that teaching happens requires

support from senior managers and a culture of change. It also requires a shift in the policy landscape within which organisations operate.

LESSONS LEARNED

By undertaking this extended activity, we have been able to highlight some factors which may support the successful implementation of Problem Based Learning:

There are some key principles of problem-based learning that are non-negotiable:

- The principle of **authenticity** – the problem-based learning scenarios need to be anchored in meaningful industry-relevant contexts, achieved through collaboration between employers and teachers. “The realistic problem must be contextualized in a scenario that students can be immersed in. Providing context will actually reveal to learners the importance of the knowledge learned as well as the situation in which the knowledge is applied” (Alwi et al, 2012);
- The principle of **assessment extending beyond qualification** outcomes – problem-based learning is designed to develop students’ knowledge, skills and behaviours holistically and to ignore the development, assessment and feedback on skills (such as teamwork, communication, independent research and learning, presentation skills, digital skills and problem-solving) is the antithesis to goals of problem-based learning;
- The principle of **flexibility** – the knowledge learned by students when they work on problems does not unfold typically or coherently and may not evidence what was initially planned when designing the problem-based learning brief. Realistic problems are messy, and this pedagogical feature requires continuous cycles of ‘plan, do, review’ and an acceptance that what the students produce could be different to what was expected when designing the problem.

- The principle of **employer input** in developing real-world problems
- The principle of **practitioner development** through dedicated CPD to successfully facilitate PBL;
- The principle of **scaffolding** problem-based learning techniques with students; mini-PBL scenarios can scaffold students in tackling larger problems which contribute to assessment, and in larger PBL tasks, careful planning of potential resources and experts.
- When using PBL as a curriculum design for evidencing external awarding body outcomes, the **principle of ensuring that PBL outputs satisfy the outcomes and assessment criteria prescribed by the qualification**; setting the parameters of learning through clarity of output provides upfront guidance, rather than "hand-holding."
- The principle of **engaging all stakeholders** to explain and justify the approach to avoid criticisms of 'lack of teaching' from parents, apprentice employers and leaders, managers and observers

CONCLUSIONS

We set out to test three hypotheses. Our research indicates the following:

Hypothesis 1: PBL needs to be adapted in different technical routes

Problem-based learning will naturally be adapted for different students learning in different contexts. It is a pedagogical approach that puts teachers' freedom and enquiry at its heart. Its starting point is individual needs. It is not the technical route that will determine the approach adopted by teachers; it is the professional decisions of teachers in planning appropriate problem-based learning episodes for individual students learning in a specific context.

Hypothesis 2: There is a process that lead to effective problem-based learning curriculum design

Yes, there is a process for curriculum design. The key steps in designing a curriculum around problem-based learning are:

- Decide if problem-based learning is to be purely a learning activity or if the solutions will evidence assessment outcomes specified in a qualification
- If it is to be an assessment, deconstruct the qualification units and reconstruct them around problems
- Engage with employers to construct appropriate problems and determine the outputs required for evidencing assessment outcomes
- Agree appropriate metrics for measuring progress with skills, behaviours and attitudes
- When implementing the problem-based learning curriculum, be prepared to adjust and adapt as students' progress. It is a flexible and responsive curriculum
- Review, reflect and continue to adapt problem-based learning for future episodes. Curriculum design continues after each problem-based learning episode. The design process goes through iterations and revisions revising scenarios, tasks and outputs to ensure all learning outcomes and assessment criteria can be developed and assessed (checked by mapping)

Hypothesis 3: Problem-based learning is an effective pedagogy for learning maths

Our evidence indicates that problem-based learning can be effective in engaging low achievers in Functional Skills Maths, building confidence and mathematical thinking skills. However, it is not a pedagogy to use in isolation. Problem-based learning must form part of a combined teaching strategy. The approach that we recommend at the present time of high-stakes standardised examination assessment is to use problem-based learning in sessions in conjunction with traditional maths pedagogy.

OUTSTANDING TEACHING, LEARNING AND ASSESSMENT

The project features several factors that represent outstanding teaching, learning and assessment:

- We are rethinking technical education as T Levels emerge

- We have continued to trial a new pedagogy
- We have experimented, we have taken risks
- We have reflected and systematically analysed findings
- We have worked collaboratively to develop our own professional skills
- We have contributed to developing an evidence-based pedagogy
- We have embraced being a research-informed profession

WHAT NEXT? (HOW WE PLAN TO CONTINUE THE WORK)

All of our partners have expressed the real energy that has been generated as a result of the project. Dedicated CPD events have been delivered to reach more teachers and more technical routes within the organisations, and the approach features in QIPs, so there is a willingness to continue to develop the activity because of the impact it has had in trusting teachers, trusting students and developing students holistically. The CPD programme, PBL experiment and deep reflections by practitioners, students and employers has helped prepare practitioners, organisations, partners and employers for T Level Teaching and developed a potential pedagogy for high quality learning during the work-placement. It has also prompted reflections on what the T Level Transition course might look like.

Derby College is keen to scale up the reach and the levels, producing an evidence base on ways of working with employers, teachers, and students to support transition through level 3 to level 5 and beyond using a PBL approach, so that progression through higher level learning is a seamless progression. The curriculum has the potential to provide progression routes to both higher apprenticeships and traditional HE routes.

ONE TAKE-AWAY MESSAGE

Problem-based learning requires faith and trust in students to believe that they could do the work and could learn without depending on the teacher to feed them everything. When students are trusted and given

freedom, they produce work beyond the “expected progress”. And the same is true for teachers.

PROJECT OUTPUTS

The following outputs accompany this case study and are intended to support other organisations build on our approach:

1. “Our Story” slideshow, which hyperlinks all additional outputs and a filmed presentation, available at: https://www.derby-college.ac.uk/otla/OTLA-Derby-College-Output-16-Our-Story.pdf
2. Overarching Poster of Project
3. Four Think Pieces:
    - Problem-Based Learning for the future – where does it fit into the policy landscape?
    - Does Problem-Based Learning need to be adapted in different technical routes? Problem-Based Learning and Teachers’ Professionalism
- Is there a process for designing a technical curriculum around problem-based learning?
- Is Problem-Based learning an effective pedagogy for learning maths? The problem with Problem-Based Learning in Functional Skills Maths