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Engaging students for learning: How Project Based Learning transforms the teaching and learning environment

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Abstract

This paper is based on research carried out during October 2012 and March 2013 in Finland, United Kingdom (UK), Brazil, United States of America (USA) and Canada. The aim of the research was to investigate aspects of Project Based Learning (PBL) and seek how PBL could be implemented successfully in New South Wales schools. PBL is a methodology that engages both teachers and students through critical thinking, collaboration, communication and creativity. In order to implement PBL teachers need to address their philosophy of teaching and learning so that they can best meet the needs of today’s students. The strategies which demonstrate the best practices for PBL are well researched and can be applied to most learning environments.

What is PBL?

Many schools use an industrial era model of ‘chalk and talk’ in order to meet the learning needs of students. It encourages a culture of compliance rather than learning, and attendance rather than participation. While for some students this approach might be helpful, it comes at the cost of most students not being engaged in their learning. This has serious implications for students who, because of disengagement, no longer enjoy being at school nor meet the objectives of why school exists for students.

The Buck Institute of Education defines Project Based Learning (PBL) as,

“an extended process of inquiry in response to a complex question, problem, or challenge. While allowing for some degree of student "voice and choice," rigorous projects are carefully planned, managed, and assessed to help students learn key academic content, practice 21st Century Skills such as collaboration, communication & critical thinking and create high-quality, authentic products and presentations.”

PBL can be broken down into two main categories, 21st Century Skills and Significant Content, which in turn contain three elements each. Within 21stCentury Skills (lifelong learning skills) are:

* **Revision and reflection:** Within each project there is significant time allocated to students drafting work, receiving feedback, making improvements and then receiving more feedback from both teacher and peers.
* **Voice and choice:** Students are more engaged when they can make choices about how they will present their work and what they will learn about. On the other side of the coin, if there is too much choice then students can find it difficult to get started. There are set parameters and timelines that students need to comply with so that they can be productive and ensure that they are ready for presenting.
* **Need to know:** Rather than students requiring an external point of reference for motivation, PBL is set up so that students have a reason to learn ‘right here and now’. Intrinsic motivation is seen to be the best way of having students work in an energised and purposeful way.

Within Significant Content (exhibition, discovery and purpose) are:

* **Public audience:** One of the key aspects of PBL is ensuring that students can share their learning with friends, family and the community in a public event. With an ordinary project, the only people who would see the assessment would be the student and the teacher who grades their work. By introducing a public audience, whether this is face-to-face or online, it communicates to the student that their hard work and learning is worth far more than just a grade. In fact, their learning can be a stimulus, encouragement, challenge and sharing experience that actually impacts the lives of others.
* **In-depth inquiry:** When a group of 30 students are lectured with ‘knowledge’ during a lesson, without any interaction, then a number of factors influence how much those students will learn. A more engaging, enjoyable and meaningful way for those students to learn is via inquiry learning. This is where students ask their own questions, work together to solve problems and apply the solutions in a presentation, product or service. For many teachers, this seems to be a risky way for students to learn since it does not rely on teacher centred ‘teaching’ however there are new skills that teachers can develop in order to engage students of all learning styles.
* **Driving question:** When an open ended question is presented, students can respond in a way so that their learning is both personalised and directed. The driving question ensures that students are able to meet syllabus outcomes as part of their learning.

Another way of explaining PBL, is that student are able to learn through creativity, collaboration, communication and critical chinking in a relevant and purposeful context.

What PBL is not

It is easy to get PBL confused with students simply completing ‘a project’. It is not uncommon for a teacher to explain everything about a topic, have students’ complete worksheets and finally have the students create a model or presentation about their learning. You will note that this particular strategy didn’t require a need-to-know, didn’t necessarily involve critical thinking, and even though the project might be publicly exhibited, there was no inquiry learning that took place. A fundamental premise of PBL is that the project will provide a reflection of the student’s passion, determination and discovery. The project will be a representation of learning significant content and a showing of lifelong learning skills. The revision and reflection stages play a special role in students hearing how their project can be improved.

Technology implications

There is no set ‘guide of technology’ for PBL so students and teachers, over time, discover what works best for them and consult their Professional Learning Network to keep abreast of new tools. There are technology tools that can help in the planning of projects, the construction of rubrics, the collaboration of student work, the presentation of student work and feedback/critique for students.

* + Google docs spread sheets: helpful for teachers or students to collaborate. Teachers need to create the project before the students begin work so that they can set a timeline of achievements and provide updates for the students as they work. Students don’t need to be working at the same time because of live updates to the document.
  + The BIE has a number of rubrics that teachers can use to help students identify their level of achievement in team work, presentations skills, product design, critical thinking and collaboration, to name a few. By storing these rubrics in a ‘Learning Management System’ or Evernote, students can access a record of their achievement and ideas of where to improve for their next project.
  + Any number of photography, video, green screen, sound recording, music recording, book building or framing apps can be used by students to present their learning. Teachers need to be flexible with the tools that students use and it’s helpful for them to have an understanding of which apps can be helpful.

Physical spaces

It was interesting to meet the various school leaders and teachers to see how they had configured their physical spaces in order to implement PBL. There are a number of spaces required in order to meet the needs of students in the different phases of their work. [At Matthew Moss High School](http://www.mmhs.co.uk/), Rochdale, Lancashire, UK there were large open spaces for students to plan and collaborate. There were also industry rooms set up for students to create, construct and model their work. There were also spaces set up for students to permanently exhibit their work. At [High Tech High](http://www.hightechhigh.org/), a Charter school in San Diego, USA, there were many integrated learning spaces so that students could read, research and plan in one part of the room and then begin building, painting or constructing in another part. The use hallways, foyers, windows and ceilings to display student was a high priority. If a student knows that the art work they produce will be shown for a period of 2 years within their school, then a special effort is put into the planning and production stages.

The Chula Vista High Tech High campus set up their spaces so that public exhibitions could take place each school term. It was amazing to see all of the different types of experiments, artworks, displays, shows, performances and movies from students of all ages. Even when the public exhibition has finished, the school still resembles an art museum and showcase because the school wishes to constantly celebrate the achievements of their students. At the [Aalto University Design Factory](http://www.aaltodesignfactory.fi/) in Helsinki, Finland there were well designed spaces for all aspects of the PBL process. We were able to see students researching, testing, collaborating, designing and creating in purpose built rooms, libraries and classrooms.

Cultural spaces

There were a number of significant leadership decisions that had been made in order to create a culture of PBL within the schools I investigated. Matthew Moss High School ensured that teachers were engaged in conversing, reading and researching so that they could be aware of the current outcomes of empirical work that was taking place. From an organisational point of view this meant that their week centred around professional development so that teachers would be equipped to plan new projects for the students. At High Tech High there was high level of importance placed on mentoring. The way that they have implemented PBL has been through a commitment to training up staff in a relational context. They offered advice on best practice for setting up mentoring relationships to ensure that new staff members were able to access help and support. Another cultural aspect of PBL schools was their approach to team work. At New Tech School of Ideas all of the teaching took place in teams. They had developed a practice of teacher planning, reflecting and providing feedback so that students could be provided with the optimal learning conditions.

How is it being implemented?

Matthew Moss High School is applying PBL in a program titled ‘My world’. Students in Years 7 and 8 participate in the program which integrates outcomes from English, Mathematics, Geography and Science. Within specified parameters the students choose how they would like to apply their learning for three lessons per week. The teachers have responsibilities in the area of design, facilitation and goal setting rather than ‘information distribution’. A significant part of the process is how the teacher teams learn to collaborate effectively so that project design is relevant for each of the students. The staff at Matthew Moss High School highlighted that learning from mistakes is very important because improvements can be identified at most levels of the design process.

I had the opportunity to visit an exhibition afternoon at the High Tech High Chula Vista campus. This was a key moment for the students to give account of their project and perform, present or demonstrate their work. The Mathematics display for Year 9 students was an interactive set of activities investigating the application of Maths and Science. Participants could learn about gravity, weight, capacity, friction and design in a hands-on way. Students were able to respond to questions and explain how and why they created the activities. It was great to see the importance of their work aside from just gaining a ‘school grade’. Not all students will present a project at an exhibition night, this means that some students will assist with logistics and welcoming.

[Seven Oaks Met School](http://www.7oaks.org/school/themet/Pages/default.aspx) in Winnipeg, Canada is part of the Big Picture Learning Network. They apply PBL with assistance from their intensive intern program. Students spend either one or two days each week working and learning in their city. They make their own preparations for a3 month internship and the teacher will personalise their learning at school based on their placement. I met with students onsite who were working in the TV industry, graphic design studios, a marketing firm, a web design company and a restaurant. Syllabus outcomes were mapped to their placement and other learning outcomes were tailored to their interests. Of course mandatory outcomes must be met but with this amount of experience and industry experience, the students are better placed to learn.

[New Tech School of IDEAS](http://dchs.msddecatur.k12.in.us/?PageName=bc&n=158316) in Indianapolis, USA applied PBL via the integration of subjects. Geometry and engineering were incorporated so that Mathematical knowledge could be applied to hands-on constructions. Students were designing and testing the strength of Ferris wheel arms so that they could construct a replica in the workshop. The students are provided with a ‘need to know’ so that their learning is not just important for when they leave school, it’s important now. Biology was integrated with literacy (English) and History was integrated with Social Studies. Eight students shared lunch with the principal as I asked questions about their learning, motivation, teachers, backgrounds and challenges. They stated that their projects were given meaning because of the public audience and personalisation.

[The Lumiar Institute](http://lumiar.org.br/?lang=en) in Sao Paulo, Brazil has a strong focus on student democracy and so it was exciting to see how they had applied the voice and choice aspect of PBL. Students were able to choose from a variety of ways to present their learning. They are also encouraged to engage with their community and suggest what they would like to learn about, given current community projects and local events.

Challenges

If schools leaders take a traditional approach to their organisational structure and learning philosophy then parents and other stakeholders don’t tend to ask questions (even if student disengagement is rampant). There were considerable challenges that PBL schools faced because of their teaching and learning methodology. Parents and administrators, rightfully, want to ascertain that the apparent ‘risks’ of PBL will be managed carefully and that students will learn effectively. In each of the schools that I visited, senior leaders spoke of the need to be in constant communication with parents and community members so that they could visibly see the benefits to students who participated in the programs. The most significant commitment that leaders faced was casting a vision for the school and then reminding staff, year after year, of that same vision. There was not one single school that implemented PBL overnight. Each school spoke of the need for leaders to be consistent, helpful, and supportive and committed at every stage of the process. Recruiting teachers who share the philosophy of PBL and believe in the power of team were vital for schools to meet their goals. This means a more rigorous process was needed to identify which potential staff would lead to creating the best teams.

Implementation for NSW schools

There are a number of guides, handbooks and websites that provide great recourses for school leaders and teachers who wish to implement PBL in their school context:

* + The Buck Institute for Education (BIE), USA is a not-for-profit research organisation that provides free and paid resources for the elements of PBL. Their index of rubrics, check lists and project libraries are very useful. They have a collection of webinars that explain aspects of project design, feedback, critique and exhibition. The BIE has partnered with the New Tech Network in order to implement PBL in schools across the world.
  + The Innovation Unit, London, UK has produced an amazing handbook called ‘Work that Matters’. It outlines the foundations of PBL and then provides a guide as to how teachers can design projects for students. It also explains how each iteration of project work can be used to improve both teacher and student learning of the process. It also provides a summary of projects that have been used in schools from the UK and the USA. Another helpful resource is titled ‘The Engaging School’. It explains the design principles that school leaders can use to implement change with their timetable, culture and structure.
  + Bianca Hewes is an English teacher, and a student of the University of Sydney, who has been championing PBL in her classroom and inspiring many other teachers to do the same. She has documented many aspects of the PBL journey including struggles, challenges, successes and wins.
  + Geoff Krall is Maths teacher who has committed considerable time to compiling a map of syllabus outcomes to problem/project based tasks. He works as a coach within the New Tech Network.
  + Mark Burgess is a science teacher, Northern Beaches Christian School, Sydney who is leading an integrated science/geography course for Middle Years students in an open learning environment. He documents much of the design and implementation aspects of his PBL work.
  + High Tech High is a series of eleven schools that use PBL. They have been a strong advocate for personalised student learning and seeing teachers as designers. The graduate school offers training for teachers in workshops and immersions. Teachers can subscribe to their project journal called ‘Unboxed’. They also provide examples of student projects based on topic and grade.
  + Jo Boaler is the Mathematics Education Professor at Stanford University who has extensively researched the benefits of inquiry based learning. She has produced considerable material that teachers can use to see how group work, open ended questions and mixed ability classes can impact the performance of students.

In order to successfully implement PBL there are other leadership areas that needed to be addressed, such as, team work, mentoring, technology tools, organisational structure, teacher professional development and Occupational Health and Safety.

Conclusion

Today’s students are facing a world that requires them to solve problems creatively, to collaborate online and to communicate clearly. By taking a teaching and learning approach that not only meets curriculum outcomes but also provides development of lifelong learning skills is of vital importance. PBL could be implemented successfully in more New South Wales schools where there is a commitment to the principles and practice of engaging learning. By following the well-researched methodology of PBL, schools will be providing their students with learning opportunities that are purposeful and inspiring. Another key aspect of implementation is the classroom teacher letting go of some ‘traditional’ beliefs about control and teacher centred classrooms, instead focusing on student ownership of learning that relates to their questions and interests. The support of the Teachers Mutual Bank has been generous. It is because of their initiative to fund this research project that I now have the responsibility to pass on these PBL practices to NSW teachers, who will in turn, improve outcomes for student learning.

References

[The Buck Institute of Education](http://www.bie.org/)

[The Innovation Unit](http://www.innovationunit.org/knowledge/our-ideas/21st-century-learning)

[Bianca Hewes’ blog](http://biancahewes.wordpress.com/)

[Mark Burgess’ blog](http://learningactivist.com/)

[Geoff Krall’s blog](http://emergentmath.com/)

[High Tech High](http://www.hightechhigh.org/)

[Professor Jo Boaler](http://joboaler.com/)

Schools, Universities and researchers visited as part of the scholarship

Aalto University Design Factory, Helsinki

GuðbjörgPálsdóttir, Assistant Professor in Mathematics Education, University of Iceland

Anne Watson, Professor of Mathematics Education, Oxford University

Charlie Gilderdale, Nrich team leader, Cambridge University

Matthew Moss High School, Rochdale

David Price, Innovation Unit, Consultation session on engagement for PBL

Andrew Chubb, Archbishop Sentanu Academy

Paul Shakey, Hull Studio School

Abdul Chohana, Essa Academy

Sally-Jane Norman, Professor, University of Sussex, Brighton

Simon Breakspear, Pearson Education, London

Celia Senna ,Lumiar Institute, São Paulo

Jennifer Inniss, Avenues (school), NYC

Belinda Nicholson, The School at Columbia University, NYC

Chris Rush, School of One Math program, Brooklyn

Paul Buck, New Tech School of IDEAS, Indianapolis

Dottie Krett, Illinois Mathematics and Science Academy, Aurora

Adair Warren, Seven Oaks Met School, Winnipeg

Hayley Murugesan, High Tech High, San Diego

d.school, Stanford University

Jo Boaler, Professor of Mathematics Education, Stanford University

Heather Rosewan, Children's Creativity Museum, San Francisco