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EVALUATING PROBLEM BASED LEARNING IN THE TEACHING OF DESIGN IN POST MODULAR EDUCATION

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ABSTRACT

This paper aims to add to the pedagogic debate surrounding the adoption of Problem Based Learning (PBL). It does this by describing the experiences of level-one students in a new course that has adopted PBL in a School environment that is more familiar with traditional teaching methodologies. The paper reviews how PBL within the course has evolved since its inception 7 years ago, and how it has arrived at the current juxtaposition of adopting two methodologies; Problem Based Learning (PBL) and Project Based Learning (PJBL)

Key Words: Problem based Learning. Project Based Learning. Product Design

1 INTRODUCTION

From its roots as an art then technical college in the 19th century, the University of Brighton has been providing technical courses for over 100 years. It is now an institution that offers a diverse range of subjects from 14 specialist Schools. In the early 1980s, it was recognised that it could offer a high quality course in Product Design by combining expertise from two of its Schools, engineering design from the School of Engineering and creative design from the School of Architecture and Design. The Schools of Engineering, and Architecture and Design have, however, had different cultures, as evidenced in differing approaches to teaching. The School of Engineering has traditionally followed a serial, subject-driven approach. The School of Architecture and Design predominantly utilises a practice-based, student-centred methodology. Although split equally between the 2 schools, it was agreed that the Product Design course would follow the applied approach of the School of Architecture and Design.

The benefits of experiential, hands-on, student-directed learning have been declared for over 100 years, finding particular credence within the medical professions [1]. Its value is, however, also well recognised in the teaching of craft-based design where it is often claimed to be an equivalent or slightly better paradigm for producing gains in academic achievement. Support for its wider role within education and the importance of its position in the range of teaching approaches within HE have also gathered momentum within the last 25 years [2].

Models of cognitive and behavioural learning show that understanding, cognition and action within learning are interrelated. Cognitive research has also revealed more about the nature of problem-solving and how this is related to experience. Learners not only respond by feeding back information, but they also actively use what they know to explore, negotiate, interpret, and create. Learning is also shown to have a socially contingent context, taking place within the realms of emotion, culture and community.

Solutions are thus constructed rather than prescribed. PBL is a more natural way of learning [3], and encourages the development of those creative, holistic and critical skills [4] so essential and relevant in product design today. Analysis of teaching over the past 200 years has provided a platform for understanding teaching in the current world. A world that can, for example, encompass issues such as social disenfranchisement and exclusion, choice, control and information overload. The world has hence changed to make the process of actively engaging students a more appropriate methodology.
Despite this apparent rising appreciation of PBL, it can still be said to be in a developmental stage. Issues arise with regard to definitions, standards, outcomes, performance and accountability, and there is insufficient research or empirical data to prove that PBL is a suitable alternative to other forms of instruction in all situations.

2 PROBLEM BASED LEARNING

Problem Based Learning (PBL) is an approach that provides students with a problem-based exercise as the vehicle for learning. It is characterised by being motivating, participative and challenging, shifting the emphasis away from the delivery of programmed information, structured by the tutor [1]. As such, students are helped to set their own learning goals, develop interests and questions and how they will find answers and solve problems. PBL may also provide a real-world context, becoming a long-term and interdisciplinary strategy.
The process uses the tutor as a facilitator to help a group analyse a realistic problem that is nominally beyond their combined expertise at the start, and develop learning outcomes necessary for its resolution. Students then investigate independently, or in groups, using whatever resource is available and feed back their responses in the next PBL meeting, where critical reflection reinforces the learning. This allows the process to iterate with more refined tasks set. Eventually, when the problem has been "solved", a full review and formalisation of the learning is carried out.
This approach aims to benefit students by:

- Overcoming the dichotomy between knowledge and thinking or applying, helping students to both "know" and "do";
- Assessing performance on content and skills using criteria similar to those that might be used in employment thus encouraging accountability, goal-setting and improved performance;
- Meeting the varying skill levels and learning styles associated with the differing needs of groups of learners;
- Increasing levels of motivation;
- Integrating subjects to achieve a wider contextual understanding;
- Supplying relevance and connections to real-life issues, encouraging deeper learning;
- Providing confidence and relevance to post study employment through opportunities for applying practical knowledge;
- Supplying additional and complimentary skills such as planning, communicating, team working and decision making;
- Improving relationships with peers through a common and visible shared experience;
- Developing a learning community through closer working and consultation with tutors and supervisors.

Having taken many years to gestate, the new Product Design course at the University was inaugurated in 1997. A central and pivotal philosophy underlying the course was

the provision of a PBL based integrative project that would aim to capitalise on the benefits afforded by PBL. Reaping these benefits has been an evolutionary experience, as exemplified by successive level 1 cohorts:

Year 1

Whilst the majority of the course was considered to have run smoothly, the PBL based project was notably problematic. The difficulties that prevented its envisaged operation included:

- Students being delivered the majority of their subject material in a modular, subject orientated manner were unable to adapt to the open nature of the project;
- The facilities and resources available did not support the PBL project. For example, hard-pressed academics were unable to provide the necessary consultation time;
- Students did not have adequate space for experimentation and development;
- The integrative nature of the PBL project required facilitation and a breadth of skills beyond the experiences of the PBL module leader;
- Academics were unused to providing students with knowledge in an unstructured and applied format.

The PBL project therefore became a nominal offering only, appearing effectively as a summative portfolio of student work.

Year 2

To overcome many of the problems raised in year 1, the project was delivered whilst heavily subsumed within a taught module. This made it easier for the project leader to administer, by effectively structuring the process to allow for the resources available and to by-pass the modular related issues.

The result was the appearance of a less nominal project, but it lacked an integrative element. The heavily structured delivery made the project far less of a problem-based exercise, and many of the root cause problems still also persisted.

Year 3

The project was again shepherded within one taught module; however, with the benefit of increasing experience, the project leader was able to afford some links to other modules providing some integrative elements. Projects were now invested for example with more significant costing and engineering elements.

It still however suffered from the same intrinsic difficulties. Levels of performance and enjoyment, as measured by grades and attendance were both low:-

The average attendance for level 1 students during the duration of the year was recorded as 47%.

The average performance of level 1 students overall was 51% (standard deviation 20%).

The average level of performance in the core project was also 51% (standard deviation 20%).

Year 4

In an effort to improve delivery, the project leader adopted:-

- Dedicated studio bases;
- Improved workshop facilities;
- Team delivery, with one adept in technical matters and the other in craft design.

Despite these actions it was considered that the project outcomes were still disappointing. The quality of student work was low, and the integrative nature of the work remained minimal.
Attendance was recorded at 50%.
The average performance of level 1 students overall was still 51% (standard deviation 23%). The level of performance in the core project was also again 51% (standard deviation 20%).

Year 5

The next major developmental step was therefore to remove the project from the safety of its taught module and to create it as an entity within its own right, the format for which it was originally conceived. Yet many of the problems persisted and student engagement and performance remained low.
Average attendance was recorded as 52 %. The average performance of level 1 students overall was 55% (standard deviation 19%). The level of performance in the core project was 62% (standard deviation 9%).

Year 6

The project was overhauled in a number of ways:

- It was made more significant, forming ¼ of the course content rather than 1/12;
- The number of peer-reviewed formative sessions was increased;
- A structured framework was mapped out, with planned milestones and events;
- Levels of integration with other modules was established through detailed advanced planning;
- Integration with the outside world was increased through the publicising of related events and trips;
- More transparent learning objectives and assessment criteria were developed;
- A separate, non-modular timetable was provided.

The outcome of this change has been to mutate the learning environment and has been perceived as the longed for step-change in the student experience. Attendance, for example, in the period to date in this year was 69%, with average levels of achievement at 55 % (although at the time of writing results for the project itself are still to be determined).

3 CONCLUSIONS

3.1 Summary

During the evolution of the course, there is no evidence to suggest that the intake quality of the students has changed or of any change in the robustness of the assessment process or standards. Nor is there evidence to suggest that problems are encountered are localised, as intake patterns have randomised yearly on gender, nationality and background. However there is evidence of improvement in both achievement and enjoyment, as measured through average grades and attendance, as shown in table 1. This seems to be consistent with findings experienced within the traditional home of PBL, medical practice, where students perform no better or worse under PBL, but enjoy the process more [5].

Table 1. Average grades and attendance

	Attendance %	Performance %
2003/04	69	55
2002/03	52	55
2001/02	50	51
2000/01	47	51

3.2 Key lessons

The studentcentric problem based learning approach originally envisaged was subject to a number of problems, but the two most important were considered to be that:

1. Classic PBL works best through the students' interaction in co-operative tasks, but much design work has a high degree of personal ownership and therefore can be difficult to share.
2. Having developed PBL to an improved state of delivery, it was clear that most of the Level 1 students lacked the skills and maturity to undertake individual, self developed projects. Students were unable to adopt new practices and open ended learning, and were instead sticking to their previous experiences, often re-enforcing bad habits rather than adopting the open minded, investigative learning that PBL aims to promote.

There were 2 actions that have been considered most successful:-

1. The increase of the significance of the project, both in terms of assessment weighting and resource, has meant that more investment has be made in building students' expectations and learning skills.
2. The change to the a more heavily structured project in Year 6, whilst standing in contrast to the envisaged approach and its more prescribed set of outcomes, effectively created a Project Based Learning (PjBL) approach. The relationship between PjBL and PBL may be summarised as:

Table 2. The relationship between PjBL and PBL

Problem based learning	**Project based learning**
• Open activities	• A structured series of activities
• Less determined outcomes	• More identifiable outcomes
• Deep learning through experience	• Deep learning through experience
• Self directed learning	• Tutor directed learning
• Repeatable to increased depth and knowledge	• Repeatable to add new knowledge
• Process support	• Technical support
• Rooted in humanities programmes	• Rooted in art based programmes

3.3 Comments

Our experiences show that operationally, there are a number of other areas that stood out as being good practice, and many of these coincide with areas that exponents of PBL traditionally cite. For example:

- Clearer expected standards, articulated goals, and support for process and technology;
- Clearer demonstrations of achievement and learning through formative assessments and reflective reviews;
- Applied and practical methodologies to aid the sense of learning and achievement;

- Maximized student decision-making and initiative – but within the limits of the students ability;
- An extended time frame;
- Academic excellence – encouraging staff to be courageous in not delivering a set pattern of material but to respond to the ebbs and flows of the learner(s), and be capable of coaching and facilitating alongside the role of subject expert
- Real-world connections - PBL context should be as large and as varied as possible – as researchers are beginning to suggest within PBL's home base of medicine [6]. Further work would also be recommended to assess the impact that this has on staff as well as students.
- Finally, the experiences at Brighton show that adoption of good PBL or PjBL practices are not on their own sufficient enough. The mixed discipline, nature and delivery of the course have required changes in culture, teaching, and administration within the School, with particular consideration given to:-
    - Facilities
    - Time
    - Timetabling
    - Administration
    - Staff development
    - Applicant recruitment policy/criteria
    - Resources available.

In this respect, the teaching methodologies have therefore required a strategic re-alignment, and one that our traditional engineering courses are now beginning to examine. School policy is looking towards the post-modular organisation across the board, with the use of larger modules and more integrated delivery through PBL or PjBL. PBL has, therefore, not been just an evolutionary experience, but it is potentially a revolutionary one as well.

3.4 Further Work

It has been decided therefore to currently persist with Project Based Learning approach at level 1, and also to consider developing it at level 2 towards a more open approach. It would be pertinent to repeat the monitoring exercise for this level.

It has also been conjectured that the actual knowledge gained through PBL is retained for longer, or deeper learning [7] Further work will therefore entail monitoring the students' performance as they progress through the levels to assess if they maintain the level of achievement.

The course team is considering the migration route from directed learning in level 1 through to a life-long learning paradigm by graduation. Professional placement and increased independent study in the final year are considered important components.

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