Title: **An Investigation of a Technology-Supported Problem Based Learning Initiative in a Transition Year Class.**

Researcher: **Naomi McGoldrick (nee Byrne)**

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Timeframe:
Data was collected throughout the academic year of 2009/2010. The researcher reported her preliminary findings to her colleagues in May 2010. The staff highlighted areas that they felt were not adequately reported upon in the findings and thus gave the researcher increased incentive to re-examine the data over the summer months of 2010. The thesis for the purpose of the Masters in Education programme was submitted in 2010. The final report for the Teaching Council was prepared during the first half of 2011.

Research idea:

Education is shifting from a primarily teacher focused structure to a more student centred approach. Appropriate teaching and learning methodologies therefore need to be explored in order to cater for this. This research investigates one such approach which was adopted as a pilot project in an Irish post-primary school. The project involved a technology-supported Problem Based Learning strategy that was introduced across all disciplines in a Transition Year class. The key aim of the research is to explore whether this form of Enquiry Based Learning is suitable for use in Transition Year. Various perspectives are included as part of the research. Firstly, the attitudes of the students, who were the recipients of the initiative were analysed; secondly the views of the teachers who delivered the programme were evaluated and finally the perspectives of the school management, who elected to implement and to manage the strategy were appraised.

Aims:
The main objective of this research is to explore the impacts of introducing a technology-assisted Problem Based Learning approach in a Transition Year context. The broad aims of the study are:

- To explore how the Transition Year students adapt to technology-assisted PBL;
- To explore teachers' perceptions of technology-assisted PBL as a methodology for teaching and learning and to consider the pedagogical implications of technology-assisted PBL;
- To examine how the use of technology affects the success of PBL as a teaching and learning methodology and
- To investigate the influence of the school context on the PBL approach.

Methodology & ethical considerations:

The approach employed during the research is a 'descriptive case-study', which would appear to be the most appropriate methodology for the chosen topic. According to Yin (1993, p.5) a case-study is an 'intensive rather than extensive study' of a small number of people or of a single setting and provides a 'detailed contextual analysis' of a limited number of events. Yin notes that the context (in this case, the particular class of Transition Year students; the unique group of staff and the distinctive school) is central to the findings. Further, Yin points out that when investigating the phenomenon (in this case, the use of technology-supported PBL); it must be acknowledged that the particular events and context influence the outcomes of the research. The pilot project of a technology-supported Problem Based Learning approach is a unique situation, driven by the school rather than imposed by government policy. There are no other known cases in an Irish context. A single case as opposed to a multi case study was therefore the only possibility.

The sample used for this research included twelve of the eighteen Transition Year (TY) students and a non-random selection of nine teachers from various subject departments, all of whom were involved in implementing the PBL approach with Transition year. This sample of teachers was chosen to represent a variety of disciplines and perspectives. The Principal, the post-holding teacher with responsibility for IT coordination and timetabling and the Transition Year co-ordinator also formed part of the sample group. As a teacher involved in the pilot project, the researcher was part of the sample by using participant-observation methods of data collection during the weekly double period of Geography.

The researcher primarily used qualitative methodologies to ascertain the experiences encountered by both staff and students, as a result of introducing the technology supported PBL programme. Interviews were conducted in a semi-structured manner, using open-ended questions to explore emerging themes. Similar core questions were posed to different groups of interviewees, to discover varying perspectives on the topic and to establish if the perspectives converged or diverged. The specific data collection methods employed were:

- Semi-structured interviews (TY teachers and school leaders);
- Focus group interviews (TY students);
- Participant observation (researcher's own detailed reflective journal notes);
- The creation of a database of documentation relating to the pilot project (e.g. minutes of staff meetings).

The recordings of the individual interviews and the focus groups were transcribed and were analysed and coded in order to identify emergent themes. The researcher's notes were analysed to draw out significant events and to interpret a variety of situations. The documentation was used as support evidence for emerging themes.

The most recent ethical guidelines for research as provided by University College Dublin were followed. As sensitive topics were not addressed ethical issues were reduced. Permission however, was sought from parents/guardians to allow the teenagers to partake in

focus group discussions. Efforts were made to protect the anonymity of participants and thus all names were changed.

Background reading:

This section is a summary of the background reading and literature review that was undertaken prior to and during the research process. The aims were to provide an overview of Problem Based Learning (PBL) and the issues involved in implementing it as a teaching and learning method and to identify gaps in the research on PBL to date. The literature that focuses on the integration of technology and PBL is most relevant to this case study and this is the most recent published work. Similarly the literature that reports on the use of PBL in post-primary schools is significant for the purpose of this study; however, most previous research has focused on the use of PBL in higher level education.

Defining PBL and the origins of PBL

Problem based Learning is part of a group of for learning and teaching methodologies that are known as Enquiry Based Learning (EBL). According to O'Rourke and Kahn (2005, p. 1) EBL is 'a broad umbrella term used to describe approaches to learning that are driven by a process of enquiry'. The classic understanding of PBL is based on the writings of Barrow. He defines PBL as 'the learning that results from the process of working towards the understanding of a resolution of a problem' (1980, p. 1). The characteristic feature of traditional problem-based learning is the 'problem' or challenge is presented first. All learning and curriculum inputs such as lectures, tutorials and video-clips follow and are related to solving this problem.

Problem based learning was originally employed by Howard Barrows and the phrase was coined by Don Woods in the 1960s, following work with chemistry students in McMaster University in Canada. This educational methodology was then used in the medical faculty of the university before being adapted and gaining popularity by spreading to medical faculties worldwide in the 1970s (de Graaff and Kolmos, 2007). It is now utilised in a variety of educational settings and a range of disciplines, mainly but not exclusively in higher education. The introduction of PBL marked an important era in educational history as the focus in education moved away from what the teacher is teaching and towards what the student is learning. Barr and Tagg (1995, p.6) state that problem solving by students represents part of the 'shift from the teaching paradigm to the learning paradigm'.

Theoretical frameworks that support PBL

There are four theoretical frameworks upon which PBL could be based. They are cognitivism (as explored by Schmidt ,2004 and Jarvis,1996 amongst others), constructivism (as supported by Piaget, 1985 and Papert,1996), social constructivism (championed by Mercer,1994 and Vygotsky, 1962) and postmodernism (Foucault 1969 and Lyotard, 1988, 1991). The first three frameworks encourage debate on the nature of knowledge and seek to answer how is it created or attained. Postmodernism negates the notion of concrete or certain knowledge and thus can be used as an argument to support PBL.

The PBL process and curriculum design

Barrows (1989) provided a PBL tutorial model that summarises the stages of the PBL process. Each stage has an emphasis on a different pedagogy such as collaboration, participant control, organisation, action learning, research, analysis and presentation

PBL is both a curriculum and a process, yet the boundary of where the curriculum ends and the process starts is not clear. This is one of the defining features of a PBL course. At the curriculum design phase the process of learning is central to the design. Conway and Little (2000) state that employing PBL involves re-conceptualising our curriculum. This notion of curriculum places the process as content and uses concepts (which become learning objectives) as the organising structure of the curriculum. PBL curricula are designed to provide the conditions for the learners to lead their own learning According to Mauffette, Kandlibinder and Soucisse (2004, p.11) 'A measure of the quality of the problem is the degree to which it stimulates the students' desire to learn'.

Assessment of learning as part of a PBL curriculum

The importance of appropriate assessment is clear from the literature as it can influence the perceived success of a PBL programme. As PBL differs from traditional approaches to teaching and learning, assessment methods must also be suitably adapted. As previously discussed, proponents of PBL view the process of problem solving to be as important as the facts accumulated. Therefore assessment must also incorporate some measure of the range of skills and competencies that students have developed. It is important to test how well a student is learning as opposed to merely how much they are learning. (Macdonald, 2005). If students can identify their need to increase their learning by naming learning objectives, it should be acknowledged by assessment. PBL thus rewards students for signalling their gaps in their knowledge and skills. This is in contrast to the traditional forms of summative assessment where students try to avoid topics where they lack knowledge and focus merely on the areas in which they can excel. According to Knight there must be 'balance and variety in the types and timing of assessment' (2000, p.142). A range of assessment methods that would be suitable in a PBL context were identified by Macdonald and Savin-Baden (2004) and Knight (2002,). Some examples include presentations, portfolios, reflective journals and reports and may take the form of a group or an individual submission. These assessment methods can be further enhanced and expanded through the use of appropriate technologies that support presentation; reflection and collaboration.

The reported benefits of PBL

This section will examine the benefits presented by proponents of the PBL tradition.

Barrows and Tamblyn (1980) established that realistic problems were very effective at motivating students to learn. This was seen as radical at the time but has since become much more mainstream. Donnelly (2005) states that learner-centred and enquiry based strategies such as those employed as part of PBL, means that "Students are more likely to

internalise the learning that takes place because they feel a greater sense of ownership of their work when required to make decisions based on real world events" (p.157).

Another benefit of PBL was proposed by both Savin-Baden (2000) and Oon-Seng (2009). Both researchers believe that PBL allows for learners' creativity to develop. According to Oon-Seng (2009, p. 5) "If only schools are able to nurture students who are curious and capable of solving new problems, we would have cultivated more intelligent and creative adults for the future society".

A further argument in support of PBL initiatives is that it can equip students for a changing world that requires more complex skills and competencies in professional spheres (Savin-Baden, 2000). Through PBL, students can gain skills that are requested by many of today's employers: problem solving, negotiation, working in teams, communication, decision-making, collaboration, presentation of information and creative thinking. The nature of what we need to know for a successful professional life has changed and continues to change. It is commonly believed that if students can use their skills to solve problems that are set by educationalists, they will thus be able to utilise those same skills and re-enact the problem-solving process when the need arises in 'real-life' situations.

Proponents of PBL believe it to be a more enjoyable learning experience. This has two associated benefits. First, is the argument that students will learn more effectively if they enjoy their work. Second, it can be argued that students' increased enjoyment is in itself a valid reason for adopting PBL. PBL supporters such as Papert (1996) highlight a correlation between enjoyment or fun and increased learning. The second argument for the adoption of PBL due to its element of enjoyment is evident in the appropriately titled paper (Barrett, 2005) "Who Said Learning Couldn't Be Enjoyable, Playful and Fun?" One of Barrett's conclusions is that PBL is a more enjoyable form of learning and this alone is an argument in favour of PBL. "From my data the idea of learning in PBL as fun, emerges. This is a fun that is not superficial and frivolous, rather a fun that is rigorous and challenging" (p.159).

A further reported benefit of PBL is the increased collaboration amongst learners. This leads to less individualism and greater opportunities for peer learning. Barrett (2004) highlights, this method of group learning brings a shift from an individual's knowledge and control to group knowledge and group control. Due to the collaborative nature of a PBL environment, students are more likely to risk making contributions. This should lead to the development of increased self-esteem among learners and is a further argument in favour of this strategy.

A final benefit, as proposed by Barrows and Tamblyn (1980) is that problem solving is a more effective way of learning than memory-based learning that is associated with traditional teacher-focused methods of teaching.

<u>The perceived limitations of PBL</u>

There are a number of criticisms that have been aimed at PBL. The first concern relates to a low acquisition of subject specific content by learners and the implication that a generation of generalists will be produced from this education system, with few students possessing

expertise Albanese and Mitchell (1993) conducted a meta-analysis of the research into PBL in medical education. They concluded that although PBL seemed to be more enjoyable and nurturing form of education, PBL students 'in a few instances scored lower on basic science examinations and viewed themselves as less well prepared'. One possible reason for this low level of content acquisition was suggested in a study by Kirschner, Sweller and Clarke (2006) entitled 'Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching' It was argued in this paper that long-term memory is the most important element of the cognitive process and thus good problem solvers are only experts due to the bank of knowledge that they have learned and stored in their long-term memory.

A second criticism is that certain groups of students do not benefit from this strategy. The most able students are thought not to be challenged sufficiently and the least able often lack organisational skills and thus are at a disadvantage (Mergendoller, Maxwell and Bellisimo, 2001). It has also been reported that PBL is more suitable for certain disciplines than others. The Science disciplines seem to fit naturally into a PBL structure but the Humanities prove more difficult.

A final view is that PBL is a passing fad that is introduced to entice students rather than being chosen on sound educational principles. The importance of attracting students is evident from Toohey's (1999) list of points that he urges educationalists to consider when designing a PBL curriculum. They include topics such as whether they have a unique selling point and how they plan to market their course? This raises questions about the merits of PBL and whether educational standard have been dropped since education has become viewed as a commodity? It could be questioned if PBL is adopted as a marketing tool or because its implementation is based on sound educational reasoning.

Supporters of PBL would be inclined to associate criticisms of PBL with poor curriculum design or too narrow a definition of PBL.

Technology and PBL

The inclusion of technology into PBL programmes is a relatively recent development. The principles of PBL are unchanged but the tools to support the approach and to provide an infrastructure for learning have changed. According to Donnelly, (2005, p. 157) PBL is a "natural setting for computer-based technologies [as they] may support and extend well designed learning activities". Five arguments have been identified as a rationale for incorporating technology in a PBL course.

The first reason is that technology provides tools and access to resources that can enhance PBL approaches and practices. "ICT as a tool and a way of organising information is one of the most important societal tools of today and PBL-approaches should therefore exploit the advantages here of" (Dircknick-Holmfeld, 2005. A second benefit associated with the use of technology in a PBL environment is that it allows students to engage with the task and may increase student motivation. By expanding the learning environment beyond the physical classroom, PBL becomes more accessible and feasible, thus ICT can be used as a lever for

PBL. A further advantage is that technology such as email, online discussions and web-conferencing increase the level of interaction between peers. As Donnelly (2005, p. 166) highlights, online discussions may "create a feeling of a learning community" and "overcome feelings of isolation". By including learning technologies into a PBL curriculum, it allows teachers and individuals to track performance. They can thus decide if there is a need for more scaffolding, prompts or disclosure for the learning to progress. A final reason for employing technology-supported PBL is that it increases the development of skills among learners. Today we need to be able to communicate with people in a variety of physical locations, with diverse cultural backgrounds and with a range of skills and knowledge. Technology allows this to occur. (Donnelly, 2005).

The previous discussions point to the potential benefits of employing technology into a PBL programme. These benefits are in addition to the wide-ranging advantages of PBL that were previously discussed.

Technologies can provide opportunities for learning but do not guarantee effective learning unless they form part of a complete educational approach. If the use of technology is not well planned, there are a number of potential pitfalls. The first disadvantage of employing technology is that it may be overused or used unnecessarily. The best PBL approach should start with the pedagogy and not be solely driven by the technology. A second area of concern was highlighted by Anstey (2000). He found that staff at higher education used the web for more passive and didactic forms of teaching and learning. This was often in the form of a Virtual Learning Environment employed to increase a teacher-led approach to learning. This student-passive and teacher-focused approach to learning is the antithesis of PBL.

Summary of findings & recommendations:

This particular technology-supported PBL programme had a number of positive outcomes. They included: an increase in motivation amongst students and staff; an improvement in students' skills and competencies; an increase in independence and responsibility for learning; improved self-esteem in students and the establishment of good peer relationships. The less successful elements of the programme that were identified from the findings were: the lack of a democratic decision making process; a low level of learning of subject-specific content; lack of engagement by academically weaker students; the misuse of technology; uninspiring assessment methods; groups dynamics leading to frustration amongst peers; technology being added on rather than being integrated into the curriculum design and an unreliable technology infrastructure. The broader findings are that for change at school level to be significant, it must be accompanied by systemic changes, including assessment procedures. Students and teachers are eager for an overhaul of the education system; however, waiting for this to occur is generating frustration. Change at a foundational school level is earnestly endorsed but it needs to be supported by the educational hierarchy, sooner rather than later.

As a result of the research findings there are a number of practical recommendations that can be made for the school in question. Firstly, teacher training in relation to curriculum design and group facilitation is necessary for the implementation of future projects. Similarly teachers need ongoing support and allocated meeting time to share ideas and good practice during the programme and to establish cross-curricular links. Secondly, in light of the issues that emerged regarding group pedagogies, different models of groups learning should be investigated for future practice (e.g. smaller groups that change on a regular basis rather than stable groups) to ensure that the most suitable group structure has been adopted. The third proposal is that the PBL approach could be further developed by creating opportunities for team-teaching to occur between teachers from different disciplines, thus enhancing cross-curricular links. The resources involved in this suggestion may be a limiting factor, as more than one teacher would need to be timetabled for each class.

A further suggestion, in light of the findings regarding the limitations of PBL in its current form, is that the school should explore other teaching and learning strategies. An alternative is to investigate the suitability of a range of EBL and group strategies, which may be more suitable for use in secondary schools than Problem Based Learning. This finding convenes with the researcher's initial view that PBL, although based on sound principles, is too narrow an approach for a post-primary Transition Year class and that it is not a panacea for all educational issues. Many of the Humanities subjects do not have specific 'problems' that need to be solved and thus PBL can seem contrived in these situations. Also in keeping with the PBL model, problems should ideally be designed to encompass a variety of disciplines, as in real life. However in the existing education model and in the post-primary sector in particular, subjects are delineated and divided. Until there are systemic changes, schools and teachers must work within these constraints, while maintaining the vision for education and learning to be student-led. Therefore appropriate teaching and learning methodologies must be sought that are suitable for the variety of subjects that are offered by schools.

The final suggestion for the school relates to its long-term aim of investigating student-based approaches that could be adopted with other year groups in the future. In light of this goal and of the findings of the case study, the researcher has identified areas that need to be considered before rolling out a PBL or other EBL approach in the Junior and/or Senior Cycles. The first is the need to avoid the mistake made during the pilot project in being overly-ambitious in its scale. One suggestion for overcoming this issue is for PBL to be implemented with a smaller selection of subjects. Another possibility is for the school to adopt any new teaching and learning initiative for only one term with one year group. This would allow teachers to properly design a small number of modules and it would be less discouraging if the outcomes were not wholly achieved. Also the recommendations that have already been made to improve the TY programme, (e.g. to provide teacher training,

investigate alternative models for groups, introduce team teaching etc.) could be incorporated into programmes for other year groups.

How the research contributed to my professional development:

As the PBL methodology has been identified in the literature as transformative to the process of teaching and learning (e.g. Barrows and Tamblyn, 1980; Papert, 1996; Savin-Baden, 2000), the researcher was interested in exploring it as a possible method for improving her own teaching. The researcher thus recognised the value of conducting research into PBL as an alternative teaching method, as she was acutely aware of the shortfalls of the current education system. As a result of this research, a variety of collaborative learning techniques that can be combined with technology were explored, experimented with and implemented by the researcher. They included co-operative learning, challenge-based learning and project based learning. The successes of these experiments have reinforced the researcher's belief of the need for collaborative learning supported by technology. Due to the questions raised during the research the researcher embarked on a journey to explore her own philosophy on the purpose of post-primary education and to find ways of teaching that were in keeping with this philosophy. As part of this journey, links were made with Bridge 21, based in Trinity College, Dublin. This provided an environment for the researcher to be immersed in and to observe collaborative, enquiry based learning that is supported by technology. The process of researching has also raised further queries such as the possibility of reimagining our roles as post-primary teachers that would see a shift away from teaching narrow disciplines to creating learning environments that allow students to tackle 21st Century challenges.

How it will benefit the education community:

The researcher recognises that an exploratory single case study has limited value for application to a wider context. However, a small number of issues emerged that require acknowledgement due to the implications they may have in a broader context. These issues will be briefly described in this section.

A recommendation on a broader level is for other schools to utilise the report of this case study to learn from the successes and weakness of this pilot project and to risk experimenting with alternative approaches to teaching and learning. The weaknesses that were encountered in this PBL pilot project included: the project being over-ambitious scale; a lack of teacher training and support; an autocratic decision-making process in relation to teaching and learning strategies; and an unreliable technology infrastructure. The emergence of the students' desire for more support from teachers during the PBL process, may point to the need for PBL to be adapted for secondary sector students to include greater teacher input upfront. If another post-primary school was to adopt a programme of reform or innovation based on a student-led inquiry model, they could consider these findings and adapt the programme to suit their own context.

The most obvious example of success was that the introduction of a new teaching and learning initiative provided opportunities for reflection and debate amongst staff. This proved invaluable for identifying values of the school and needs of the school community as well as allowing space for teachers to consider their own philosophy regarding teaching and learning. A similar sentiment was expressed in the NCCA document 'Innovation and Identity: Ideas for a new Junior Cycle' (2010):

> "Schools embracing the freedom to be flexible and to be different will require maturity but will reward the prudent risk-takers with learning outcomes of greater relevance and sustainability as well as professional fulfilment not always evident in the existing models of schooling."

The second implication of this research is that it illustrated that a change in education can occur at grass-roots level by individual schools, even on a small scale. The findings of this dissertation may be useful for other Irish post-primary schools that are considering introducing an alternative approach to education. A PBL approach may be a suitable initiative for Transition Year students in other schools as this strategy is in keeping with the National Council for Curriculum and Assessment's (NCCA) vision for Transition Year. According to the NCCA Transition Year should be

> ' designed to act as a bridge by facilitating the smooth transition from the more dependent learning of the Junior Cycle to the more independent self-directed learning required for the Senior Cycle. The Transition Year offers students an opportunity to engage in independent, self-directed learning, to develop general, technical and academic skills, and to mature and develop without the pressure of an examination'.

It emerged during the course of this research that teachers are ripe for a change in how education is delivered, but that training and support need to accompany any initiatives to maximise success. The teachers that were interviewed acknowledged the need for learning to be central to the education discussion and for teaching to take a background role. It could be reasonably assumed that these teachers are not alone in their thinking and that there is an appetite for change in the Irish education system. The conditions however must be provided to allow change to occur. This means that training in and experience of student-led inquiry approaches such as PBL, should be considered for novice teachers as part of teacher education programmes. It should also be made widely available to established teachers as part of continuous professional development.

Finally, the case study identifies that school-based reform will not make a significant impact on teaching and learning unless it is accompanied by an overhaul of the entire education system. Change in the education system needs to be initiated by the policy makers. The findings of this study point strongly to two reasons that a change in the system is needed: firstly the young people of today need to learn new things and in new ways to enable them to cope with the challenges of 21st Century living and secondly the current educators recognise the need for change and are ready to adopt alternative approaches to raise the educational

horizons of their students. As stated in the introduction, there is a global shift towards the need for educational change. One only has to see the publicity that Sir Ken Robinson's talks (www.Ted.com, 2006, 2010) have received, regarding the need to revolutionise education to appreciate the undercurrent of dissatisfaction with the current provision of education. Currently skills and competencies are undervalued and subject specific content and rote-learning are overvalued. Therefore the PBL approach of other teaching and learning initiatives will have limited impact until the education system adapts and expands to encompass a broader understanding of the purpose and process of education. There have been small system-level advances made in the Irish context. An example of this is the recent document published by the NCCA entitled 'Innovation and Identity: Ideas for a new Junior Cycle'. It is part of a consultation process aimed to foster innovation and change of the Junior Cycle in post-primary schools. Some of the elements of change discussed in this document include schools leading change at a local level, being adventurous in teaching and learning methodologies, including elements of investigation and employing thematic learning. These same elements could also be identified in the aims of PBL programme. This shows some alignment between the goals of the policy makers and those of the educationalists.

In conclusion, the attempt to engage in a change process at the school level is timely, due to the appetite for change amongst the education community. However, for a change in teaching and learning to be sustainable, school-level changes must be accompanied by systemic changes in education at national policy level and by changes in teacher education practice.