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LINKING LEARNING *to* COMMUNITY *for* INDIGENOUS COMPUTING COURSES

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■ Abstract

Since its inception, Problem-based learning (PBL) as a process for learning and teaching has been used to enhance many skills based courses, including education programs at Bachelor College and the Aboriginal Technical Health Worker training program at the Centre for Appropriate Technology in Alice Springs. While PBL is an approach to learning and teaching which has been designed to provide a more holistic educational process for all students, Foster and Meehane (2007) suggest that many aspects of the courses are ideally suited for Indigenous students. In particular, this approach is useful when introducing students to a subject matter which is new both in being derived from another culture and not being accessible to Indigenous parents in the past. PBL provides a flexible approach to enable motivation and involvement of the students and their community. This paper considers the benefits of PBL for learning Information Technology and presents some course templates developed to support teaching Indigenous students at school.

■ Introduction

Finucane et al. suggests that:

> Problem-based learning (PBL) in medical education uses clinical cases as the context for students to study basic and clinical sciences. Its possible advantages over traditional approaches include its greater relevance to the practice of medicine, its ability to promote retention and application of knowledge, and its encouragement of self-directed life-long learning. Possible disadvantages include higher costs, both in resources and staff time. Although its efficacy is difficult to evaluate, the current enthusiasm for PBL seems justified and its use is likely to increase further (Finucane et al., 1998, p. 445).

The authors of this paper have been involved in teaching IT and/or Indigenous students for many years. We see PBL as one approach to education which supports learning in an authentic context with student control over their learning. This provides an ideal environment for Indigenous learners. The paper reports the outcomes of a federally funded project which aims to provide students with the opportunity to learn new skills to enable them to fulfil their creative and intellectual potential. Indigenous people have been marginalised in all areas of development in Australia, yet their contribution has remained significant, even in the "industrial arts". Eric Willmott's continuous variable ratio transmission system for vehicles and David Unaipon's lateral cutting sheering machine are examples of how creative minds can contribute greatly to technology without requiring strict adherence to the educational stepladder applied to engineers and scientists.

Unless technical courses are provided in a flexible and motivating manner, much of the future creativity of Australian society, and not just the mainstream section, will be lost. At the same time, the large body of knowledge, which is maintained within the Indigenous community in Australia, will remain separate and relatively unsupported by the growing IT resources for knowledge storage, handling and development.

The resources described here were developed during a project funded by the Federal government's Curriculum Unit to support school teachers who wish to run their own PBL courses in line with the existing New South Wales school curriculum in Information

Technology (IT) courses. The projects include projects which involved students in: developing a database of Indigenous recipes for podcasting; games which incorporate protocols for social interaction within the community; and websites for placing community features and information within a *Google* map. The projects are designed to require the students to incorporate the Indigenous community in the information gathering, and to acknowledge the community knowledge that is required to develop the IT resources. The courses seek to encourage Indigenous students to see IT as relevant to their lives and their community, and also for non-Indigenous students to learn the breadth of application of IT across cultures.

The curriculum development was mostly involved in developing templates for the project courses. PBL teaching and learning requires a lot more preparation than conventional courses, and requires the teacher to have a much broader understanding of their domain than is normally expected. At the same time, the main focus of PBL is to provide support for students to learn at their own rate, level and interest focus. Hence the resources were developed and made available at: http://cgi.cse.unsw.edu.au/~ckutay/ASISTM. This paper is about how these resources can be used in a manner which supports Indigenous students in computing courses, and how teachers can contribute and add to the projects which are available.

Why Information Technology?

The courses were developed for teaching IT as there is growing interest amongst Indigenous people in developing and accessing IT resources which support the aims of the community (Dyson et al., 2007). At the same time these resources need to be sensitive to the specific needs of Indigenous knowledge and knowledge sharing. Hence, the development of an increased pool of Indigenous IT experts is vital for this process.

Information Technology is about sharing information, which can form knowledge for the user, depending how it is presented or shared. The type of knowledge we are sharing and how we share it will vary between cultures. The present non-Indigenous knowledge system is a hegemonic system which has usurped most other systems. Both Indigenous and non-Indigenous researchers are concerned by social barriers to knowledge sharing and the effect this has both on the knowledge retained and how it is shared. Keiichi Nakata (1999) points out that an essential step in creating social knowledge is to capture individual's interests, and new knowledge should emerge from sharing individual knowledge. Social knowledge is a mediator that brings people together. Martin Nakata (M. Nakata, 2006) has written of the use of knowledge databases such as

Our Story at Angurugu and the need for community involvement in such projects.

It is recognised that there is a paucity of ideas and processes to tackle present day problems, such as global warming. Providing the viewpoint from outside the mainstream can suggest approaches which overcome the stalemate. For instance Stuurman (2007) in his presentation suggests that an identity footprint must be mapped out by individuals before people can relate to what is their carbon footprint and be motivated to make any changes.

In some knowledge domains developed as part of recent scientific research, Indigenous knowledge systems are capable of explaining or conceptualising the issues better than the European systems. Peat (1996) has written extensively about the debate over the interpretation of quantum theory as developed by western abstract thinking, comparing this to indigenous world views in North America. Peat suggests that the impersonal subjectivity of Indigenous American knowledge can contribute to our understanding of these concepts.

As a final point, if knowledge is to be controlled and shared by Indigenous people, then non-Indigenous people need to understand Indigenous knowledge in its context. For example, Christie (2007) was involved in a consultation on environmental management using fire-making in the Northern Territory. The scientists involved were interested in applying this knowledge of land management with fire, to a different environment, so wished to abstract it from its present use. Unfortunately, communication failed as the Western scientists wished to separate the knowledge of fire-making from the environment in which it was used.

Present use of IT in Indigenous communities

While the uptake of IT in Indigenous communities both urban and rural is developing rapidly, Information Technology curriculum design is often not ideal, nor does it necessarily satisfy the participants, or the community involved. Some issues that arise may be the result of factors such as:

- Non-Indigenous teachers do not have the knowledge or skills to redesign for diverse cultures;
- Indigenous children are growing up in a world of IT which was not available to or can appear to deny the skills of their elders;
- IT resources do not include the needs of Indigenous people;
- IT resources are not providing a suitable cultural context for Indigenous knowledge.

The development of IT resources for Indigenous communities can be compared to the development of Indigenous languages post invasion. Pitjantjatjara is a strong language which has survived and is used in many

communities still as the main language. Yet when talking about Western items, such as the chair, the words that have been created (*tjiya*) are pidginised forms of the word, rather than an attempt to take a technology and redefine it in terms of the Pitjantjatjara culture. Thus, technology remains an external process and object. Yet computing provides a technology which is highly flexible. This allows those with design skills, sufficient IT knowledge and endless creativity to develop IT resources and processes that will support the promotion of Indigenous culture into the mainstream, in a manner which is under the control of Indigenous people.

Teaching computing in the community

Problem based courses are designed to provide courses which satisfy various criteria. These criteria tend to map well with some of the aspirations for learning as defined by educationalists researching Indigenous learning such as Brady (2007), Harris (1990) and Nichols (2006). While there is debate about the relevance of some features which Nichols (1998) asserts as crucial, there is clear relevance to PBL approaches in providing suitable cross-cultural learning.

PBL courses provide the opportunity for teachers to develop a learning environment which:

* Provides practical real-life culturally relevant projects: Fits with Indigenous students choosing practical VET courses over more theoretical components (Nichols, 1996), supports learning as a cooperative process (Brady, 2007);
* Involves community in the project: Supports processes of learning in context and personal links with information that are important (DAA, 2003);
* Provides an integrated course structure rather than compartmentalisation: Supports holistic learning style (Brady, 2007) and relatedness not compartmentalisation (Harris, 1990);
* Provides a practical learning environment where students can develop and use their ideas in practise: Supports learning is visual and kinaesthetic through observation and imitation rather than verbalisation (Brady, 2007);
* Promotes projects that tend to iterate through the learning syllabus either within a project or through subsequent projects: Supports cyclic process rather than linear concepts of time (Harris, 1990);
* Encourages involvement in professional process from the start: Supports being rather than doing (Harris, 1990);
* Encourages students to develop their own solution and interpretation of the problem and solution: Supports an open view of work and economics (Harris, 1990);
* Involves group work emphasising learning from peers: Supports contrasting views of authority (Harris, 1990);
* Promotes learning through understanding: Involves spiritual rather than positivist thinking (Harris, 1990).

Process of developing teaching resources

If PBL teaching is to provide a more favourable environment for learning, the learning and teaching process needs to be supported in such a way that the teachers are well prepared in their support of the learner. Developing teaching resources on a web site enables ideas to be shared and the resources to be updated as teachers use them, make changes where needed, hence develop more resources to support each course.

The courses at present are designed mostly for Information and Software Technology as this is the level that most Indigenous students achieve to date in Sydney schools. However there are clearly many Indigenous high school students who go onto University after completing the year 11-12 courses. Hence, the PBL projects need to be expanded to cover all HSC syllabuses.

Currently templates have been developed for all computing syllabuses taught in New South Wales high schools – Information and Software Technology (IST), Information Processes and Technology (IPT) and Software Systems Development (SSD). However given the range of options in these courses, not all options are covered yet in the templates. The templates include:

* Notes to guide teachers as to where course material would fit into the project and opportune times to introduce specific concepts into the students learning.
* Student Handbook to introduce students to PBL process and the project they will carry out, provide training in some of the basic skills needed such as brainstorming and reflection, the assessment criteria for the project and the Project Management process.
* Specific learning materials which will help the student carry out that project.

Importantly, teachers can upload their own documents and ideas into the course material to improve the support.

Illuminating Information Technology courses in PBL

We would now like to describe the sort of process that occurs in PBL learning to illustrate the appropriateness of these resources to Indigenous learners and their teachers, and how these courses can be developed and enhanced through the repository or database of resources being developed.

Developing practical real life projects

The projects developed on the site are described below:

1. IndigiTucker: Students can arrange to talk to the manager of local Indigenous catering services about ways to promote the organisation and its recipes. By developing a database of food resources linked to diet and other information the project will provide a service where the user can select menus for specific occasions or needs, or download a podcast of the latest creations.
2. Roads and Traffic Authority: This project used the interest that all students have in learning to drive. What if the RTA was to provide a service to search for information that other people might need to obtain their driving permit? What would be a good system? What sort of information would it provide? How would you search it and how could you add new information to it?
3. School Tour: New students coming to your school can get quite lost. Can you provide a podcast of maps where the user selects the start and end square and you provide a video and audio stream describing how they go to their destination?
4. Community Game: When you go home from school, you usually travel around through the community, meeting people, visiting their homes. What are the rules you follow in social interactions? Can the student define these rules in terms of game goals and strategies? These are written into a straightforward game which they can then play.
5. Story Map: You and your family have a long knowledge of your community and its environment. What can you put onto a map to show visitors what there is to offer, or how the present links to the past. The project uses *Google* maps programming language, and *Google SketchUp* program. Video and audio links can also be used to locate knowledge on the map.

▧ Involving the community

These projects require students to gather information from their own community. Even the RTA project will have a different set of information needs to support Indigenous learner-drivers in many cases and their families would have this knowledge having done the process themselves. Hence, the community knowledge is respected and vital to the success of their project.

In practical terms, all the projects provide tools for students to include information in a context (e.g., game, map, tour) without great programming skills. That's why the students and the community can start off with little background and be motivated to increase their skills and knowledge. All of the projects are designed so that students work in groups so as to encourage them to share their knowledge and learn from others, celebrating their discoveries, solving the difficulties while mastering the new technology, and uncovering new ways of using this technology (e.g., writing games as well as playing them).

Providing integrated courses

In PBL, the teacher focuses on the concepts, (e.g., on telling the story). The details of the process and the intricacies of the knowledge are left for the students to confront. However when students do find they are "stuck" they need to be able to get help. Where possible we are trying to encourage teachers to publish material that can be available for students to search themselves. The process requires teachers to take a less didactic and expert role, develop a relationship with the students and involves teachers learning as much as possible about how the students understand the project and the learning material. In essence, teachers need to be involved as much as the students are in learning about the course material.

We believe this will be facilitated by students being encouraged to ask what they need to know when they need to know it. Rather than being told by the teacher what is required, students are encouraged to seek out what they need. If students are not making progress by raising issues and asking questions the teacher is provided with notes to guide the students and provide hints and ideas for them to progress.

The projects are designed to be open and flexible enough to allow students to use many different approaches and technologies. Thus, by using PBL the students share in the process by solving problems and learning from each other, and more importantly educators can see their pride when the IT project is demonstrated and showcased at the end of term. For this reason, PBL provides greater student control and scope for shared learning and building self-esteem.

Encouraging a cyclic process

In essence developing an IT solution is a cyclic and never-ending process. One of the hardest steps in a large project is when to say "enough is enough" and put the product to market. For this reason the end of term (or end of year for larger projects) provides a good deadline. However to achieve this deadline students are encouraged to have a "working product" at all times. This enables the students to always have a game to play or a web site to view; they are continually improving or adding to the site. While this retains some notion of linear development, it does ensure the student appreciates the cyclic nature of software development. To assist this work, feedback is given regularly (assessment is on going rather than based on set outcome tasks) and groups redo work on the basis of this feedback. Assessment is highly interactive, even

at the end, for the final iterated product. Thus, each iteration is important for learning, not just the last iteration. However, this does not mean the standard of learning suffers. One of the features of this project was to involve academics who are teaching in the project areas to include a direction to the projects which reflects the learning goals for university students. The aim is that at the end of the projects in the HSC years the students will have an understanding of the domain that is suitable for entering first year university courses in IT.

Being an IT person

The project provides time to reflect and discuss ideas. In fact from the first week reflection exercises are set, to encourage students to be aware of the group's processes, the software development processes, and the learning proces ses they are using. As important as it is that the projects be real life projects and that the working environment should reflect a real environment, the scope and result of the students work should also demonstrate that each project is under the students' control. The teacher's role is to emphasis the process more than the subject matter. In doing this the teacher is building up an identity as an IT person, rather than putting the students through various "skills tests" activities. Additionally, in line with Quality Teaching principles, PBL offers IT teachers the chance to critically reflect on not only **how** they are teaching but **what** they are teaching in the classroom and **why** they are teaching it (DET, 2003).

Encouraging self-paced learning

As much as possible the courses can be self-paced within the school term. This supports an open view of work and economics in that the student is given more control of their contribution. Also within the group their individual contribution can be arranged around other commitments.

Group authority

As mentioned before, the learning is in groups, and the teacher is less of an expert and more of a guide. This enables the students to share their concerns in a more supportive environment than they generally share with the teacher. Also the expertise of others besides their peers and the teachers can be used. The project does not rely on the technology solely.

Learning through understanding

One of the most interesting areas of PBL (if handled by an inspired teacher) is that it provides the freedom to enact highly creative and original solutions rather than tying the project to the syllabus. The learning

becomes an adjunct to what can be an exciting project. And it is in this area which we hope Indigenous students will provide inspiration for generations to come.

Conclusion

The authors are interested in the development of Indigenous IT expertise, and expertise that goes beyond using the standard products developed to satisfy mainstream needs. We do not only wish to train up people to work in a *Microsoft* office environment. We are interested in ways to put Indigenous knowledge in the public domain in a suitable context which ensures the knowledge is correctly understood, attributed to its authors and fully controlled by the originators. For this we need programmers, we need database developers, we need designers. We present this project as it combines the useful attributes of PBL courses with topics which involve Indigenous students and community in novel IT development projects. We hope this ongoing project will go some way towards encouraging these aspirations in Indigenous Australian communities. Additionally the authors hope that showcasing some of the PBL projects illustrated in this paper will lead to greater understanding of PBL, encourage more teachers to become involve in teaching IT and therefore engage more Indigenous students in IT courses in schools and beyond.

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