

International Education Journal



Educational Research Conference 2004 Special Issue
Volume 5 Number 5
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Volume 5, Number 5, June 2005

Educational Research Conference 2004 Special Issue



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Designed by Katherine Dix

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IT, e-learning and teacher development¹

Jonathan Anderson

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This paper traces some of the ways that IT has changed and continues to change our lives, and how information and communication technologies or ICT are changing learning in schools. The real potential of ICT is the way it changes learners and the major focus of the paper is on e-learning, a term that combines pedagogy and technology. For this potential to be realised, teacher development is critical, and to this end some of the rich resources available for use by teacher educators through global gateways are described. The paper concludes by outlining why e-learning is important in teacher development.

Information technology, e-learning, ICT, online learning, teacher development,
global gateways, portals

PREFACE

It is a privilege to present this year's Jim Richardson Annual Lecture in Education, in honour of a great educator. It is a particular pleasure because Professor Jim Richardson's career and mine have been very much intertwined, rather like the game of catch up as I'll explain.

Jim's first academic appointment in Australia was to the Remedial Education Centre at the University of Queensland, there to work with Professor Fred Schonell. Later, when Fred Schonell, who was now Sir Fred Schonell, became Vice-Chancellor at the University of Queensland, Jim Richardson became Director of the Remedial Education Centre. It happened that my first academic appointment was also to the Remedial Education Centre – at the lowest level in universities at that time, namely as Tutor in Education. However, when I took up my appointment, Jim Richardson had moved on and was now Professor of Education at the University of New England in Armidale. At the Remedial Centre I got to know something of Jim Richardson and became acquainted with his classic publication, *Books for the Retarded Reader*, which was to go into six editions, quite an achievement for books in education.

Three years later I was appointed to the University of New England as Lecturer in Education but again our paths were not to meet because in the preceding months Jim Richardson had taken up an appointment as Foundation Chair at Flinders University. His was a joint appointment for he was also Principal of the then Bedford Teachers' College, in whose buildings we are now meeting. Jim seemed like a star figure to me but he was always a step ahead and our paths did not cross. However, he influenced me indirectly because in Armidale I founded and became director of the NEED Educational Clinic, which was modelled very much on the Remedial Education Centre at the University of Queensland.

We were to meet finally, three years later, when I was appointed to the second Chair of Education at Flinders University, there to work alongside Jim Richardson. At last I had caught up with him. I could not have wished for a finer model and colleague.

¹ Paper presented for The Jim Richardson Annual Lecture in Education, Flinders University, Adelaide, 18/11/2004.

One other episode at the University of Queensland has a bearing on today's lecture. In the first few months of my initial appointment there, the university took delivery of its very first computer, only the third in Australia. I remember it well – it was a GE50 and the 50 might have stood for 50 tons for it occupied a whole room. Each department of the university was invited to send a staff member to learn about this 'new' machine and, as newest member in my Department, the Director of the Remedial Education Centre who followed Jim Richardson, called me in and said, "I'm not quite sure what these computers are but I think they could be important. You should find out about them." He was right and I followed his advice, for when I moved to the University of New England I became the first graduate in what was Australia's first post-graduate Diploma in Computing Science.

Let's move 40 years forward to the present.

INFORMATION TECHNOLOGY UPDATE

The old GE50 mainframe computer soon became a dinosaur as computers went through wave upon wave of innovation. Any of today's desktops or laptops is far more powerful and faster than that early GE50. Coded instructions on paper tape gave way to batch processing via 80-column cards, which in turn gave way to typing instructions at an individual workstation, to today's pointing and clicking in a windows-like environment. Developments in the near future are likely to see finger interaction replaced by voice communication.

Let's look at other trends in IT.

- The days of videotape are numbered. Multinational companies like Philips Electronics announced that they have ceased production of the video-recorder.
- DVD has replaced CD-ROM as a storage medium, as is readily evident if you visit any video rental store.
- Dial-up access to Internet service providers has been overtaken by broadband connections.
- The world of photography has changed markedly as still print and slide cameras have given way to digital cameras. "Digital boom forces Kodak to shutter up shop" was a recent headline in *The Weekend Australian* (18-19 September 2004).
- The end of the phone as we know it has arrived, announced the chief executive of Telstra recently. Australia is on the cusp of a "sharp change" he said at the company's October 2004 AGM as the number of fixed-line telephone services dropped by more than 100,000 compared with a year ago. We are seeing landlines increasingly replaced by mobile and internet-based telephony.
- Laptops are giving way to a new generation of powerful pocket PCs, Palm Pilots, and PDAs.
- The world has become googled as we google for information, and another new word from IT has entered our vocabulary. A recent newspaper report describing the release of an Australian hostage in Iraq said that his captors "Googled his name on the Internet to check his work before releasing him".

Other IT trends that are changing our lives include the following:

- The occupation of door-to-door encyclopaedia salesman has passed into history as their DVD counterparts or virtual copies on the Internet have replaced hardbound encyclopaedias.
- Bankbooks and chequebooks have become casualties of Internet banking.
- The personal letter has almost disappeared having been replaced by instant SMS messaging on mobile phones using a new kind of English language.

Because IT changes the way we interact with the world, IT changes us.

At the same time, IT has left in its trail many unfulfilled promises such as, for instance:

- gadgets that clean one's home automatically;
- food pills that do away with cooking;
- the paperless office; and
- more leisure time.

Meanwhile, what has been happening in our schools?

CHANGING PARADIGM FOR SCHOOLS

Much has been written about the way IT, or rather ICT (information and communication technologies), are changing, or perhaps it would be better to say, have the potential to change, much of what happens in our schools. Morel and his colleagues at the University of Geneva (2003), for instance, have stated that we are witnessing a paradigm change in our schools – from teacher-centred to learner-focused. As ICT becomes integrated into every aspect of a school's activities, UNESCO's (2002b) *A Planning Guide* succinctly captures the changes in student and teacher roles in the newer kinds of emerging learning environments noted by Morel and his co-authors (see Table 1, adapted from UNESCO, 2002b). These changing roles of teachers and students have been aptly summed up in the quip that teachers change from being “sages on the stage” to becoming “guides on the side”.

Table 1. Changes in student and teacher roles in teacher-centred and learner-centred learning environments resulting from ICT integration

Learning Environments	
Teacher-centred	Learner-centred
Student role <ul style="list-style-type: none"> • Passive recipient of information • Reproduces knowledge • Learns as a solitary activity 	Student role <ul style="list-style-type: none"> • Active participant in the learning process • Produces and shares knowledge, participates at times as expert • Learns collaboratively with others
Teacher role <ul style="list-style-type: none"> • Knowledge transmitter, primary source of information, content expert, and source of all answers • Controls and directs all aspects of learning 	Teacher role <ul style="list-style-type: none"> • Learning facilitator, collaborator, coach, mentor, knowledge navigator, and co-learner • Gives students more options and responsibilities for their own learning

Along with changed student and teacher roles, ICT is contributing to changing the whole structure of schools. ‘Closed door’ classrooms are stretching their walls to embrace the wider community; the instructional emphasis is moving from memorising facts to inquiry-based learning; rigid class timetables are becoming more flexible; and technologies once firmly located in schools are being accessed from beyond the perimeters of the school (Moran et al., 1999).

The changing nature of schools brought about by the integration of ICT in teaching and learning is supported by a further UNESCO publication (2004) that has as one of its major themes how ICT can create new, open learning environments:

More than any other previous technology, ICT are providing learners access to vast stores of knowledge beyond the school, as well as with multimedia tools to add to this store of knowledge. (UNESCO, 2004)

This UNESCO handbook's incredibly wide coverage – embracing educational technology of the mind, the new literacy, multiple intelligences, wearable computers, goals of education, information objects, the mathematics of informatics, and much, much more – details the potential

of ICT to impact on every aspect of the life of schools, changing them irreversibly from schools as we now know them.

The real potential of ICT is the way it changes learners, which brings us to e-learning.

WHAT IS E-LEARNING?

Today nearly everyone is familiar with e-mail and progressively we are becoming acquainted with e-banking. We also hear about e-commerce, e-business and e-trading, and so it was almost inevitable that the term *e-learning* would be coined. How common is this term?

Look up *e-learning* in one Internet search engine and receive 13,929 hits (AltaVista). In another search engine, receive a staggering three and a half million hits (Google) – even more hits in both search engines if the variant *e-learning* spelling is added!

As a market activity in commerce and industry, e-learning has been enthusiastically accepted by the corporate sector. “Corporate e-learning is one of the fastest growing and, we believe, most promising markets in the education industry” according to Urda and Weggen (2000, p.1). On Wall Street, stocks in e-learning companies form a key part of the Nasdaq Index. The same corporate report concludes: “We believe e-learning will change the way corporations deliver training in nearly all segments of the business process” (p.31).

E-learning is making a similar impact in education. Numerous papers have begun to appear on the topic in the K-12 schools sector, the higher education sector, and the vocational training sector. The following reports, chapters in books, and research journal articles typify the increasing interest in e-learning, and appropriately all are available online:

- *From teacher education to professional development for e-learning in an e-society* (Morel, et al., 2003)
- *ICT and future teachers: Are we preparing for e-learning?* (Jones, 2003)
- *E-learning: emerging issues and key trends* (Eklund, et al., 2003)
- *Future trends in eLearning: lessons from history* (Martinich, 2003)
- *Developing e-learning content* (Australian National Training Authority, 2003)

But what is e-learning and how does it relate to ICT? In answer the first question, one definition of e-learning goes as follows:

the delivery of content via all electronic media, including the Internet, intranets, extranets, satellite broadcast, audio/video tape, interactive TV, and CD-ROM. (Urda and Weggen, 2000, p.8)

Other writers (for example, Jones, 2003, p.1), equate e-learning with digital learning – what is often referred to as online learning – and therefore exclude media like audio and video tape, CD-ROM and DVD. But it is useful to distinguish e-learning from online learning, as does the Australian National Training Authority:

e-learning is a broader concept [than online learning], encompassing a wide set of applications and processes which use all available electronic media to deliver vocational education and training more flexibly. (Australian National Training Authority, 2003, p.1)

It is useful also to separate e-learning from distance learning, which generally includes text-based materials as well as electronic media. These relationships between e-learning, online learning, and distance learning are seen graphically in Figure 1.

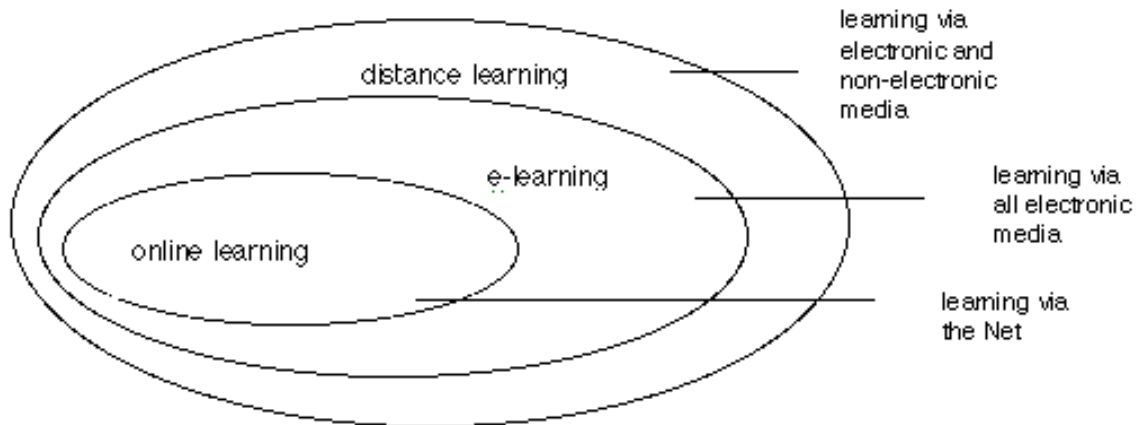


Figure 1. The relationship between online learning, e-learning, and distance learning

Figure 1 serves as a reminder that e-learning is broader than online learning since it includes all electronic media, like CD-ROM and DVD for instance, both of which are off-line media, as well as web technologies. At the same time, e-learning is a sub-set of distance learning, which also utilises print media.

E-LEARNING AND ICT

The second question posed above was how ICT relates to e-learning.

UNESCO uses the term *ICT* or information and communication technologies to describe:

the tools and the processes to access, retrieve, store, organise, manipulate, produce, present and exchange information by electronic and other automated means. These include hardware, software and telecommunications in the forms of personal computers, scanners, digital cameras, phones, faxes, modems, CD and DVD players and recorders, digitised video, radio and TV programmes, database programmes and multimedia programmes. (UNESCO Bangkok, 2003, p.75)

In so far as ICT include hardware, software and telecommunications, ICT is seen to be the means to support student learning via electronic media. E-learning, then, is the growth in students' understanding and knowledge when they utilise ICT in instructional settings. Thus in the context of teacher development – both the initial training of teachers and their continuing professional development – e-learning for teacher development includes all the courses, workshops and other activities, formal and informal, where student and practising teachers learn about integrating ICT across the curriculum to support student learning.

E-learning, then, is a useful term because it places the focus where it should be – jointly on pedagogy and the new information and communication technologies. It embraces learning by, with and through ICT. The term itself – *e-learning*, or learning via electronic media – nicely combines in its name all these concepts.

GLOBAL GATEWAYS TO ONLINE RESOURCES FOR TEACHER DEVELOPMENT

In this section, the focus turns to teacher development and the enormously rich resources that are available online for use by teacher educators who are familiar with how to access them.

The world's most popular Internet search engine, Google, announced (19th February 2004) that it had added a billion pages to its gigantic store of 4.28 billion pages. A problem arising from this growth is how to sift through the enormous number of 'hits' that result from most search queries, such as the three and a half million hits for the entry *e-learning* noted at the beginning of this

paper. Not only is the number of hits far too many to look at in a single lifetime but many of the web pages in Google's vast database are of dubious quality, or may even have changed location or disappeared since being indexed. For this reason, it is now a recognised convention to indicate in a list of references the date when a website was accessed (see the URL references at the end of this paper).

A practical solution to the problem of too much information is the emergence of global gateways to online knowledge networks in particular fields. These global gateways might be more familiarly known as *web portals*, although a large number of other terms are in vogue – information portals, super portals, vortals, hubs, networks, directories, digital libraries, virtual libraries, and clearinghouses (Lonsdale, 2003). These terms all refer to a single access point or website to which users can go for particular information, and sometimes, as well, for a range of other services such as news, weather information, and discussion forums.

Whatever the term used, global gateways provide a necessary filter to help reduce information overload. Even more importantly, the filtered information has been evaluated before placement, and often links to sources and resources are accompanied by brief descriptions or annotations. Like the rapid growth in information, the number of web portals has similarly increased markedly in recent years, as evident in the fact that Lonsdale's (2003) guide to online knowledge networks in education is already in its third edition (the first edition appeared in 2001). This most recent edition is online, making it additionally valuable.

Six web gateways from around the world are overviewed briefly below (see Table 2). Between them, these portals provide links to a rich source of e-learning materials for teacher development.

Table 2. Selected education web gateways from around the world

Web Gateway	Particular Focus	Developer
• ICTs in Education	• Distance education and ICT	• UNESCO, Paris
• Education Network of Australia	• K-12 schools, vocational education and training, higher education	• Educationau, Adelaide
• Institute for Information Technologies in Education	• ICT in education	• UNESCO, Moscow
• Multimedia Educational Resource for Learning and Online Teaching	• Higher education	• California State University, Los Angeles
• Knowledge Resources	• ICT for education and teacher training	• UNESCO, Bangkok
• National Grid for Learning	• K-12 schools and teacher education	• British Educational and Communications Technology Agency, London

Two further web gateways that might have been included (AskERIC Education Information and ERIC Clearinghouse on Teaching and Teacher Education) were closed at in 2003 and are expected to open in a new form at a later date.

ICTs in Education

UNESCO's newly developed web portal on ICTs in Education offers an entry point to a multitude of resources and sources dealing with education, particularly with open and distance education, teacher education, and information and communication technologies.

Its seven major sections and sub-sections each of which contains an annotated listing of links to websites that are judged generally useful to Member States indicate the scope of this UNESCO web portal:

Definitions of key terms

- Distance education
- Information and Communication Technologies

Educational organisations and associations

- Higher education
- ICT in education
- Open and distance education
- Teacher education

Online books, theses, research publications and newspapers

- Education and ICT research publications
- Education research theses
- Electronic books
- Online newspapers

Policy documents, reports and databases

- ICT in education
- ICT in teacher education
- Open and distance learning

Online education journals

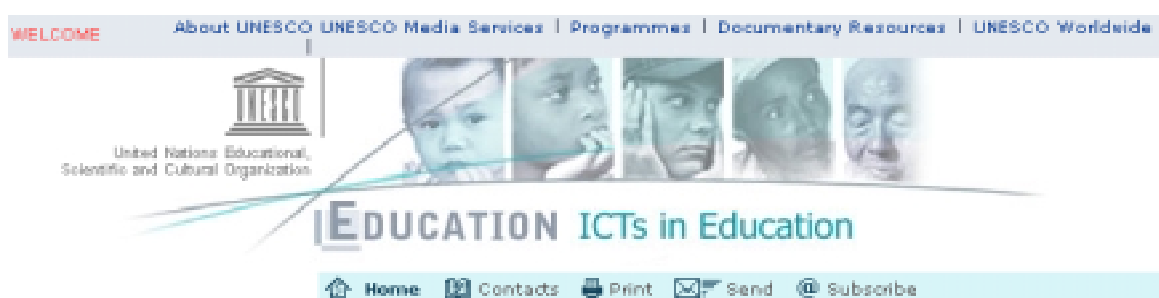
- Education across the curriculum
- ICT in education and teacher education
- Libraries and archives
- Research in education

Resources for teacher educators

- Online tools
- Web teaching/learning materials

Other education portals

- Distance education and learning
- Teaching, teacher education and ICT



(Developed by UNESCO, Paris, France)

http://portal.unesco.org/education/ev.php?URL_ID=18613&URL_DO=DO_TOPIC&URL_SECTION=201

Figure 2. Part of the Home Page of UNESCO's Education: ICTs in Education gateway

This UNESCO web portal is additionally valuable in that it provides direct access to the organisation's key educational publications in the area of information and communication technologies. All titles may be downloaded in PDF format thus ensuring exact replicas of the original printed books. The following titles, in Figure 3 for instance, all of which would be of interest to readers of this paper, are freely available to be downloaded in full text to all who have an Internet connection.

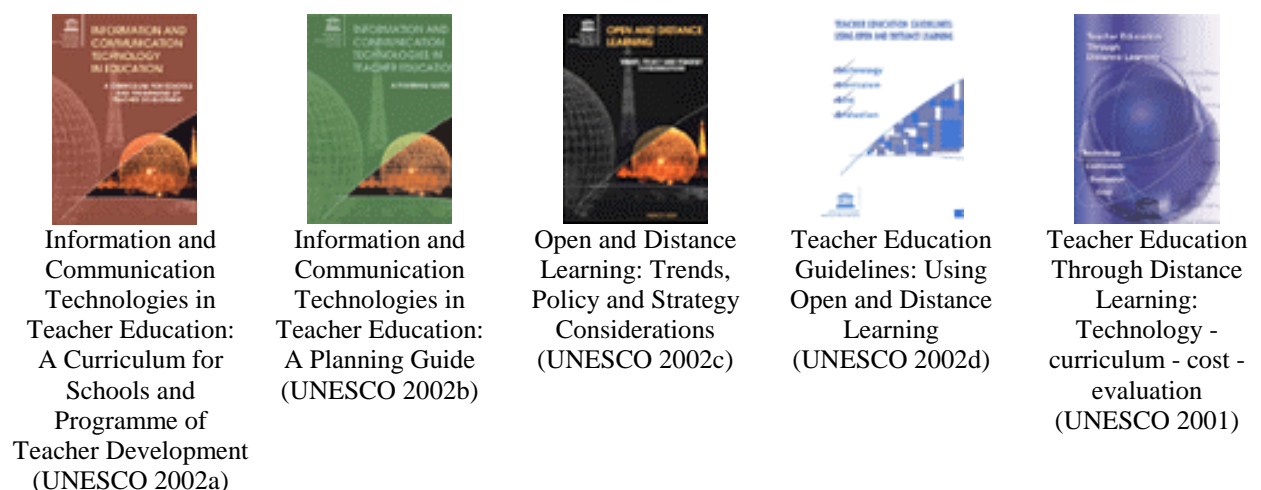


Figure 3. ICT publications available online at the UNESCO gateway

Education Network of Australia

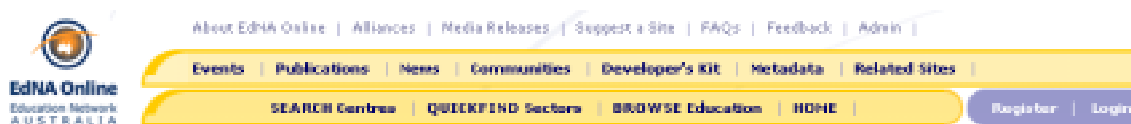
The Education Network of Australia, or EdNA portal as it is more familiarly known, with its emphasis on ICT and e-learning, is Australia's gateway to resources and services for education and training (see Figure 4). Information and resources are organised by levels of education (school education, higher education, vocational education and training, adult and community education, and international education) and what are termed *sibling sites*, which include:

ICT Leading Practice: (examples of leading practice in use of ICT; ICT leadership sites; innovative schools; ICT research; ICT models and support; ICT skills for teachers)

Technical Standards: (accessibility; architectures; assessment and competencies; collaborative technologies; learning design; learner profiling)

National Software Evaluation Project: (choosing software; software reviews; software sites; review guidelines)

Information and Communication Technologies Research: (ICT and cross-curriculum; ICT and equity and disadvantage; ICT and learning areas; ICT and levels of schooling; ICT and school change; ICT and the role of teachers/leaders)



(Developed by education.au limited, a non-profit company of the Australian Education and Training Ministers, based in Adelaide, Australia) <http://www.edna.edu.au/>

Figure 4. Homepage for the Education Network of Australia or EdNA gateway

The EdNA portal also includes information about online projects for teachers and their students, as well as information about national and international conferences, and links to reports and newsletters. What enhances the EdNA portal is that content contributors include all sectors of education – schools, technical and further education, vocational education, and universities.

Institute for Information Technologies in Education

Designed for policy makers of educational systems of UNESCO Member States as well as teachers and teacher educators who use ICT, this web portal, presented in Figure 5, is a rich source of information about the use of ICT in education. The portal's resources are sub-divided into the following ten categories: a) Policy Papers and Plans on ICTs in Education, b) Legislation, Curricula and Standards, c) Organisation, Administration and Financing, d) Teacher Training, e) Research and Development, f) Statistics, g) Internet in Education, h) Multimedia in Education, i) ICT in Distance Education, and j) ICT in Education for People with Special Needs.

In addition to English, specialised resources are available also in Russian, Spanish and French on this web portal.

Multimedia Educational Resource for Learning and Online Teaching

The resource material collection in MERLOT (see Figure 6), as the Multimedia Educational Resource for Learning and Online Teaching is called, is designed primarily for students and faculty in higher education institutions. Access is free though registration is required if adding to the collection. To be included in the collection, materials are peer reviewed and rated, placed into categories, and briefly annotated. Links are then made to the materials themselves, which can be located anywhere on the Internet. A useful additional description is called *Assignments*, which are designed to indicate how the particular materials might be used in a course.



Figure 5. Homepage for the UNESCO Institute for Information Technologies in Education gateway



Figure 6. Part of the homepage for the Multimedia Educational Resource for Learning and Online Teaching (MERLOT) gateway

An Assignment is a detailed explanation of how an instructor has used a learning material. In addition to the text of the assignment, the assignment form contains Learning objectives, Pre-requisite skills and knowledge, Educational level, Technical requirements, and other information necessary to contextualise the use of the material. These examples are provided to help faculty understand a variety of ways the material might be integrated into a learning environment.

(Online at <http://www.merlot.org/home/Assignments.po>)

The categories of materials include Education and Science and Technology, along with Arts, Humanities, Social Sciences, Business, and Mathematics. A typical entry in the Education collection, which has in excess of 1200 items, is the following:

Information Literacy Competency Standards for Higher Education

Author: Association of College and Research Libraries (ACRL)

Information literacy standards for higher education were developed by the Association of College and ...

Location: <http://www.ala.org/acrl/ilcomstan.html>

Date when added to MERLOT

Registered users can add materials (to be reviewed), comment on materials in the collection, and add Assignments. When users register, they are invited to indicate their broad interests. They may then see which other members have similar interests and, if they wish, communicate with them by email.

Knowledge Resources

This comprehensive UNESCO gateway (see Figure 7) contains several components that are highly pertinent to teacher education and e-learning, in particular its collection of web portals and its virtual library.



(Developed by the UNESCO Asia-Pacific Regional Bureau for Education, Bangkok, Thailand)
<http://www.unescobkk.org/ips/>

Figure 7. Part of the Home Page of the Knowledge Resources gateway (UNESCO Asia-Pacific Regional Bureau for Education in Bangkok)

Web portals

The growing list of portals includes those developed by the UNESCO Bangkok Regional Bureau, as well as those developed by other organisations. Two portals most relevant to teacher education and ICT are:

- ICT for Teacher Training, and
- ICT for Education in Asia-Pacific.

ICT for Teacher Training. This gateway to Internet resources and websites, dedicated to training teachers in utilising information and communication technologies to enhance their teaching skills, contains sections on: a) ICT in Education, b) Teachers' Roles in the ICT Environment, c) ICT Training Strategies and Online Courses, d) Integrating ICT into Teaching, e) Teaching Ideas, Lessons and Curriculum Materials, f) Educational Software/Courseware, g) Using Internet Resources, h) Electronic Collaboration, i) Bringing Your Classroom Online, and j) Evaluation Tools and Indicators.

ICT for Education in Asia-Pacific. This second portal promotes initiatives within the Asia and the Pacific Program on ICT in education and is funded through the Japanese Funds-in-Trust. Included is information on different dimensions in the use of ICT in education, ranging from ICT policy development in education; integration of ICT in both formal and non-formal education; professional development; collection, processing and dissemination of innovative practices and successful approaches; to the development and application of a set of indicators to evaluate the impact of ICT use in education. The portal also serves as a clearinghouse for a wealth of resources arising from ICT-based education programmes throughout the region and elsewhere, organised under the following sections: a) Projects in ICT, b) ICT Policy and Strategy, c) ICT in Teaching/Learning, d) ICT in Professional Development, e) ICT Indicators, f) ICT Resources, and g) Links to other ICT-based Education Programs.

Virtual library

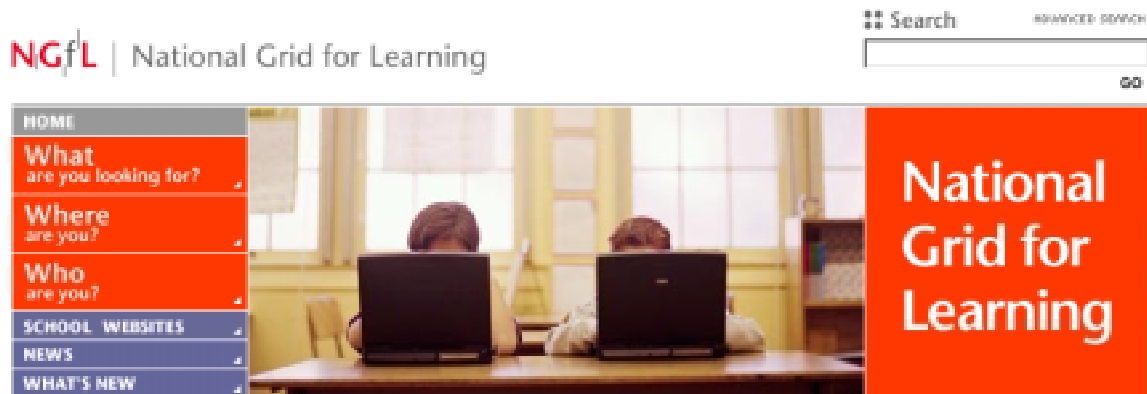
The IPS Virtual Library contains links to a wealth of worldwide electronic information resources, from many different sources, on topics dealing with education, social and human sciences, culture and communication. This website facilitates virtual access to library resources without being physically present in any library or information resource centre.

The Virtual Library offers over 1,000 website links to bibliographic, full-text and statistical databases in specific subjects related to various aspects of education, social and economic issues, gender, population, social, science, culture, health, HIV/AIDS, and related areas. It also contains

links to libraries and archives; full text electronic journals and periodicals; Internet references; and reference materials such as atlases, encyclopaedias, dictionaries and maps.

National Grid for Learning

The National Grid for Learning (NGfL, see Figure 8) is gateway to a large network of selected websites that offer high quality content and information in a wide range of areas: learning resources, games and quizzes, lesson plans and worksheets, reference material, libraries and archives, museums and galleries, and learning opportunities. NGfL is funded by the Department of Education and Skills and developed by BECTA, the Government's leading agency for ICT in education. Although much of the material focuses on the United Kingdom, there is much that would be applicable elsewhere.



(Developed by the British Educational and Communications Technology Agency (BECTA) on behalf of the British Government) <http://www.ngfl.gov.uk>

Figure 8. Homepage for the National Grid for Learning (NGfL) gateway

The resources are organised into user groups across K-12 and further/higher education, and also by broad subject category (business and economics, IT and computing, and maths and sciences, for example). The range of learning resources is extensive, for instance, an online course on using the Internet, courses and tutorials on use of software such as Photoshop and Illustrator, and collections of resources to support teaching of all subjects in primary and secondary schools. Similarly, users may access a wide selection of lesson plans and worksheets, including games and tests for all school subjects and many at the tertiary level too.

Use of the National Grid for Learning is free but registration is required. Registration allows users to save links to their searches and favourite teaching materials in their own user area, as well as to receive free alerts when new resources are added in areas of particular interest.

WHY E-LEARNING IS IMPORTANT IN TEACHER DEVELOPMENT

Knowing about global gateways or portals to online resources can help key decision-makers with responsibility for teacher development who may be asked why e-learning is important. Additionally, it is useful to consider the changing emphasis in the national goals of education in countries around the world. In all UNESCO Member States, there is a realisation of the role education plays in making the transition to an information economy in order to contribute and prosper in the globalised context of which all countries are now part. As White (2003) succinctly puts it:

It is the school system that provides a foundation for [each country's] future intellectual, social, moral, spiritual and aesthetic contributions in an increasingly complex and integrated world order. Competence in information technology is key to this development. (White, 2003, p.2)

Australia's national goals for schools in the 21st century typify what many other nations are striving towards. Included in Australia's set of goals is the statement that:

... when students leave schools they should be confident, creative and productive users of new technologies, particularly information and communication technologies, and understand the impact of those technologies on society. (Ministerial Council on Education, Employment, Training and Youth Affairs, 1999)

Malaysia, similarly, has declared a Vision 2020 Plan for industry and education that has established a "Multi-media Super Corridor" close to the nation's capital, and has developed prototype "Smart Schools", with the goal that all schools in Malaysia should be Smart Schools by 2010. The Outline Prospective Plan further aims to:

- have a quality workforce which is knowledgeable with highly tuned thinking skills, able to use technology and new resources optimally, to combine creativity and innovation effectively and has a diversity of skills and knowledge in the use of ICT.
- produce students who are knowledgeable and ICT literate and able to use technology for the betterment of themselves, their communities and their nation. (Downes et al., 2003, p.C5).

To realise the national goals for education that Malaysia, Australia, and many other nations have advanced, teacher development is clearly required to prepare teachers with e-learning skills to equip students with the kinds of critical skills necessary if they, as members of the work force, are to contribute meaningfully in their country's future development. All teachers need to be familiar with e-learning and competent in the use of ICT to assist in this development, and in order to be comfortable in these roles "teachers need to experience online learning as part of their ongoing professional development" (White, 2003, p.5).

Whatever stage of development in the use of learning technologies that teachers around the world have reached, there are new ways of storing and manipulating data and information that will influence individual intellectual development for as White (2003) goes on to explain:

Teachers and lecturers use data and information as basic building blocks to assist learners to develop conceptual knowledge. As a result, engaging with technology can enable teachers and lecturers to store, view, manipulate and present information in many new ways. (White, 2003, p.5)

Therefore, e-learning for teacher development must play a key role if national education goals for education are to be achieved, thereby changing schools as we have known them in the past from predominantly teaching institutions to learning institutions. Many educators describe these changes as nothing less than a transformation of education (UNESCO, 2004).

REFERENCES

- Australian National Training Authority. (2003). Developing e-learning content (Australasian Flexible Learning Framework Quick Guide series). [Online] <http://flexiblelearning.net.au/guides/content.pdf> [Accessed 17 Nov 2004]
- Downes, T., Khun, T., Scott, D., Leonard, R. and Warhurst, J. (2003). *Preservice Teacher Training and Teacher Professional Development in the Use of ICTs in the Training of Mathematics and Science in Participating SEAMEO Countries* (a SEAMEO-Australia Project). Department of Science, Education and Training, Canberra. [Online] <http://www.acce.edu.au/documents/store/1/ReportV4.doc> [Accessed 16 Nov 2004]
- Eklund, J., Kay, M. and Lynch, H.M. (2003). *E-learning: Emerging Issues and Key Trends (A Discussion Paper)*. [Online] <http://www.flexiblelearning.net.au/research/2003/elearning250903final.pdf> [Accessed 6 Nov 2004]

- Jones, A.J. (2003). ICT and future teachers: Are we preparing for e-learning? Paper presented at the IFIP Working Conference on ICT and the Teacher of the Future, Melbourne, January 2003. [Online] Available: <http://crpit.com/confpapers/CRPITV23Jones.pdf> [Accessed 16 Nov 2004]
- Lonsdale, M. (2003). *Global Gateways: A Guide to Online Knowledge Networks* (3rd ed.). Australian Council for Educational Research, Melbourne. [Online] http://www.educationau.edu.au/research/global_gateways_v3.pdf [Accessed 16 Nov 2004]
- Martinich, L. (2003). Future trends in eLearning: lessons from history. [Online] <http://www.educationau.edu.au/globalsummit/papers/lmartinich.htm> [Accessed 8 Nov 2004]
- Ministerial Council on Education, Employment, Training and Youth Affairs. 1999. *National Goals for Schooling in the 21st Century*. [Online] <http://www.curriculum.edu.au/mceetya/nationalgoals/natgoals.htm> [Accessed 16 Nov 2004]
- Moran, L., Thompson, L. and Arthur, P. (1999). *Strategic Analysis: Improving Teaching and Learning in Australian School Education Through the Use of Information and Communication Technologies*. [Online] http://ltg.parra.catholic.edu.au/Technol/LTG/Ed_Reports/Support/Strategic%20Analysis.pdf [Accessed 16 Nov 2004]
- Morel, R., Domenjoz, J-C., Lachat, C. and Rossi, C. (2003). From teacher education to professional development for e-learning in an e-society. In C. Dowling and K-W. Lai (Eds). *Information and Communication Technology and the Teacher of the Future*. Kluwer Academic Publishers, Boston. [Online] <http://www.wkap.nl/prod/b/1-4020-7604-5> [Accessed 5 Nov 2004]
- UNESCO. (2001). *Teacher Education Through Distance Learning: Technology – Curriculum – Cost – Evaluation* (Ed. H. Peraton). UNESCO, Paris. [Online] <http://unesdoc.unesco.org/images/0012/001242/124208e.pdf> [Accessed 16 Nov 2004]
- UNESCO. (2002a). *Information and Communication Technology in Education: A Curriculum for Schools and Programme of Teacher Development* (Eds J. Anderson and T. van Weert). UNESCO, Paris. [Online] <http://unesdoc.unesco.org/images/0012/001295/129538e.pdf> [Accessed 16 Nov 2004]
- UNESCO. (2002b). *Information and Communication Technologies in Teacher Education: A Planning Guide* (Ed. P. Resta). UNESCO, Paris. [Online] <http://unesdoc.unesco.org/images/0012/001295/129533e.pdf> [Accessed 16 Nov 2004]
- UNESCO. (2002c). *Open and Distance Learning: Trends, Policy and Strategy Considerations* (Eds M.M. Moore and A. Tait). UNESCO, Paris. [Online] <http://unesdoc.unesco.org/images/0012/001284/128463e.pdf> [Accessed 16 Nov 2004]
- UNESCO. (2002d). *Teacher Education Guidelines: Using Open and Distance Learning – Technology – Curriculum – Cost – Evaluation* (Ed. H. Peraton). UNESCO, Paris. [Online] <http://unesdoc.unesco.org/images/0012/001253/125396e.pdf> [Accessed 16 Nov 2004]
- UNESCO. (2003). *Developing and Using Indicators of ICT Use in Education*. UNESCO Asia and Pacific Regional Bureau for Education, Bangkok. [Online] <http://www.unescobkk.org/ips/ebooks/documents/ICTindicators/ICTindicators.pdf> [Accessed 14 Nov 2004]
- UNESCO. (2004). *ICT in Schools: A Handbook for Teachers or How ICT Can Create New, Open Learning Environments* (by A. Semenov and edited by J. Anderson and E. Khvilon). UNESCO, Paris.
- Urdan, T.A. and Weggen, C.C. (2000). *Corporate E-learning: Exploring a New Frontier* (Report for W.R. Hambrecht and Co.). [Online] http://www.e-learning.nl/publicaties/marktonderzoek/New_Frontier.pdf [Accessed 16 Nov 2004]
- White, G. (2003). *E-learning – Key Australian Initiatives (An Opportunity for All Learners)*. [Online] http://www.educationau.edu.au/papers/elearning_poland03.pdf [Accessed 16 Nov 2004]

WEB PORTALS**Education Network of Australia (EdNA)**

<http://www.edna.edu.au/>

ICTs in Education (UNESCO)

http://portal.unesco.org/education/ev.php?URL_ID=18613&URL_DO=DO_TOPIC&URL_SECTION=201

Institute for Information Technologies in Education (UNESCO)

<http://is.iite.ru/html/>

Knowledge Resources (UNESCO)

<http://www.unescobkk.org/ips/>

Multimedia Educational Resource for Learning and Online Teaching (MERLOT)

<http://www.merlot.org/>

National Grid for Learning (NGfL)

<http://www.ngfl.gov.uk/>

Are Learning Technologies making a Difference? A Longitudinal Perspective of Attitudes

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The call for quality research into the effectiveness of learning technologies is a common feature in much of the related literature and the broad question of how schools use technology to transform and improve the quality of student learning is one main area of concern. Projects like DECStech have flagged the need for research into student learning outcomes and the changes “attributable to the use of learning technologies across the full spectrum of learning areas” (DETE, 1999, p.22). This three-year study involves nine schools that received support to embed ICTs throughout mainstream curricula and affords a unique opportunity to measure change. The resulting study designed and used an online survey to measure change in student attitudinal outcomes. This paper summarises the longitudinal study and presents some preliminary findings.

ICT, learning technologies, student attitudes, longitudinal study, middle school

INTRODUCTION

Learning technologies, or more recently termed, information and communication technologies (ICTs), have become a major focus of state and national efforts to improve student educational outcomes. Around Australia, millions of dollars have been channelled towards the integration of technology into school curricula. South Australia is no exception.

The use of learning and information technologies has the potential to enhance learning for all students in our schools. In recognition of this, the South Australian government established the \$85.6 million DECStech 2001 Project aimed at ensuring that by the year 2001 technology ... is able to be an embedded, integrated part of learning activities, and technological applications will be, at all levels, curriculum driven. (DETE, 1999, p.1)

The call for quality research into the effectiveness of learning technologies is a common feature in much of the related literature (Cuttance, 2001). Kilvert (1997) highlighted this need in his paper discussing research issues facing Australian schools in the next ten years. The broad question of how schools use technology to transform and improve the quality of student learning was one such concern. The DECStech 2001 Project held a similar concern, and as one of its main objectives, flagged the need for research into student learning outcomes and the changes “attributable to the use of learning technologies across the full spectrum of learning areas” (DETE, 1999, p.22). As the cornerstone of this three-year project, a network of nine focus schools was given support to embed ICTs throughout mainstream curricula and afforded a unique opportunity to measure change.

In response to the need for quality research examining the impact of ICTs on student learning outcomes, collaboration between the Flinders University School of Education and the Learning Technologies Project resulted in the development of an online survey designed to measure change

in student outcomes at the focus schools. This paper summarises the attitudinal component of the longitudinal study and presents preliminary findings.

A LONGITUDINAL DESIGN

The design of this study was mainly shaped by two areas of need raised in the *DECStech* Report (DETE, 1999). The first was in response to one of the project's objectives, to measure changes in student learning outcomes attributable to the use of learning technologies, and the second was in recognition of the need for longitudinal research, as highlighted in the report, under directions for research:

... what is now required is a longitudinal study to establish structures and processes through which clear and useful advice and support relating to curriculum applications of learning technologies can be provided to department schools. (DETE, 1999, p.15)

The major school-based impetus for the *DECStech* Learning Technologies Project involved six Adelaide metropolitan public schools (four Primary and two Secondary schools), known as *Discovery Schools*, and three South Australian rural schools (two Primary schools and a R-12 Area school), called the *Global Discovery Schools*. The Project spanned a three-year period between 1999 and 2001, during which time the Discovery and Global Discovery schools were intensively involved in a process of development and change. The first year was an establishment year where the Discovery and Global Discovery schools identified their needs, planned and initiated strategies to build curriculum more widely enriched by ICTs. Over the following two years, students and teachers continued to experience changes in the learning environment as ICTs were increasingly embedded throughout the curriculum, with the objective of increasing students learning outcomes. Clearly, the *DECStech* Project offered a unique opportunity to measure change and a longitudinal study was considered the most appropriate method.

Student Learning Outcomes

Improving student learning outcomes clearly goes beyond merely increasing academic achievement. In Australia, many reports (DETE, 1999; Moran, Thompson, and Arthur, 1999; Education Victoria 1998) foresee opportunities for learning technologies to:

- increase and change the methods students interact and collaborate with each other and their teachers;
- support students' growth in independence along with an increase in the range, depth, the complexity and the originality of the thinking and production;
- allow students to take greater responsibility for their learning in classrooms that are more student centred and student controlled;
- allow students to participate in a more varied range of learning activities matched to their individual needs, interests and capabilities; and
- support students in acquiring knowledge, skills and attitudes which will be essential for a successful and fulfilling life in a digital community.

A United States study, based on 176 research reviews and reports (IESD, 1999), provides compelling evidence that technology, combined with good teaching practice, can:

- have a significant, positive effect on student achievement in all major curriculum areas;
- have positive effects on student attitude towards learning and self-concept; and

- encourage equality for students of different socio-economic background when used in the classroom, reducing the divide between the 'haves' and the 'have nots'.

The integration of technology into a classroom changes the learning environment – what is being learned, why and how it is learned, the role of the teacher, social interaction, and more. It also changes how people think about technology, and how they think about themselves, learning and the school environment. Much of the research into the effects of ICTs recognises that student learning outcomes encompass the growth of the person and not just their performance. One method commonly used in longitudinal research to measure personal development is through the use of attitudinal questionnaires and it is the main tool adopted in this study.

The Attitudinal Surveys

Three well-known attitude scales were chosen that specifically address students' attitudes towards school (Keeves 1974), self-esteem (Coopersmith, 1986), and the use of computers in learning (Jones and Clarke, 1994). These scales require students to respond to statements using a three-point or five-point Likert scale. The Likert Scale is used because it is easy to administer and is generally considered to be the most useful type of attitude scale for use in a group-testing situation. Additional questions, compiled and constructed by the author, measure students' computer skill, expertise and access. The resulting survey, comprising a total of some 155 items, including responses indicating gender, age and the language most commonly spoken at home, was conducted online on three occasions during the term of the Project. Reports describing the instruments and detailing results of the first two student surveys are available (Dix, 2000, 2001).

THE DISCOVERY AND GLOBAL DISCOVERY SCHOOLS

The nine schools, originally chosen from among many entrants for the DEC*Stech* Project, were selected on both the quality of their submission and because they represented a diverse spectrum of learning environments. The diversity of these environments requires the analysis to be sensitive to the classroom, school, Primary/Secondary and metro/country level. At the classroom level, the teacher provides the greatest influence and differences in the teacher's approach are evident. Students reflect these differences when they attribute their success or failure in a subject to a particular teacher. School level differences are evidenced when a visitor observes a distinct culture unique to that school. Usually the Principal and other teachers of seniority have greatest influence in shaping the climate of the school since they are in the position of leadership and provide guidance to less experienced teachers. At the Primary/Secondary level, other influences emerge, stemming from the different structuring of Primary and Secondary schools in South Australia. And at the country/metro level, the influence of community and distance emerge. The schools involved represent both Primary/Secondary and country/metropolitan settings and, to optimise findings, should be analysed in context at the school and even classroom level (Archer, 1999; Rowe, 1996). However, such an in-depth analysis is beyond the scope of this paper and can not afford more than a brief demographic of each learning environment.

The Discovery Primary Schools

The first of the four Discovery Primary schools is located in the western suburbs. This large school of approximately 630 students, comprises separate Junior Primary (R-3) and Primary (4-7) schools managed by two Heads and under one principal. The school development priorities of ICTs and Literacy support their long-term objectives to develop cultures of effective communication, of local and global inquiry and of critical thinking and creativity. The school has been recognised in the educational community for its participation and success in educational reform with a strong tradition of using ICTs, and include being selected as an Apple Distinguished School and a Technology Focus School (1995-1998).

Further south, the second school has approximately 400 students from reception to Year 7. Although ICTs are a priority, full network and internet access was only recently made available in 2000, assisted by their selection as a Discovery School. The school has a computing suite of 17 multi-media stand-alone IBM computers along with one in each classroom. A number of Apple Laptops are available for staff and students to book.

The other two Primary schools are located in the northern suburbs and both cater for a diverse range of students from reception to Year 7. One school provides for approximately 380 students with a strong focus on developing an information literate community. Through learning teams, constructivist approaches to learning and curriculum integration of ICTs are supported. The other school consists of approximately 250 students and has been involved in the disadvantaged Schools Program. Their main priority, to increase student directed curriculum, is supported by their focus and development in ICTs.

The Discovery Secondary Schools

The first of the two Secondary schools, located in the western suburbs, provides for a diverse range of approximately 700 students from Year 8 to 13, as well as Adult Re-entry. The school has a large number of Aboriginal students and as a Focus school, has been recognised as a leader in catering for students with Disabilities. Their strategic partnership with Microsoft allows the school to deliver the Microsoft Certified Professional course and the 3COM Networking Certificate.

The second High school is much larger with approximately 1200 students from Year 8 to Year 13 and lies south of Adelaide. The school caters for a diverse student population and continues to maintain a strong academic tradition. With one of the highest student to computer ratios of approximately 3:1, the school is focused on embedding ICTs throughout the curriculum in ways that enhance students' learning and support their development of lifelong learning skills.

The Global Discovery Schools

The three Global Discovery Schools are as diverse as their metropolitan counterparts as they are in location and play an integral role in their communities. One Primary school of approximately 60 students ranging from reception to Year 7 is located in the South East of the state. The main priorities include the expectation that ICTs are used in all classes and to implement strategies to support positive student attitudes, especially in boys. The other Primary school, on the Yorke Peninsula, caters for approximately 80 students organised into three class groupings (R-2, 3-4 and 5-7) along with a pre-school. A main priority is to promote a community of lifelong learning with a focus on the integration of ICTs throughout the general curriculum and learning programs.

The third Global Discovery School is an Area School located in the far north of South Australia and provides for approximately 360 students from reception through to Year 13, many of whom are from multi-cultural or Aboriginal backgrounds. As a LOTE Focus school, a major priority is to use ICTs to improve language teaching.

All nine schools were given support, through the appointment of Technology Project Managers, to research, develop and model exemplar ways to embed learning technologies across the curriculum over the three-year life span of the project. To assist in this aim, additional support was provided in the form of cash grants to upgrade ICT facilities. As part of their commitment to the Project, the Discovery and Global Discovery schools were supported in disseminating their experiences through focus school programs and liaising with educational organisations to participate in research. The Student Survey was one such research project.

The Study Sample

The Discovery Schools and Global Discovery Schools were encouraged to allow all middle school students, Years 5 to 7 in the Primary sector, and Years 8 to 10 in the Secondary level, to participate in the online survey conducted during the third term of each of the three years. Ultimately, however, the resulting number of students responding to the three scales depended on the schools' success in administering the online survey.

A total of 1749 Primary and 2463 Secondary students from the Discovery and Global Discovery Schools responded to the surveys, a response rate of approximately 78 per cent, and constitutes the database upon which the proceeding analysis was conducted. Table 1 summarises the number of students and average age at the time of data collection by year level and gender and demonstrates that the demographics of the students are representative of the broader educational sector.

Table 1. Discovery and Global Discovery school sample

		Year 5		Year 6		Year 7	
		Male	Female	Male	Female	Male	Female
Global Discovery Schools							
1999	N = 64	11	6	5	15	7	20
	Mean (SD)	11.21(0.52)	11.15(0.25)	12.06(0.60)	11.94(0.36)	13.07(0.28)	13.14(0.37)
2000	N = 65	17	16	6	10	5	11
	Mean (SD)	10.46(0.62)	10.72(0.39)	11.98(0.53)	12.16(0.66)	12.80(0.27)	12.72(0.36)
2001	N = 105	11	16	23	22	16	17
	Mean (SD)	10.88(0.36)	10.69(0.39)	11.68(0.50)	11.56(0.35)	12.77(0.50)	12.50(0.70)
Discovery Schools							
1999	N = 489	47	75	88	92	92	95
	Mean (SD)	10.79(0.33)	10.69(0.39)	11.78(0.56)	11.90(0.44)	12.61(0.45)	12.71(0.36)
2000	N = 533	99	78	73	102	93	88
	Mean (SD)	10.84(0.38)	10.75(0.49)	11.89(0.36)	11.80(0.34)	12.84(0.35)	12.92(0.41)
2001	N = 493	86	75	89	77	63	103
	Mean (SD)	10.82(0.38)	10.74(0.29)	11.68(0.40)	11.66(0.32)	12.79(0.30)	12.70(0.34)
		Year 8		Year 9		Year 10	
		Male	Female	Male	Female	Male	Female
Global Discovery Schools							
2000	N = 23	9	6	1	1	3	3
	Mean (SD)	13.94(0.39)	13.89(0.39)	15.59	15.75	16.88(1.14)	15.56(0.10)
2001	N = 64	10	21	12	7	9	5
	Mean (SD)	14.19(0.32)	13.94(0.43)	15.27(0.49)	14.96(0.31)	16.33(0.63)	16.49(0.35)
Discovery Schools							
1999	N = 736	159	124	138	117	115	83
	Mean (SD)	13.81(0.42)	13.73(0.36)	14.71(0.36)	14.65(0.39)	15.78(0.42)	15.69(0.34)
2000	N = 785	170	165	132	106	110	102
	Mean (SD)	13.92(0.75)	13.85(0.44)	14.93(0.42)	14.85(0.37)	15.79(0.50)	15.74(0.86)
2001	N = 855	157	160	144	144	146	104
	Mean (SD)	13.83(0.45)	13.72(0.46)	14.86(0.66)	14.73(0.36)	15.79(0.43)	15.76(0.37)

Missing Data and Statistical Comparison

The occurrence of missing data can arise through several different causes. Students can inadvertently miss an item, or choose not to answer on personal grounds. Some students omitted a whole section if they did not complete the survey in the allotted time or were absent. A final difficulty in obtaining complete data resulted from computer network conflicts, in which case the school server crashed with the result that any students in the midst of a section were unable to send their responses. Encouragingly, this cause of data loss, although a concern during the 1999 survey, appeared to be non-existent in the subsequent 2000 and 2001 surveys, an observation that is supported by the nine per cent increase in data obtained each year. In the case where the

majority of items were completed within any one of the three sections, those items missed were assigned the mean gender and year level value for that item, yielding a complete section.

Due to the small student populations in the three Global Discovery schools, total numbers were amalgamated and treated as a single entity during statistical analysis. All other schools retained their own identifications. To generate all statistical calculations, a spreadsheet and two statistical packages were employed; Microsoft Excel, SPSS and WestVar. Descriptive statistics (means and standard deviations) are used to describe the central tendency and dispersion on all measures. To test for differences between groups, probability testing was selected as the appropriate statistical method, since just two groups were compared in each case. Significance testing was performed using WestVar to allow for the effects caused by the clustering of students at the school level. The 0.05 level of significance was chosen for the rejection of the null hypothesis of no difference between groups.

Given the longitudinal nature of the study, information was collected from boys and girls on three separate occasions, in 1999, 2000 and 2001, and across six Year levels or grades. Such an array of data affords a multitude of statistical comparisons that can possibly be somewhat confusing. Figure 1 attempts to provide clarity. The main format in which students' attitudes are presented throughout this report uses the bar graph and represents the mean response for each occasion, clustered by Year level. Any changes in mean attitude over the period can be viewed at a glance. If the changes are sufficiently different, beyond the normal level of random variation (set at the probability of 0.05), these are considered to be statistically significant and potentially attributable to any major influence in the environment. Year 5 students show two significant positive shifts in attitude, indicated by the convex curves in Figure 1. Between the first and second and, the first and third testing occasions, the change in attitude is significant and possibly due to the increased use of learning technologies. The decline in attitude between the second and third occasion is not statistically significant. This main method of comparison looks at students in the *same grade* over the three occasions. Alternatively, students from the *same occasion* but different grades can be compared to examine attitudinal trends with age, or students from the *same group* can be tracked as they move from Year 5 in 1999 to Year 6 in 2000, and so on. In addition, but not represented on the graph in Figure 1, is the comparison of gender. Only the statistical comparisons of same grade, indicated by the curved arrows in Figure 1, along with the comparison of gender, are employed in this paper and reported when of interest.

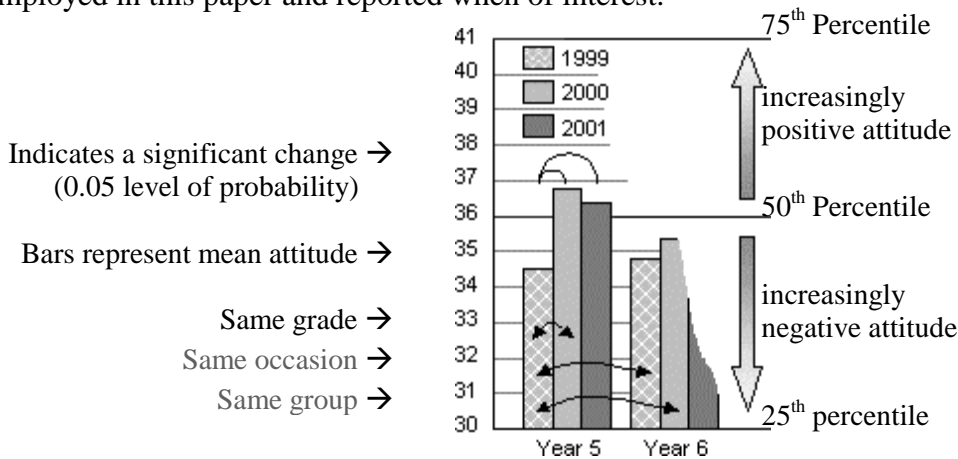


Figure 1. Comparison over three years (the convex curves represent a significant change in attitude between occasions)

To further aid interpretation, the lowermost and uppermost values of the graph represent the 25th and 75th percentiles, respectively. Responses above the 50th percentile, indicated by the black,

rather than grey grid lines, are increasingly positive, while those falling below, are increasingly negative. Percentiles are calculated for each variable from the entire data set of that variable.

RESULTS: CHANGES IN ATTITUDE

The nature and degree of change in the Discovery and Global Discovery schools will vary in extent from school to school, and although the use of ICTs is a major priority within each school, it may not be the only program that effects the learning environment or influences attitudes. With this caveat, any changes in student attitude could be attributable to the increased use of technologies in the learning environment.

Changing attitudes towards school

Attitudes towards school and school learning

Students responded to items that ranged from a strong dislike for school and a strong desire to leave school as soon as possible, to enjoyment of school and a desire to obtain as much schooling as possible. Primary school students, particularly those in Years 6 and 7, show significant increases in their attitudes towards school and school learning and, in the final year, show an increase with age (see Figure 2). Students in Secondary school, on the other hand, reveal a decline in school attitude with age but show a growth in these attitudes over the three-year period. These changes are significant in Years 8 and 9. The 50th percentile score of 36 shows that students in Primary school generally like school and are considerably more positive than their senior colleges who show a general dislike for school and learning. The influence of ICTs appears to be most significant in Years 6 to 8 and generally appears to have been positive.

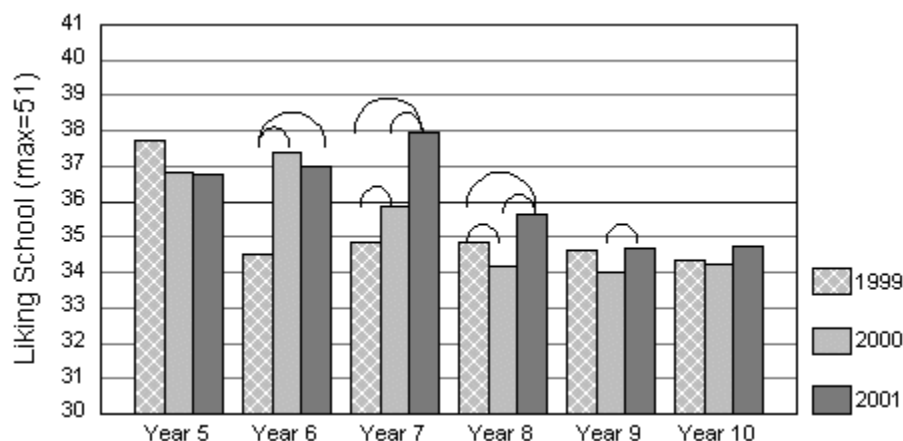


Figure 2. Attitudes towards school and school learning (the convex curves represent a significant change (0.05 level) in attitude between occasions)

Motivation to achieve in school learning

Students' academic motivation is measured by questions ranging from, a lack of effort and involvement in school learning, to a desire to succeed in school learning and achieve academically. The 50th percentile score of 42, shown in Figure 3, suggests that Primary school students maintain strong motivation towards school learning, but that this clearly declines with age. The influence of learning technologies is questionable, with only significant increases in the Year 7 and 10 cohorts. Although Secondary students' are less motivated academically than their younger counterparts, an increase in attitude across all Year levels suggests that the increased use of ICTs may have positive benefit.

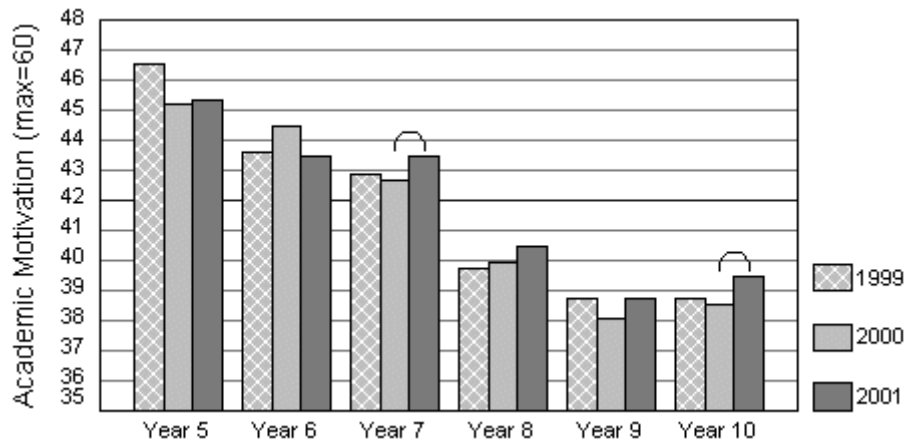


Figure 3. Motivation to achieve in school learning (the convex curves represent a significant change (0.05 level) in attitude between occasions)

Gender differences in school attitude

Female students continue to maintain a higher regard to school and learning than their male peers, shown in Figure 4, significantly so, across both Primary and Secondary school settings. The shift in girls' attitudes toward schooling significantly increases over the three-year period, unlike their male counterparts. Secondary school boys show a significant increase in their liking of school but only between the second and third year. A similar shift in academic motivation is observed in their female peers. Primary school girls generally hold a positive attitude towards school, falling above the 50th percentile score of 77, while only Year 5 boys hold a similar attitude.

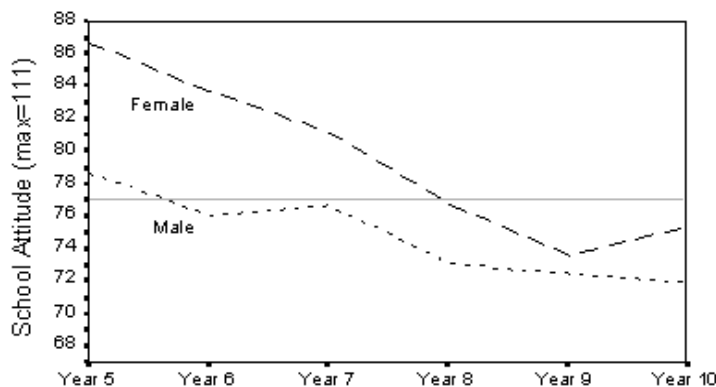


Figure 4. Gender differences in school attitude over six grade levels

Changes in self-esteem

Self-esteem is viewed as a many-faceted personality characteristic, which may vary according to differences in age, gender, life experiences and aptitude and can be described as, "a personal judgement of worthiness that is expressed in the attitudes the individual holds towards him or her self" (Coopersmith, 1967, p.5). Four areas of self-attitude were examined and include general interests, peer, parents and school. Combined, these areas form an overall measure of self-esteem and provide important insight into the influences on students of embedding ICTs into the curriculum.

General personal attitudes and interests

Students responded to questions ranging from not being easily bothered and having a high opinion of themselves to often wishing they were someone else and taking a long time to get use to

anything new. The use of ICTs in learning appears to be beneficial across all age groups, significantly so in all but Year 8 students, presented in Figure 5. The 50th percentile of 61 suggests, however, that on average, general self-esteem is low but increases with age.

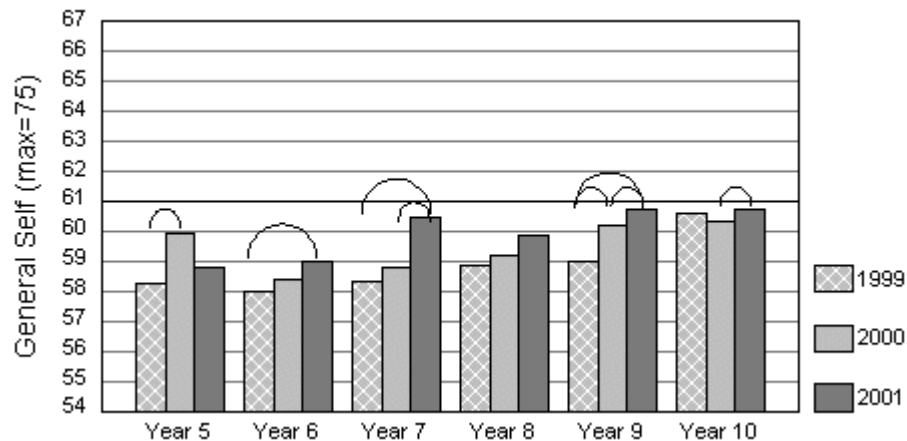


Figure 5. General Self-esteem (the convex curves represent a significant change (0.05 level) in attitude between occasions)

Attitudes towards peers

The influence of ICTs on peer and social relationships is an interesting but little studied area in relation to ICTs. To gauge changes in these beliefs, students responded to a selection of statements ranging from, being popular with kids their own age and having ideas that other kids usually follow, to not liking to be with other people and often being picked on by other kids. All but Year 10 students, as depicted in Figure 6, experienced significant positive shifts in social self-attitudes and may reflect the effectiveness of the communication aspects of learning technologies.

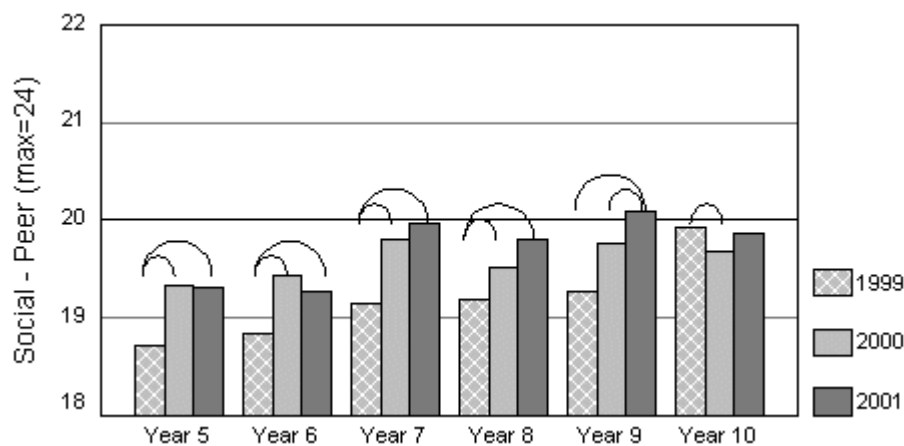


Figure 6. Attitudes towards peers and social relationships (the convex curves represent a significant change (0.05 level) in attitude between occasions)

Attitudes towards parents and the home environment

Although schools were the main focus of increased use of ICTs in learning, their influence on students' beliefs about parents and home is of interest and may give insight into the increasingly high levels of computer ownership at home. Questions ranging from, being considered and understood by their parents to, wanting to leave home and being pushed too hard, are the kinds of items to which the students responded. Compared to the other measures of self-esteem, Figure 7 shows that the use of ICTs appears to have had relatively little influence on students' attitudes

towards parents and the home environment. Over the three-year period, however, an increase in students' attitudes towards their parents is experienced across the cohort with the majority of significant shifts occurring in the older students.

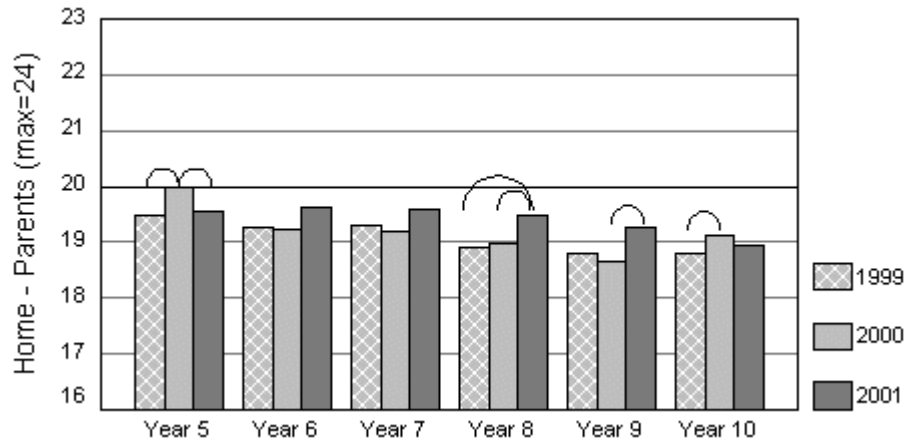


Figure 7. Attitudes towards parents and the home environment (the convex curves represent a significant change (0.05 level) in attitude between occasions)

Academic self-esteem

To gauge students' school and academic self-attitudes questions were posed ranging from being proud of their school work and wanting to do better in school to, finding it hard to talk in front of the class and believing that the teacher does not make them feel good enough. Students' attitude toward themselves as learners (see Figure 8) strongly mirrors their attitudes towards school and learning. Across all age groups, a positive shift in academic self-attitude occurs over the three-year period, and suggests that the increased use of ICTs has provided beneficial influence, significantly so in the older cohorts.

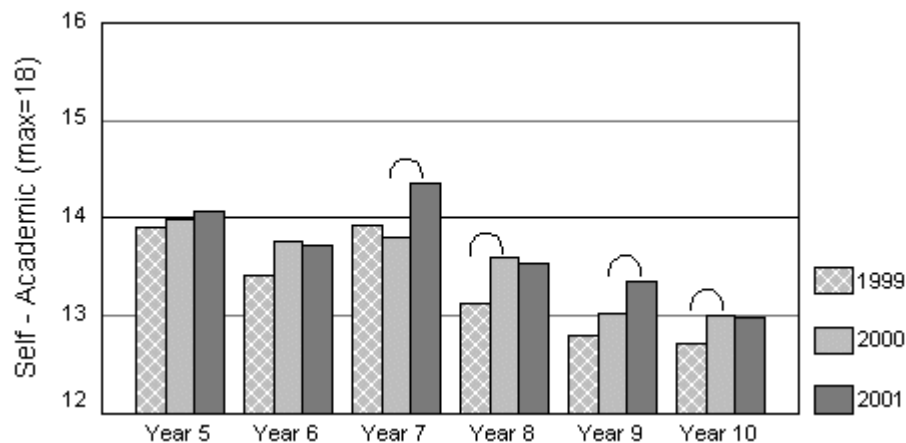


Figure 8. Students' attitude toward themselves as learners (the convex curves represent a significant change (0.05 level) in attitude between occasions)

Gender differences in self-esteem

The difference in self-esteem between boys and girls has been a topic of much debate in research. The findings presented in Figure 9 are common to many previous studies and show a divergence of attitudes with age. Male students grow increasingly positive as they get older, whereas female students show declining self-esteem with age, differences that are significant in both the Primary and Secondary sectors. The change in girls over the period, however, is significantly positive,

while the change in boys self-esteem is inconclusive, and suggests that the increase use of ICTs supports girls attitudes towards themselves.

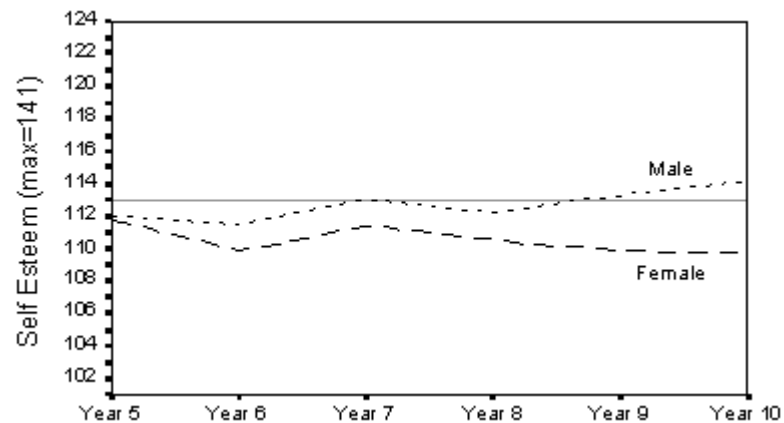


Figure 9. Gender differences in self-esteem over six grade levels

Changing attitudes towards the use of computers in learning

Any direct influence between students' increased use of ICTs and their attitudes towards themselves and towards learning is not obvious, but nonetheless, well documented and supported by research. Although these attitudes may reflect the influences of ICTs indirectly, they are an important consideration in the overall learning outcomes of a student. Equally important and possibly more direct, is the relationship between the use of ICTs in learning and students' attitudes towards them. To measure changes in students' attitudes towards the use of computers in learning, students responded to a series of statements formulated within the framework of a tripartite model of attitudes, which identifies affect, behaviour and cognition as three distinct but interrelated attitudinal components (Jones and Clarke 1994).

Affective attitudes towards computers

The affective component contains the encoding of feelings associated with an attitudinal object and requires students to respond to a selection of negatively worded items ranging from, being highly intimidated and threatened by computers and feeling helpless when asked to perform new tasks on a computer, to being bored and frustrated with computers. In an environment where students are increasingly confronted about their feelings towards computers, the positive shift, overall, in affective attitudes (presented in Figure 10) is encouraging. Students in Years 6, 7 and 10 show significant growth over the period and generally hold a positive attitude towards technology, by falling around the 50th percentile score of 59. These changes in affective attitudes could, arguably, be attributed to the increased use of ICTs and appears to be equally supportive in both the Primary and Secondary school environments.

Behavioural attitudes towards computers

The behavioural component includes behavioural intentions, verbal statements regarding behaviour and overt behaviours in response to an attitudinal object. Students responded to positively worded items that range from, wanting to learn more about computers and to use computers more often, to finding ways to use computers more efficiently and wanting to learn new tasks independently by trial and error. Students appear to find the increasing use of ICTs behaviourally more confronting, particularly in the older cohort, as evidenced in Figure 11. Although positive shifts in attitude, overall, were experienced in the Primary sector, only those increases in Years 5 and 7 were significant. The influence of technology on behavioural attitudes in the Secondary school environment is less optimistic and shows significant declines in Year 9

and 10 students' attitudes between the first and second occasion. The final testing appears to be more encouraging with sufficient improvement that results in an overall drop in behavioural attitude that is not significant. Across the cohort a clear decline in behavioural computer attitudes is observed and may indicate an increasing pressure on access to computers.

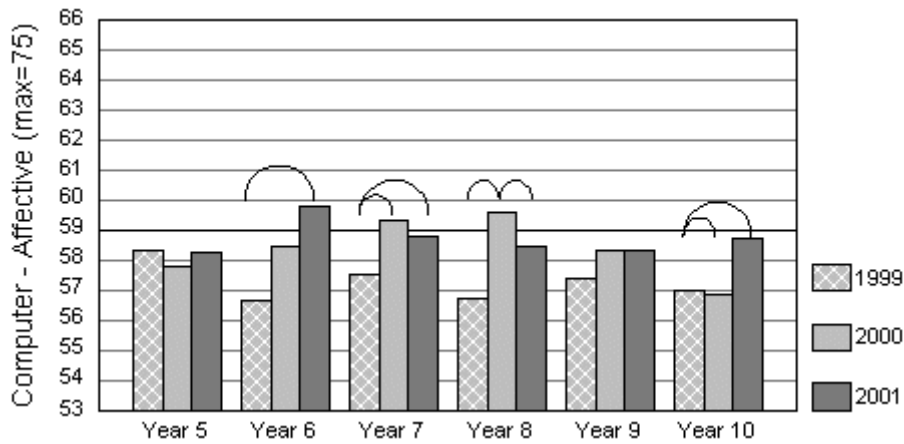


Figure 10. Students' affective attitudes toward computers in learning (the convex curves represent a significant change (0.05 level) in attitude between occasions)

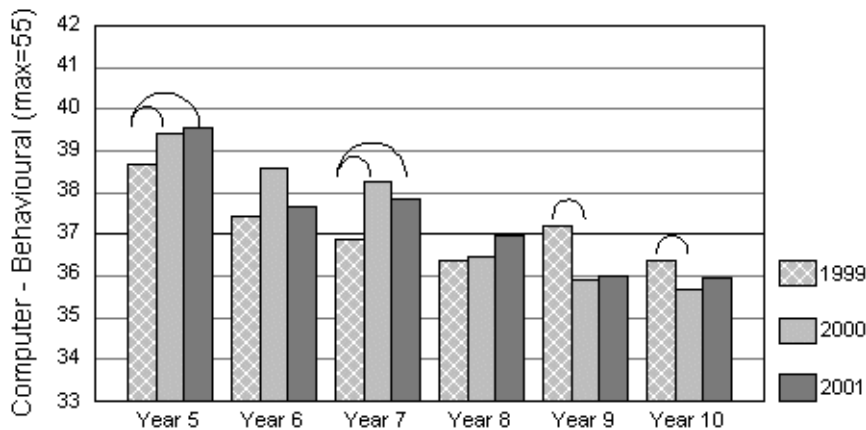


Figure 11. Students' behavioural attitudes toward computers in learning (the convex curves represent a significant (0.05 level) change in attitude between occasions)

Cognitive attitudes towards computers

The cognitive component refers to beliefs, knowledge structures and thoughts held, regarding the attitudinal object. Students responded to statements ranging from, being creatively inhibited when using computers and believing computers to be a waste of time, to finding computers difficult to understand and isolating. Compared to students' behavioural attitudes, reverse trend with age is apparent. Figure 12 shows that Year 5 students provide an anomaly by finding strong accordance with the negatively phrased items. More encouragingly, the older students show positive shifts in cognitive attitude towards computers over the interval that generally increases with age. In Years 6, 7 and 10, some of these shifts are significant and are a probable result of their increasing exposure to ICTs.

Gender differences in computer attitude

The difference in computer attitude between boys and girls has been a topic of much concern in research, particularly for girls. The findings presented in Figure 13 are common to many previous studies and show a divergence of attitudes with age. Male students grow increasingly positive as

they get older, whereas female students show declining computer attitudes with age; differences that are significant in both the Primary and Secondary sectors. Encouragingly, the change in girls over the period is significantly positive, while the change in boys' computer attitudes is inconclusive, and suggests that the increase use of ICTs may support girls' attitudes towards the use of computers in learning.

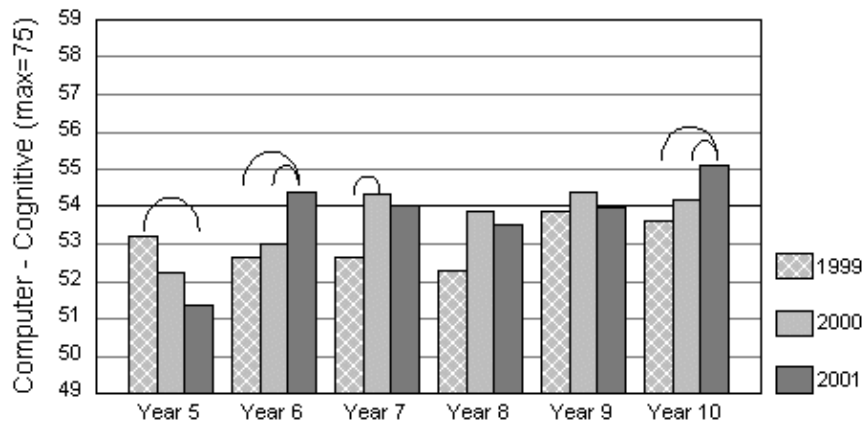


Figure 12. Students' cognitive attitudes toward computers in learning (the convex curves represent a significant change (0.05 level) in attitude between occasions)

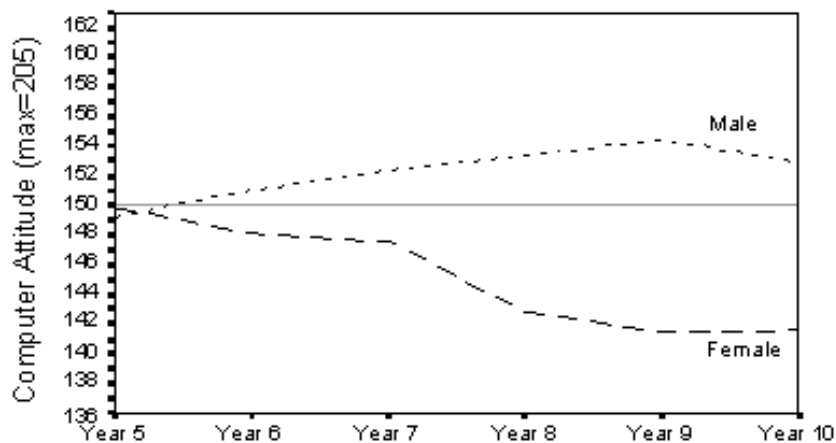


Figure 13. Gender differences in attitudes towards the use of computers in learning

IN SUMMARY

With so many attitudes, what does it all mean? Are Learning Technologies making a difference? At this early stage of the analysis, definitive answers to the driving inquiry of how learning technologies influence and support students', are not yet available. Clearly, the preliminary findings presented in this paper should at best, be treated as conjecture, but do present an encouraging longitudinal perspective of students' attitudinal development. The overall view of technology as an educational tool is highly optimistic and reflects much of the findings from similar research. In general, Learning Technologies are found to have positive effects on students' attitudes towards learning and on student self-concept. Students feel more successful in school, are more motivated to learn and have increased self-esteem when ICTs are employed as an integral tool in their learning environment.

REFERENCES

- Archer, L. (1999) Teachers' beliefs about successful teaching and learning in mathematics. *AARE Annual Conference Proceedings* [Online] <http://www.swin.edu.au/aare/99pap/arc99491.htm> [2000, September 29].
- Coopersmith, S. (1986) *Self-Esteem Inventories*. United States, Consulting Psychologists Press.
- Cuttance, P. (2001) *School Innovation: Pathway to the Knowledge Society*. Department of Education, Training and Youth Affairs, Australia. [Online] <http://www.detya.gov.au/schools/publications/index.htm> [2001, July 8].
- Department of Education, Training and Employment (1999) *Learning Futures: DECStech 1997 – 2001 Making Connections*. DETE: Adelaide. [Online] <http://www.decstech.nexus.edu.au/learn.htm> [1999, November 9].
- Dix, K.L. (2000) *Learning Technologies Project:1999 Baseline Student Data*. Department of Education, Training and Employment, Adelaide.
- Dix, K.L. (2001) *Learning Technologies Project:2000 Student Data*. Department of Education, Training and Employment, Adelaide.
- EducationVictoria (1998) *Learning Technologies in Victorian Schools: 1998-2001*. Community Information Service, Department of Education, Victoria; Melbourne.
- Interactive Educational Systems Design, Inc. (IESD). (1999) *1999 Research Report on the Effectiveness of Technology in Schools: Executive Summary 6th edition*. Report commissioned by the Software & Information Industry Association. Washington, DC: Software Publishers Association. [Online] <http://www.siiia.net/pubs/education/99effrptexecsum.htm> [1999, July 2].
- Jones, T. and Clarke, V.A. (1994) A computer attitude scale for secondary students. *Computers in Education* 22 (4), 315-318.
- Keeves, J.P. (1974) *Some Attitude scales for Educational Research Purposes*. Home Environment and School Study ACER Report, Melbourne, ACER.
- Kilvert, P. (1997) Research issues for schools in the next ten years: researching what we value, rather than valuing what we research. Unpublished paper presented at the Flinders University 1997 Education Research Conference, Flinders University, Adelaide.
- Meredyith, D., Russell, N., Blackwood, L., Thomas, J. and Wise, P. (1999) *Real Time: Computers, Change and Schooling*. DETYA, Australia. [Online] <http://www.DETYA.gov.au/schools/publications/realtime.pdf> [2000, March 10].
- Moran, L., Thompson, L. and Arthur, P. (1999) *Strategic Analysis: Improving Teaching and Learning in Australian School Education Through the Use of Information and Communications Technologies*. Paper for the EdNA Advisory Group. [Online] <http://www.edna.edu.au/edna/system/llreport/home.html> [2000, June 5].
- Rowe, H.A. (1996) I.T. is failing to revolutionise the curriculum, because to date we have failed to evaluate its benefits in context. *Proceedings of the Australian Computers in Education Conference*, Canberra. [Online] <http://www.spirit.com.au/ACEC96/papers/rowe2.htm> [1998, September 28].

Computer-animated instruction and students' conceptual change in electrochemistry: Preliminary qualitative analysis

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This paper discusses the potential of applying computer-animated instruction (CAI) as an effective conceptual change strategy in teaching electrochemistry in comparison to conventional lecture-based instruction (CLI). The core assumption in this study is that conceptual change in learners is an active, constructive process that is enhanced by the pedagogic use of computer-animated images. The combination of pretest-posttest written answers and interview transcripts were used to analysis interviewees' conceptual change progression. The preliminary results of this study support the conceptual change model as proposed by Posner, Strike, Hewson and Gertzog (1982) and Strike and Posner (1992).

Computer-animated instruction, conventional lecture-based instruction, constructivist, conceptual change, electrochemistry

INTRODUCTION

Computer-mediated instruction compared to conventional lecture-based instruction has not been widely implemented in higher education. In fact, conventional lecturing remains the main teaching method in delivering knowledge to students. A typical conventional lecture uses overhead projectors and prepared transparencies with charts, graphs or static illustrations. Most of the time, the conventional lecture is conducted through one-way communication, ignoring class discussion and other student involvement. Students are passive listeners, taking notes from transparencies and from the lecturer's explanations. The explaining of complex conceptions through static illustrations on overhead transparencies is time consuming. This is made more difficult if the conception is not only complex, but also abstract and dynamic. Practically, it is also hard to update the content of the transparencies, thus, limiting the reusability of the transparencies.

Numerous computer software products are available to substitute the practice of using transparencies. One of the more advanced software applications is computer animation. This dynamic application is potentially useful to stimulate students' engagement in fulfilling their learning objectives (Neo, 2002). Such stimulation is essential to generate a constructivist teaching and learning environment. It is argued that embedding animations to create a constructivist environment in tertiary education will enhance students' conceptual change. As stated by Maier, Barnett, Warren and Brunner (1998, p.69), the advantages of using computer animation in teaching at higher education institutions rely on its ability "to stimulate real-life processes....create, elaborate, develop and explore graphical representations interactively".

The intensive researches in constructivist approaches and computer-mediated instruction have recently led to the use of computers as an innovation in teaching and learning science. Researchers claim that computer-mediated instruction in comparison to the conventional methods of teaching can enhance the discovery environment (Reid, Zhang and Chen., 2003), transform learners' alternative conceptions (Jimoyiannis and Komis, 2001), support a collaborative learning environment (Milrad, 2002), create technological processes (Micheal, 2001), enhance understanding of scientific conceptions (Ronen and Eliahu, 2000), provide an interactive 3-D visual stimuli environment (Sung and Ou, 2002); stimulate students' scientific problem solving skills (River and Vockell, 1987), and enhance students conceptual change (Toa and Gunstone, 1999).

This study used Flash MX as the authoring computer software program to create animations as teaching materials. These materials conceptualise and portray scientific phenomena in a dynamic and constructivist way. Animation for the purpose of this study is defined by Byrne, Catrambone and Stasco (1999) as a process of moving and changing any object on the computer screen to replicate a simulation of a theoretical dynamic, abstract and evolving process, event or phenomena. According to McNaught (1996), animation presentation is aligned with the constructivist view especially when it is designed to provide real situations or processes in step-by-step sequences. Moreover, integrating contents and processes together increases the students' experience with the authentic environment as well as in-depth content understanding (Edelson, 2001). This is quite distinct from the use of computers as reinforcement tools using ready-made courseware, which learners work by themselves.

CONCEPTUAL CHANGE MODEL

In 1982, Posner, Strike, Hewson and Gertzog proposed their conceptual change model (CCM), which became one of the most influential and guiding theories to understand conceptual change in science pedagogical research. This founding article stressed that constructing new knowledge is related to the modification of students' existing conceptions. In explaining the conceptual change from a constructivist epistemology, the authors redefined the term assimilation (generally described as weak conceptual change) to be "the use of existing concepts to deal with new phenomena" whilst the term accommodation (generally describes as strong conceptual change) to be "if the student's existing concepts are inadequate to grasp some new phenomena successfully...then the student must replace or organise his central concepts (own conceptions)" (Posner, Strike, Hewson and Gertzog, 1982, p.212). Thus assimilation involves the addition of new knowledge without the involvement, changing, linking or interaction of existing conception. This simple addition of information can be considered as rote learning if the information is purely memorised without understanding. The accommodation involves the revision of conceptions, which leads to a revisionist theory of conceptual change by Strike and Posner (1992). They stressed accommodation more than assimilation because accommodation is hard to achieve and is a process of cognitive development.

Strike and Posner (1992) highlighted four conditions of teaching and learning processes, which must first be fulfilled before accommodation takes place in a student's mind. In the same article, they described briefly factors of conceptual ecology, which may influence the student's conceptual change process. The conditions are as follow:

- a) the learner must be dissatisfied with his or her current conception;
- b) the alternative conception must be intelligible;
- c) the alternative conception must be plausible; and
- d) the alternative conception must be fruitful.

Another concept in the CCM is called conceptual ecology, which may influence the student's conceptual change process. The most important features of a learner's conceptual ecology, as adapted from Posner, Strike, Hewson and Gertzog (1982, p.215), are anomalies which arise from the learner's existing knowledge; analogies and metaphors, which facilitate the meaning and intelligibility of new ideas; epistemological commitments which include successful explanation in some interviewee matter; and metaphysical beliefs about science and science concepts. Epistemological commitments and metaphysical beliefs then become part of a learner's rationality to accept or to reject new ideas.

From the ontological perspective as proposed by Chi, Slotta and deLeeuw (1994) and Chi and Roscoe (2000), conceptual change is considered easy when the initial conception and the new conception belong to the same category or are ontologically compatible. For example, "atom releases electrons" (initial conception) can be easily exchanged to "cation releases electrons" (new conception). If the initial conception and new conception are ontologically different, conceptual change is a bit harder. It needs radical conceptual change. For example, the understanding that "cathode is an electrode" (initial concrete conception) and "cathode is where the process of reduction occurs" (abstract scientific conception) needs rearrangement of the ontology category.

Specifically in chemistry education, Greenbowe (1994) has suggested in his article the need for computer-mediated instruction, especially computer animation. He mentioned that most conventional chemistry lectures emphasise the symbolic representation (such as balancing equations) and macroscopic representation (such as changes in state), but leave the microscopic representation unexplored. He specifically stated that "as a result, students have difficulty thinking about chemical processes at the molecular level". Therefore, he suggested that the computer animations could be used as an effective tool in presenting chemical processes at the microscopic level as well as symbolic and macroscopic level, and so to enhance students' conceptual change.

There are indeed critics about the practicality of the conceptual change model in science education. Even though CCM is "the best known conceptual change model in science education" (Duit and Treagust, 2003, p.673), it does possess certain limitations. In one of their latest articles, the authors listed limits of the CCM approach in application to science education. First, CCM only focuses on isolated conceptions of science rather than the changes of overall views of the underlying concepts of the nature of science. Secondly, CCM approaches do not take into consideration affective aspects of learning such as students' perception towards science learning. As supported by Lee, Kwon and Park (2003, p.587) "sometimes, affective reasons are more important than logical/cognitive reason in students' learning".

METHOD

Sampling

Eighty-five first-semester science matriculation students at the Matriculation Centre, International Islamic University, Malaysia were randomly chosen from the total research population of 250 and were randomly assigned to form a CAnI group (n=45) and a CLI group (n=40). Six subjects were selected for interview from the CAnI group (n=3) and the CLI group (n=3) on the basis that they obtained the highest gained score between pretest and posttest. The subjects in the CLI group were coded as A1, A2 and A3 and the subjects in the CAnI group were coded as B1, B2 and B3. This purposeful sampling, also known as judgmental sampling (Berg, 2001) was used to select a specific sample of participants with certain criteria. The criterion was based on the hypothesis that the higher the increase in score obtained by the participants, the more conceptual change progress had occurred. They can be considered as a reference group or key informant and provide valuable information in understanding the process of conceptual change.

Procedure

First, the pretest was administered to the CLI and CAnI groups. The pretest and posttest instruments were designed to evaluate students' understanding of the targeted electrochemical conceptions. The pretest took 40 minutes to complete. This was followed by four unit lectures on electrochemistry as treatments. Each unit was designed as a normal 50-minute lecture. The instructor for the CLI group used conventional methods, using prepared transparencies and whiteboard. Instruction was primarily based on the lecturer's direct verbal explanation and presentation using prepared transparencies. Meanwhile, lectures in the CAnI group used computer-animated instruction, employing a lap-top computer and data projector. Their lesson focused on explaining the step-by-step process of electrochemistry through computer-animated presentation. For each step, students were engaged with class discussion and animation sequences. At the completion of sessions, a 40-minute posttest was administered to both groups. Finally, six students who obtained the highest gain scores (three students from each group) were selected. These students were interviewed for 30 to 40 minutes.

Interview Techniques

The purpose of the interview was to explore the interviewees' ideas or thinking processes behind their pretest and posttest written answers and to obtain in-depth explanation in order to track their conceptual change progress in electrochemical conceptions.

This study used a focused interview, which adapts clinical interviews, interviews-about-instances (IAI) and interviews-about-events (IAE). The combination of semi-structured and unstructured questions in clinical interviews, IAI and IAE, gave a more flexible design, with the main function being to "focus attention on a given experience and its effects" to the interviewee (Kidder and Judd, 1986, p.274). These types of interview give more scope for the interviewer to focus and direct the flow of the interview onto the specific knowledge content of electrochemistry. Moreover, clinical interviews, IAI and IAE have common characteristics in terms of probing learners' understanding. In this study, the questions were focused on the interviewee's written answers in pretest and posttest, with follow-up questions asked to obtain in-depth specific information and to probe the interviewee's understanding, reasoning and strategies used in answering pretest and posttest questions.

Each interview took approximately 30 to 40 minutes. The interviews were conducted on a one-to-one basis. The interview was audio-taped and then transcribed by the interviewer as soon as possible as suggested by Osborne and Freyberg (1985) for the interviewer to improve the technique of asking questions for the next interview. During each interview, the interviewees were asked to verbalise their answer and to illustrate their explanations of diagrams or chemical equations. This may provide extra information about their current understanding or existing knowledge. Finally, by combining interviewee's responses with written answers in pretest and posttest it was hoped to provide an insight into the interviewee's conceptual change progression.

ANALYSIS OF QUALITATIVE DATA

The combination of pretest-posttest written answers and interview transcripts, were used to analyse interviewees' conceptual change progression. The analysis of five pretest-posttest questions are given in the following section.

Question 1:

- | |
|---|
| Define each of the following:
a. Oxidation (pretest) / Reduction (posttest)
b. Cathode (pretest) / Anode (posttest) |
|---|

CLI Group: A1, A2, A3

In the pretest, only A3 was able to write the correct answer. The response shows only A3 remembered the factual knowledge about oxidation and so was a part of her existing knowledge about electrochemistry. Meanwhile, A1 and A2 have some idea about oxidation; but they showed confusion between the definitions of oxidation and reduction, a basic foundation to understanding electrochemistry conceptions. A1 defined oxidation as “no. [number] of oxidation decrease” while A2 defined oxidation as “gain electron”. Both definitions are actually correct for reduction.

For the second question, all subjects seemed unable to give a correct definition of cathode. A1 and A2 tried to associate cathode with “something negative”. For example, A1 defined cathode as “an electrode, which attract electron” and A2 defined it as a “negative pole”. A1’s and A2’s responses to the definition of cathode indicate typical examples of incorrect existing knowledge or misconception, which seems to be a common phenomena among students. To justify her answer, A2 said that “anode is positive”, perhaps she was unsure of her own answer.

In the posttest, the definition of reduction was asked instead of oxidation. A1, A2 and A3 had no difficulty in giving the correct answer. All of them defined reduction as a process of gaining electron(s). This suggests that conventional instruction was able to change the subjects’ definitions about oxidation and reduction.

For the second question, A1 and A2 again answered correctly. A1, for example, wrote that the anode “is the electrode where the oxidation occurs”. Both students rationally accepted the new definition of oxidation-reduction and anode-cathode. A3, who had no idea in the pretest about a cathode, responded to the posttest question incorrectly about the anode as “the positive electrode that attracts negative ions”. She was not aware of her misconception. Her reply established her strong misconception that the cathode is negative. This belief is then obviously repeated in the posttest when she answered that the anode is positive.

CAnI Group: B1, B2 and B3

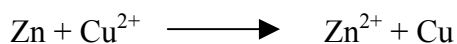
In the pretest, only B3 gave the correct answer for the oxidation definition. She answered oxidation is “release the electrons to increase the oxidation number”. We note that B3 seemed to remember such a definition without any reasonable understanding. B2 defined oxidation as a “process of gain[ing] electrons”, while B1 had no idea about oxidation at all. These answers provide evidence that some students memorised the relationship between oxidation-reduction with the process of releasing-gaining electrons. That is why some of them were lucky to give the correct combination (oxidation-releasing electrons or reduction-gaining electrons) but some were not. In B3’s case, she just remembered the combination oxidation-releasing electrons without any explanation to justify her answer.

For the second pretest question, B1, B2 and B3 failed to give the correct answer for the definition of cathode. B1, B2 and B3 defined a cathode as “receive the anion”, “the negative terminal” and “receive anion” respectively. Such responses suggest that B1, B2 and B3 held misconceptions as they tried to associate cathode with ‘something’ negative (terminal or ions) even though it is obvious that statements such as “cathode attracts anion” contradicts with scientific common sense – anions (negative ions) move away from negatively charged electrode.

In the posttest, B1, B2 and B3 gave the correct definition of reduction. B1 and B3 defined reduction as a process of gaining electrons. For B2, reduction is a “process of accept[ing] electron in chemical reaction”. This revealed that after instruction, all of them were able to grasp the definition of reduction. For the second question, B1, B2 and B3 were able to give a correct definition for anode. For B1 and B3, the anode is a terminal at which oxidation occurs while for B2, the anode is a terminal at which electrons are released.

Question 2:

Choose the reducing agent and oxidising agent in the following reaction:



(i) Reducing agent is _____ (ii) Oxidising agent is _____

Question 2 was constructed to probe the extension of the subject's understanding about oxidation and reduction processes or reactions and can be easily tracked using three possible sequences of conceptual sets as follows:

Zn (reactant): Lost electrons \longleftrightarrow Oxidation \longleftrightarrow Reducing agent

Cu^{2+} (reactant): Gained electrons \longleftrightarrow Reduction \longleftrightarrow Oxidising agent

CLI Group: A1, A2 and A3

In the pretest, A1 gave correct answers in determining the reducing agent and oxidising agent, Zn and Cu^{2+} respectively. A2 and A3 however, chose Zn and Cu as the answers. Surprisingly, they gave the same answers in the posttest.

A1's responses:

Researcher: *How did you know Zn is a reducing agent?*

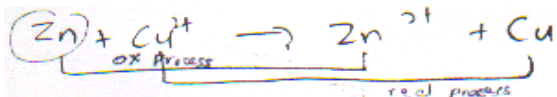
A1: *Zinc releases electrons to form zinc ion, zinc reducing agent*

Researcher: *So, an oxidising agent?*

A1: *Gaining electrons.... so copper ion is oxidising agent*

A2's responses:

Researcher: *Rewrite the equation.*

A2:  [Equation 1]

Researcher: *Which is a reducing agent?*

A2: *Reducing agent...reduction...it reduced others...Zn is a reducing agent (referring to Equation 1).*

Researcher: *What about oxidising agent?*

A2: *It oxidised others.....definitely copper
Zn is a reducing agent so Cu^{2+} is an oxidising agent*

Researcher: *But your answer is Cu?*

A2: *I didn't realise that ion could be a reducing agent*

Meanwhile A3 explicitly expressed her answer:

Researcher: *Which one is a reducing agent?*

A3:  [Equation 2]

A3: *Zinc [referring to Equation 2]*

Researcher: *How did you know?*

A3: *First I determine which one has been reduced...copper [Cu]*

Researcher: *Can you explain?*

A3: *Because the oxidation number is decreased.....*

Researcher: *Please explain.*

A3: *Definitely the process of reduction....*

A1 used the concept of releasing and gaining electrons to determine the reducing agent and oxidising agent. In this case, A1 confidently associated releasing electrons (oxidation) with reducing agent and gaining electrons (reduction) with the oxidising agent. A2 gave Zn as the reducing agent because “it reduced others”, and then made a conclusion that Cu is the oxidising agent. Without understanding the role of electrons, A2 failed to realise that Cu^{2+} was the one that reduced (decreasing oxidation number) not Cu. On the other hand, A3 used the oxidation number to determine which species had been reduced, then made a conclusion that Zn was a reducing agent. The way A2 and A3 explained their answers suggests their incomplete mental model and weak conceptual change regarding the concept of reducing and oxidising agents.

CAnI Group: B1, B2, B3

In the pretest, B1 and B3 wrote Zn and Cu as reducing agent and oxidising agent respectively. B2 however chose Cu^{2+} and Zn as her answers, which were definitely wrong. In the posttest, B1, B3 and B2 correctly chose Zn as reducing agent and Cu^{2+} as oxidation agent. In describing the answer, B1 for example made the following responses:

Researcher: *How do you determine a reducing agent?*

B1: *Reducing agent.....undergoes the oxidation process*

Researcher: *So, which one is the reactant which undergo oxidation?*

B1: *The reactant which releases electrons...*

Researcher: *Write down the equation*

B1: $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$ [Equation 3]

Researcher: *The other one.*

B1: $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ [Equation 4]

Researcher: *Please circle the oxidising agent and reducing agent*

B1: *Definitely zinc [Zn]*

Researcher: *Which one undergoes reduction reaction?*

B1: *Copper ion*

B2's responses:

Researcher: *Which one is a reducing agent?*

B2: *First, I noticed Cu^{2+} to Cu....reduction*

Researcher: *How do you know it is reduction?*

B2: *Because...it receives electrons....*

Researcher: *Please explain further.*

B2: *It [Cu^{2+}] receives electron...*

Researcher: *From which source?*

B2: *Zinc metal.....so reduction agent is zinc*

Researcher: *What about zinc?*

B2: *Zinc...oxidation process...copper...reduction agent.*

Researcher: *Which 'copper' did you mean according to your equation?*

B2: *Cu²⁺*

Researcher: *Why?*

B2: *The reduction of oxidation number...*

Researcher: *Please explain.*

B2: *Reduction process...so it's oxidation agent...*

B3's responses:

Researcher: *Which one is reduction agent?*

B3: *Zinc*

Researcher: *How do you know?*

B3: *From oxidation process*

Researcher: *Please explain.*

B3: *The oxidation number increase.*

Researcher: *Oxidising agent?*

B3: *Copper*

Researcher: *Copper ion or copper atom?*

B3: *Copper ion...*

B1, B2 and B3 explained their answers based on the process of oxidation and reduction. B1 then divided the redox equation into two half equations (Equation 1 and Equation 3). This excerpt illustrates in-depth understanding and a complete mental model possessed by B1. The way B1 explaining the answers suggests the strong conceptual change regarding the concept of reducing and oxidising agents. Meanwhile B2 and B3 also used oxidation number to describe their answers. Oxidation number is actually not explained in the lecture but may be retrieved from their existing knowledge.

Question 3

What makes the molten PbBr₂ conduct electrical current?

Describe you answer (pretest)

What makes aqueous solution CuSO₄ conduct electrical current?

Describe you answer (posttest)

For this question, subjects should know the definition of electrolyte and the properties of ionic compounds (PbBr₂ and CuSO₄) in solution or molten state. Electrolytes such as PbBr₂ when in molten state or CuSO₄ when dissolved in water, produces free anions and cations. Anions (negative ions) release electrons to cations (positive ions) through the process of oxidation and reduction respectively. Electric current is carried through molten PbBr₂ and aqueous solution of CuSO₄ by the movement of ions, demonstrate the electrical conductivity of these electrolytes.

CLI Group: A1, A2 and A3

In the pretest, only A1 and A2 tried to answer the questions. For A1, molten PbBr_2 conducts electrical current because “in the molten PbBr_2 , electrons move freely”. When asked further, A1 explained:

Researcher: *What did you mean by ‘the electrons move freely’ in molten?
Where do the electrons come from?*

A1: *Bromin is negative....*

Researcher: *Where is the source of electron?*

A1: *From plumbum...it releases electrons to bromin*

The answer given by A1 indicated that she associated electron with cation. However, she then clarified that plumbum is the source of electrons.

Meanwhile, A2 gave her response as “...the electron[s] can move to transfer the electrical current”. In each of these answers, A1 and A2 tried to construct a logical meaning of conductivity phenomena based simply on the existence of free electrons, instead of free anions and cations.

In the posttest, A1 wrote that aqueous solution of CuSO_4 conducts electrical current because “there are lots of free ions”. This was the answer given in the pretest. The way she repeated the answer, confirm the surface understanding possessed by A1. A2 wrote that “ CuSO_4 have free cations and anions that can transfer the electrical current”. For A3, aqueous solution of CuSO_4 conducts electrical current “because of the anions and cations free to move”. These answers show that the way A2 and A3 had learnt was dominated by what they had already known about aqueous solutions. They realised an aqueous solution consists of free cations and anions, but not how these ionic particles produce free electrons. If A2 believed that electrons flow through the electrolyte without mentioning the redox reaction, they will not be able to understand the whole process completely.

There is a similarity in the subjects’ answers. They all used the word ‘free’ to explain the flow of electrical current. A1 used free ions to justify her answer while A2 and A3 used free cations and anions. However, none of them described in what way that free electrons or free ions could explain the electrical conductivity of the electrolytes. If they knew that free electrons or free ions can cause electrical conductivity but did not know the conception (in this case the redox reaction) underlying this process, they have experienced weak conceptual change rather than strong conceptual change. Despite the incompleteness, all of them seem satisfied with the logic of their answers.

CAnI Group: B1, B2, B3

In the pretest, B2 and B3 mentioned the existence of cations and anions as being responsible for the electrical conductivity for molten PbBr_2 , but failed to describe any further. B2 however, used the wrong terminologies - ‘positive atom’ and ‘negative atom’ for cation and anion respectively. In fact, there are no positive or negative atoms, because atoms are neutral. This indicates that B2 held some kind of misconception regarding the properties of atoms.

In the posttest, B1 described CuSO_4 as an ionic compound, which undergoes “oxidation and reduction to produce electrons”. B3 knew that CuSO_4 contains free ions and wrote “the discharge of the ions produce the electrical current”. Meanwhile B2 in the posttest wrote “anion will release electron and cation will gain electron”. B1 and B2 noticed the role of anion and cation in the redox reaction in order to produce electrons. These responses show that all subjects in the CAnI group are able to provide an explanation of the phenomena, which is consistent with the conceptions as held by scientific views. The analysis indicates that the subjects in the CAnI group

experienced a strong conceptual change process. It suggests the conceptions seem intelligible and plausible to the students.

Question 4:

Explain why the cathode in an electrolytic cell of molten KCl is negatively charged whilst the cathode in Zn-Cu (Galvanic) cell is positively charged?

To answer this question, students should know that in the electrolytic or Galvanic cells, the anode is the electrode at which oxidation occurs and the cathode is where reduction occurs. However, in Galvanic cells, the anode is negative and the cathode is positive, while in electrolytic cells, the anode is positive and the cathode is negative. These differences are shown in Table 1.

Table 1. Anode and Cathode

Electrode	Process	Electrolytic Cell (molten MgCl ₂)	Galvanic Cell (Zn-Cu)
Anode	Oxidation	Positive electrode Equation: $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$	Negative electrode Equation: $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$ (zinc is preferable of releasing electrons)
Cathode	Reduction	Negative electrode Equation: $\text{Mg}^{2+} + 2\text{e}^- \rightarrow \text{Mg}$	Positive electrode Equation: $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$

CLI Group: A1, A2 and A3

In the pretest, A1, A2 and A3 did not write any answer to the question. Probably they did not have any ideas from which to analyse the conceptions required for this question. In the posttest, A1, who gave a correct definition of anode in Question 1b, gave a partially correct answer to Question 4. She wrote that the cathode in the electrolytic cell is negatively charged “because it receive $\bar{\text{e}}$ [electrons] from the battery whereas cathode in the Galvanic cell is producing the $\bar{\text{e}}$ [electrons]”. A2 and A3, did not try to answer the question in the posttest, suggesting that the conceptions are not intelligible and plausible to them even though they had attended a series of conventional lectures. When asked further in the interview:

A2's responses:

Researcher: *Why did you think that cathode (in electrolytic cell) is a negative terminal?*

A2: *Because it has a lot of electrons.*

Researcher: *Can you explain?*

A2: *Electrons have negative charge...*

Researcher: *What about Galvanic cell?*

A2: *Emmm...it should be reversed.*

A3's responses:

Researcher: *Which are the anode and the cathode?*

A3: *This is cathode because it is negative*

Researcher: *Anode?*

A3: *Anode is positive electrode...*

Researcher: *Which electrode is anode or cathode (Galvanic cell)?*

A3: *Copper is anode.*

Researcher: *Why?*

A3: *Anode...positive electrode*

Both A2 and A3 associated the cathode with the negative and positive electrode, respectively. They knew that the electrodes in a Galvanic cell have opposite charges but failed to explain further. This confusion suggests that the conceptions are not intelligible and plausible to them even though they had attended a series of conventional lectures. All subjects in the CLI group gave correct answers on the surface or symbolic level of conception but failed to understand the macroscopic and microscopic explanation of the concepts. This suggested that the subjects in the CLI group experienced a weak conceptual change progression.

CAI Group: B1, B2 and B3

In the pretest only B1 and B3 tried to answer Question 4. B1 wrote that “molten KCl is negatively charged because it gains electrons from anode” which is incorrect and meaningless because molten KCl is not a cathode. Meanwhile, B3 wrote that cathode in molten KCl cell is negative because “K [sodium] is on the top of the Chemical Reaction Series [the Electrochemical Series] Zn-Cu below the Chemical Reaction Series”. Again, B3 referred to molten sodium, K^+ and Zn-Cu as electrodes for both cells respectively. This answer shows that B1 and B3 did not possess fundamental understandings of electrolytic and Galvanic cells. They failed to recognise the electrodes and to distinguish them from electrolytes.

However, in the posttest B1 and B2 provided correct answers while B3 got it partially correct. B1 wrote that the cathode in the electrolysis cell of molten $PbBr_2$ is negatively charge because “it contain excess electrons...the battery will flow the electrons” while the cathode in Galvanic cell is positively charged because “it give e^- [electrons]”.

B2 gave the answer that the cathode in the electrolysis cell of molten $PbBr_2$ is negatively charged because “it accepts/gains electron from the battery” while the cathode in the Galvanic cell is positively charged because “it releases the electron”. B3 explained that the cathode in electrolytic cell is negatively charged because “cathode is connected to the negative part [of the battery].

B1, B2 and B3 seemed to understand the reason why the cathode in the electrolytic cell is negatively charged, but they failed to explain completely why the cathode in the Galvanic cell is positively charged. However, all of them gave the correct answers for the electrolytic cell, suggesting that they experienced better conceptual change progress. For example, when asked further in the interview, B1 explained:

Researcher: *What makes you choose the electrode as negative electrode?*

B1: *It is connected to the battery...which flow charges*

Researcher: *The battery flow charges?*

B1: *The battery flow the electrons....then...plumbum receives the electrons*

Question 5

In a Galvanic cell, is the more active (reactive) metal more likely to be the anode or the cathode? Briefly explain your answer.

Question 5 examines the concept that the more active a metal, the greater is its tendency to release or donate electrons (to oxidise). The activity of metals is ordered in the Electrochemical Series and may be accordingly used to determine the anode (more active) and cathode (less active) for a Galvanic cell. The three possible sequence of conceptual set for this question is:

Active metal: Easy to release electrons \leftrightarrow Oxidation (reducing agent) \leftrightarrow Anode

CLI Group: A1, A2 and A3

There was no response at all in the pretest for this question. A1, A2 and A3 probably did not have any idea how to apply the activity of metals for determination of anode or cathode.

Surprisingly, all of them gave correct answers in the posttest. They recognised the anode based on different features. A1 associated anode with "giving out electrons" while A2 and A3 associated anode with "reducing agent" without further explanation. No one related activity of the metal with the preference to lose electrons or preference to undergo oxidation as a basis of their explanation. This suggests that the conceptions underlying the question are intelligible but are not considered as a plausible idea. It also suggests that subjects in the CLI group experienced weak conceptual change progress.

CAnI Group: B1, B2 and B3

In the pretest, B1, B2 and B3 gave completely wrong and irrelevant explanations even though they tried to answer the question. These initial answers showed that they did not understand the concept of anode. However, in the posttest, all of them got the correct answer.

B1's, B2's and B3's responses show evidence of conceptual change. B1 recognised the anode based on the logical possible ideas that active metals prefer to release electrons and undergo the process of oxidation. For example in the interview, she repeated the answer why she chose zinc as electrode anode:

Researcher: *Which is anode?*

B1: *Zn....Zn more reactive*

B2 gave a straightforward answer that the anode donates electrons. She gave a more detailed explanation in the interview. B2's responses:

Researcher: *Why did you chose Zn^{2+} releasing electrons and Cu receiving electron?*

B2: *Zinc is located at higher position in the electrochemical series....so zinc is electropositive....*

Researcher: *Please explain your answer, why reactive metal tend to be an anode?*

B2: *Reactive metal.....more electropositive...*

Researcher: *So?*

B2: *It tend to release electrons...*

Researcher: *Then...?*

B2: *Wait.....donate means oxidation....oxidation means anode....*

B3 chose to explain that active metals are strong reducing agents and therefore undergo oxidation. In the interview, she explained:

Researcher: *Which substance undergoes oxidation?*

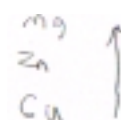
B3: *Zinc.*

Researcher: *Why?*

B3: *Zinc is located above copper in the Series of Electrochemistry*

Researcher: *What does it mean?*

B3: *Zinc is more reactive*



Thus, the concept of anode for the Galvanic cell seems intelligible and plausible for B1, B2 and B3. A strong conceptual change process is believed to have occurred as B1, B2 and B3 correctly

explained why in a Galvanic cell, the more active (reactive) metal is more likely to be the anode in comparison to their counterparts in the CLI group.

CONCLUSION

Most interviewees retained only a small amount of knowledge regarding electrochemistry conceptions before attending the instruction and therefore failed to respond successfully in the pretest. It is believed that the interviewees possessed little understanding of the topic taught to them during their secondary level studies. Pretest analysis shows that most interviewees left the questions unanswered or answered with erroneous conceptions. However, the study found that interviewees in both groups succeeded in answering questions of low-level cognitive domain in the posttest.

Despite the incompleteness of their answers in the posttest, the subjects in the CLI group had problems elaborating the underlying processes at both microscopic and macroscopic levels during the interview sessions. This suggests that they experienced only weak rather strong conceptual change progress. The complex, abstract and dynamic conceptions within the redox process remained unintelligible and implausible to them even after attending the series of lectures. The posttest answers and the responses during the interview session, show that subjects in the CANI group were able to provide better explanations of the complex, abstract and dynamic conceptions. This indicates that they experienced a strong conceptual change process.

In summary, it can be concluded that after exposure to a series of lectures on electrochemistry, targeted conceptions were found to be more intelligible and plausible to the subjects in the CANI group in comparison to their counterparts in the CLI group. It appears both groups experienced weak conceptual change, while the former significantly outperformed the latter in experiencing strong conceptual change. It is hoped that this analysis lends support and invites further study into implementation of the CANI method as an ICT rich alternative to conventional lecture format.

REFERENCES

- Berg, B.L. (2001). *Qualitative Research Methods for the Social Sciences*. Boston: Allyn and Bacon.
- Byrne, M.D., Catrambone, R. and Stasco, J.T. (1999). Evaluating animations as students aids in learning computer algorithms. *Computers and Education*, 33, 253-278.
- Chi, M.T.H., Slotta, J.D. and deLeeuw, N. (1994). From things to processes: A theory of Conceptual Change for Learning Science Concept. *Learning and Instruction*. 4, 27-43.
- Chi, M.T.H. and Roscoe, R.D. (2002). The processes and challenges of conceptual change. In M. Limon and L. Mason. (eds) *Reconsidering Conceptual Change. Issues in Theory and Practice*,(pp.3-27). Netherlands: Kluwer Academic Publishers.
- Duit, R. and Treagust, D.F. (2003). Conceptual change: A powerful framework for improving science teaching and learning. *International Journal of Science Education*, 25(6), 671-688.
- Edelson, D.C. (2001). Learning-for-Use: A Framework for the design of technology-supported inquiry activities. *Journal of Research in Science Teaching*, 38(3), pp. 355-385.
- Greenbowe, T.J. (1994). An interactive multimedia software program for exploring electrochemical cells. *Journal of Chemical Education*, 71, 555-557.
- Jimoyiannis, A. and Komis, V. (2001). Computer simulations in physics teaching and learning: a case study on students' understanding of trajectory motion. *Computers and Education*, 36, 183-204.
- Kidder, L.H. and Judd, C.M. (1986). *Research Methods in Social Relations*. New York: Holt, Rinehart and Winston.

- Lee, G., Kwon, J. and Park, S-S. (2003). Development of an instrument for measuring cognitive conflict in secondary-level science classes. *Journal of Research in Science Teaching*, 40(6), 585-603.
- Maier, P., Barnett, L., Warren, A. and Brunner, D. (1998). *Using Technology in Teaching and Learning*. London: Kogan Page.
- McNaught, C. (1996). The nature of IT and its implications for practices and policy in higher education. Paper presented at the Annual Conference of Australian Society of Computers in Learning in Tertiary Education, University of South Australia.
- Michael, K.Y. (2001). The effect of a computer simulation activity versus a hands-on activity on product creativity in technology education. *Journal of Technology Education*, 13(3), 31-43.
- Milrad, M. (2002). Using construction kits, modelling tools and system dynamics simulations to support collaborative discovery learning. *Educational Technology & Society*, 5(4), 1-18.
- Neo, M. and Neo, K. (2002). Building a constructivist learning environment using a multimedia design project - a Malaysia experience. *Journal of Educational Multimedia and Hypermedia*, 11, 141-154.
- Osborne, R.J. and Freyberg, P. (1985). *Learning in Science: The Implication of Children's Science*. London: Heinemann Educational Books.
- Posner, G.J., Strike, K.A., Hewson, P.W. and Gertzog, W.A. (1982). Accommodation of a scientific conception: Towards a theory of conceptual change. *Science Education*, 66, 211-227.
- Reid, D.J., Zhang, J. and Chen, Q. (2003). Supporting scientific discovery learning in a simulation environment. *Journal of Computer Assisted Learning*, 19, 9-20.
- River, R.H. and Vockell, E. (1987). Computer simulations to stimulate scientific problem solving. *Journal of Research in Science Teaching*, 24, 212-234.
- Ronen, M. and Eliahu, M. (2000). Simulation - A bridge between theory and reality: The case of electric circuit. *Journal of Computer Assisted Learning*, 16, 14-26.
- Strike, K.A. and Posner, G.J. (1992). A revisionist theory of conceptual change. In D.R. and H.R. Albany, (eds) *Philosophy of Science, Cognitive Psychology, and Educational Theory and Practice*, (pp.147-176). SUNY Press.
- Sung, W.T. and Ou, S.C. (2002). Learning computer graphics using virtual reality technologies based on constructivism: Case study of the WebDeGrator system. *Interactive Learning Environments*, 10(3), 177-197.
- Tao, P.K. and Gunstone, R.F. (1999). The process of conceptual change in force and motion during computer-supported physics instruction. *Journal of Research in Science Teaching*, 36(7), 859-882.

Creativity in problem solving: Uncovering the origin of new ideas

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Innovation and enterprise depend for their success on the development of new ideas. But from where do new ideas come? How do they arise? Finding solutions to such questions is at the heart of creativity research and the solving of novel problems. Reflection, not only in cognitive processes but also in the non-cognitive ones used in solving novel mathematics problems, is uncovering a way in which the origins of new ideas occur. A study involving protocol analysis of five expert problem solvers identifies three critical elements. These elements have been employed to construct a framework of creative problem solving which may be used to foster creativity among young people under instruction and provide a cognitive explanation of the origin of new ideas.

Creativity, problem solving, cognitive, non-cognitive, reflection

INTRODUCTION

Uncovering the origin of new ideas conjures many benefits in the resolution. These benefits include the innovative, the entrepreneurial, the educational, the social, and the global. The source of new ideas also merits a search from different orientations. These orientations may include the historical, the sociological, the philosophical and the theological to mention but a few. While each orientation contributes a different perspective, a comprehensive disclosure as to the origin of new ideas may ultimately depend for its resolution on the synthesis of many such perspectives.

The orientation adopted in this paper is one taken from cognitive psychology and neurobiology. In this orientation the focus is on differentiating the creative processes in human cognition that may be used to solve novel mathematics problems. The purpose of the study is to identify and describe some elements of creativity that may be used to construct a framework of creative problem solving. By so doing a cognitive explanation as to the origin of new ideas may be found.

A Working Definition of Creativity

Many definitions of creativity can be found within the research literature on creativity. However one definition finding increasing acceptance in both education and psychology is that describing creativity as the production of effective novelty (Cropley, 1999; Lubart, 2001; Mumford, 2003a). This definition implies that for something to be creative it must be both original and useful.

The National Advisory Committee on Creativity, Culture and Education in England, for example, advises that creativity is “Imaginative activity fashioned so as to produce outcomes that are both original and of value” (NACCCE, 1999, p.30). In the same vein cognitive psychology, adopting a more processed orientation, defines creativity as “the sequence of thoughts and actions that leads to a novel adaptive production” (Lubart, 2001, p.295).

One definition that makes explicit the nature of thought and action within the creative process is that by Koberg and Bagnall (1976) who describe creativity as:

both the art and the science of thinking and behaving with both subjectivity and objectivity. It is a combination of feeling and knowing: of alternating back and forth between what we sense and what we already know. (Koberg and Bagnall, 1976, p.8)

This definition implies that not only is cognitive activity involved in the creative act but non-cognitive activity as well. According to Koberg and Bagnall (1976), the act of creation, involves oscillating between what individuals think or know (namely, cognitive activity) and what they sense or feel (i.e. non-cognitive activity). This conceptualisation is significant in light of the protocols that are described below.

Valuing Cognitive and Non-cognitive Elements

That there is a need to value both subjective and objective elements in the creative process, is a view shared by a number of notable proponents in the field. Russ (1993) for example has developed a model of affect and creativity. Cropley (2001) has mapped different emotions to particular phases of the creative process and Shaw (1989) highlights positive and negative poles of emotion arising at different stages of creative production. These poles of emotion are overlaid with a series of feedback loops involving conscious and non-conscious mental activity (Shaw, 1989).

Each of the affective models referred to above employs an adaptation of the classic four-stage model of creativity put forward by Wallas (1926) and others (Hadamard, 1945). The four stages in the classic model are preparation, incubation, illumination and verification. Although the phases of preparation and verification are marked by conscious activity, the phases of incubation and illumination may include non-conscious activity.

Cycles of Conscious and Non-conscious Activity

Shaw (1989) predicts that a series of feedback loops arises between each of the phases of the creative process. The 'Areti loop' for example, predicts conscious and non-conscious oscillatory behaviour occurring between the phases of preparation and incubation, the 'Vinacke loop' to cycles of non-conscious and conscious mental activity arising between incubation and illumination, while the 'Lalas loop' predicts cycles of illumination and verification occurs whenever a given explanation leads to further illumination. The 'Communication loop' predicts feedback between the stage of verification and further validation of the creative product. Finally, multiple feed-back loops, involving conscious and non-conscious mental activity are theorised to exist from the verification and validation stages of creativity to all previous stages in the creative process. These multiple feed back loops are collectively referred to as the 'Rossman loop'.

This interplay of conscious and non-conscious mental activity with respect to each of the four phases of creativity can be explained in neural network theory in terms of a large net of interconnecting neurons (Martindale, 1995) or nodes. A neural network explanation of the stage model of the creative process follows.

Neural Networks and the Creative Process

During the preparation stage, when attention is greatly focused, a small number of highly activated nodes dominate consciousness (Martindale, 1995). These highly activated nodes inhibit other nodes from becoming active in a process of lateral inhibition. However, when attention is gradually defocused, such as occurs during incubation, lateral inhibition is diminished and other nodes primed through remote association with the problem may be activated. Should a partially

primed node become fully active, it may enter consciousness in an act of illumination (Martindale, 1995). The verification phase is once again marked by focused attention when an idea or solution is being examined for suitability and a small number of nodes are highly activated.

Thus, in the confines of this study both cognitive and non-cognitive elements of creativity need to be identified and described in order that a comprehensive representation of the creative process may be articulated within the proposed framework of creative problem solving.

Creativity within the Education Context

In the field of creativity research some argument arises as to the degree of effective novelty required before a given production may be classed as creative. Some proponents consider only eminent productions to be creative (Simonton, 1988) while others regard more modest representations of the everyday kind as creative (Crompton, 2001; Richards, 1999a). Creativity in this study has been interpreted relative to the originator of the novel production. If an individual found an effective solution to what was to him a new and different problem, even if others had already solved the problem, then, for the purposes of this study the individual demonstrated creativity. Thus, an interpretation of creativity consistent with the everyday kind has been adopted, a perspective useful in the education context.

METHODS OF ANALYSIS

Protocol Analysis

Verbal data from five expert problem solvers were collected using protocol analysis (Ericsson and Simon, 1993), a technique developed to study cognitive processes in human subjects. Three of the experts were teachers of secondary mathematics, one a university lecturer in applied mathematics and one a Grade 11 student who was a proficient problem solver in mathematics. The verbal data were recorded by audio, video or on-line means.

Two forms of verbal report were gathered. The first of these involved concurrent reporting. The second involved retrospective reporting. Concurrent reporting involves subjects verbalising their thoughts while performing a specified task or problem. Such reports are often disjoint since the subject does not explain what he or she is doing, but verbalises only that to which he or she is attending. Without the encumbrance of explanation, the subject's sequence of verbalised thought is considered to reflect the sequence of information processing (Ericsson and Simon, 1993). The theory of sequenced thinking reflecting sequenced information processing is significant in light of the patterns of alternating and concurrent thinking reported in this study.

Retrospective reporting requires the subject to recall the sequence of thoughts from start to finish at the completion of the task. Retrieval cues remaining in short term memory allow effective recall of the sequence of thought. Since concurrent reporting does not permit explanation of process, when it is combined with retrospective reporting a more coherent picture of human information processing is achieved (Ericsson and Simon, 1993). It also provides an opportunity for seeking clarity on any point in the protocol.

Indeed, a limiting factor of protocol analysis is that, although the brain may be a parallel processor (Tank and Hopfield, 1987), speech is sequential and thus the sequential nature of thought may be over accentuated (Das, 2003; Khandawalla, 1993). To alleviate this difficulty both kinds of reporting were used in the study.

An Expanded Focus of Information

Unlike traditional studies of protocol analysis where the focus is on functional mechanisms of cognition that can be replicated in a computer program, an expanded focus that included non-

functional as well as functional mechanisms was used in this study. Non-functional mechanisms include such processes as sensing, feeling, incubating, reverie, imagination and inspiration. Thus, an expanded notion of information to be heeded in the information-processing context was adopted, that included both non-cognitive and cognitive aspects.

RESULTS AND DISCUSSION

Exploratory Protocols and the Identification of Themes

Content analyses of five exploratory protocols led to the identification of three themes around which cognitive and non-cognitive elements within the creative problem solving process could be described. Consistent with published research findings (Damasio, 1994; Dehaene, Spelke, Pinel, Stanescu, and Tsivkin, 1999; Epstein, 1994; Sloman, 1996) these themes involved:

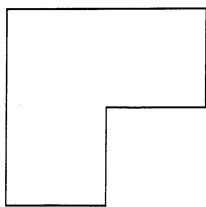
- the interaction between visual-spatial and analytical reasoning
- the role of feeling in listening to the ‘self’; and
- the interaction between conscious and non-conscious reasoning.

The interplay between visual-spatial and analytical reasoning was the first theme to be identified. Analyses of protocols within this theme led to the identification of the second theme, namely the role of feeling in listening to the ‘self’. One individual, for example, consistently used the expression “I think” when displaying analytical reasoning, but the turn of phrase “I feel” when displaying visual-spatial reasoning. In addition, a second individual articulated the need to obtain a “visual feel for the shape” linking a feeling approach with visual spatial reasoning. Since the concurrent turns of phrases were not, in the main, consciously chosen, (as revealed by the retrospective accounts) the third theme, the interaction between conscious and non-conscious reasoning, was identified.

The following are extracts taken from each protocol broadly grouped on the basis of theme. While the labels of A, B, C, D and E have been applied to each individual, pseudo-names have also been given in order to facilitate semantic memory and preserve participant anonymity.

Theme 1: On the Interaction between Visual-spatial and Analytical Reasoning

The protocol abstracts from individuals A, B and C, referred to as Anne, Barbara and Chelsea, relate to problem solving attempts of a novel geometric problem related to area that may be solved using either analytical or spatial reasoning or a combination of both. Anne is a new graduate teacher in secondary mathematics education. Barbara is an established secondary mathematics teacher with more than ten years experience, while Chelsea is a Grade 11 student of mathematics. A copy of the problem and its rubrics solved by Anne, Barbara and Chelsea is given in Figure 1.



Divide the shape above into four pieces, which are exactly equivalent in shape and area. The shape is a regular shape with each of its short sides being half the length of its long sides. Use any materials or procedures you think will help you complete this task.

Figure 1. The L-shaped area problem (investigated by Anne, Barbara and Chelsea)

The solution to this problem involves identifying an arrangement of ‘L’ shaped patterns nested along side each other within the diagram.

Individual A: Anne

Individual A: Anne is first observed using an analytical approach to solve the problem but when this approach fails Anne switches to a visual-spatial approach. Anne eventually solves the problem by visual-spatial means.

While using analytical reasoning Anne concurrently reports:

I am trying to think of irregular shaped patterns, shapes that are more complex that will divide the area ...

I think what I am trying to do is keep everything sort of basically symmetrical...

As I say, if I can put a diagonal line from corner to corner. If I can, then just deal with one side of it, then whatever I do to that one side I can do to the other, but I'm not sure if I can do this either. May be it shouldn't be a diagonal line.

While using visual-spatial reasoning Anne verbalises:

I'm just trying to visualise patterns in my head to see what areas spatially will fulfil the requirements...

I definitely feel that the shapes are going to be geometric and that will most easily allow me to make sure the areas are the same size...

So I feel that somehow it is like that (pointing to a swastika superimposed with L shapes she has drawn upon the page). It will be made of Ls.

Anne then silently draws the solution upon the page and counting four L shapes embedded within the diagram exclaims:

Where did that come from?

It is interesting to note that when using an analytical approach to solving the problem Anne is recorded using the expression 'I think' but when using a visual-spatial approach to solving the problem she is recorded using the expression 'I feel'. In addition Anne's final exclamation indicates that the solution process involving visual-spatial reasoning was not entirely conscious.

Invited to reflect on her unconscious choice of the word 'feel' when using a visual-spatial approach Anne reports:

It was a feeling in the respect that it had its own self-similarity. I know I was sort of seeing these sorts of patterns in my head... If I had plasticine I would have started shaping these Ls. In my head I was moulding them... which was like an emotional shaping ... the only way I could describe it, is that it was a kind of an instinct, which I would argue, wasn't thinking because it was more primitive than that.

Anne elaborates:

You've got to sit back and see how you feel ... there are no boundaries, you have to open your mind and see what comes in... I was outside of my mathematics domain... I just went global.

Anne concludes:

It was an awakening of ideas. I'm thinking the images but feeling their correctness... It's taken all of me to solve it... True problem solving is using all of you to solve it.

When invited to reflect on her final comment, "Where did that come from?" Anne explains:

I must admit, when I was drawing it ... I didn't know the solution until I'd finished drawing it. You know what I mean? I must have had a glimmer of it in my head. It was almost like my head wasn't controlling my hand...my subconscious just fully took over.

This protocol indicates that in the case of Anne a total engagement of the 'self' was essential to the formation of a successful solution. Anne opened her mind to conscious and non-conscious aspects of cognition and employed visual, spatial, analytical and feeling elements in the problem solving process. Of note is the observation that the feeling approach used by Anne served an evaluative function, in the navigation of a solution path. Further this feeling aspect was expressed during the employment of visual-spatial reasoning.

Individual B: Barbara

During this interview Individual B: Barbara was observed alternating back and forth between analytical thinking and spatial thinking until the solution was found. While an analytical approach was used to determine the unit shape and its area, a spatial strategy was employed to determine the collective orientation within the figure. Beginning with an analytical approach Barbara reports:

Well the first thing I think when I look at it, is that it's very easy to divide it into three shapes; because we have three squares... one on each side, placed together to form an L.

Later changing to a visual-spatial strategy Barbara verbalises:

So I'm trying to visualise how I can put lines in that will allow me to make four pieces.

Returning to an analytical approach Barbara relates:

Starting to think that straight lines aren't the answer, starting to think that perhaps I need to step my lines.

Reverting to a spatial-verbal approach Barbara reports:

So I'm putting markers on the shape just so I can get a visual feel for the shape.

As mentioned above it is interesting to note the use of the word 'feel' with a visual representation of the shape. It is also interesting to note the word 'think' being articulated during an analytical approach. Further when invited to comment on her alternating analytical and visual spatial behaviour Barbara retrospectively explains:

Definitely... I could feel it. I could actually feel it in my brain. The analysis would take over, and then that would reach a dead end and then I would look for some intuition of where to go. I could feel it happening in my head.

Of relevance to this protocol is the suggestion by neuroscientists that mathematical intuition may emerge from the interaction between visual-spatial and linguistic reasoning circuits (Dehaene et al., 1999). Barbara's articulation of the word intuition in the context of her alternating behaviour concurs with this view.

Further when invited to elaborate upon her feeling of what was happening in her head Barbara explains:

It's pretty hard, but it's something I've always known about myself mathematically that if I can't see the answer straight away; if I just sort of let my head go fuzzy and stare at it, it comes. The answer just comes. And I've always been the same. It's not always the right answer. Sometimes I go off on the wrong path but when that path is exhausted, same procedure. And that's how I get my direction in solving things. So

here, once I'd eliminated the straight lines and I'd got my 3 and 6 and that wasn't going to work then it was an analytical thing to think OK, go to shapes. And then to work out areas, that was definitely analytical. But then the actual orientation (of shapes) was very much intuition. Was very much just look at it, not even think, just let your brain, work on it.

This verbal account indicates that Barbara utilised analytical, rule based reasoning together with associative, spatial reasoning in an alternating fashion in order to solve the problem. A conscious non-conscious interplay in the problem solving process is also indicated by the statements "If I sort of let my head go fuzzy and stare at it, it comes" and "the actual orientation was very much intuition ... not even think, just let your brain work on it." Such statements are also indicative of defocused attention and pre-conscious activity.

It is noteworthy that Barbara reports feeling the reasoning processes alternating in her head. Such feeling reflects a total engagement of the 'self' in the problem solving process and relates to the second theme 'the role of feeling in listening to the self'. The fact that Barbara is definite about knowing she has a feeling and further, that she is able to heed that feeling in the problem solving process, is relevant to work in metacognition.

Barbara's retrospective protocols also reveal that she models the use of this intuitive reasoning to her pupils. Indeed, in the event of becoming stuck in a problem Barbara advises her students to relax their minds while continuing to absorb the problem. This strategy, she advises, is particularly useful in solving deductive geometry problems.

When I really notice myself doing it is in a class with kids, particularly with deductive geometry... I say to the kids "OK I need to have a think". That's how I do it. I just pull up a chair and sit at the front board and just stare at it and it just happens, ... the answer just jumps off the black board at me. But nobody can talk to me while I'm doing it... I actually say, "Have you just sat and looked at it. Just sort of let your mind go blank?" And quite often the kids are then able to go on and solve things ... I won't help a student until they've actually sat and looked at it... if they have just sat and looked I'll give them one clue, and then, you know, say "Have another try". And you can see the lights come on. And I'd have to say I've been reasonably successful in teaching the topic.

Although this account of fostering intuitive reasoning among students warrants closer examination, the fact that Barbara takes the trouble to model this approach to students indicates that an intuitive reasoning approach works successfully for her, particularly in the field of deductive geometry. Moreover it is evident that Barbara has confidence that the approach will work for her students. When asked to confirm the success of just sitting back, looking and letting your mind go blank during problem solving, Barbara comments:

I've got to say, it used to worry me ... that I didn't appear to be thinking, like other people think, or... how I thought other people thought... for me to actually think about it... was actually more the emptying of the mind than the filling of it. But I pretty well always got the right answer.

This account points to the benefits of defocused attention in a novel problem solving context and the usefulness of incubation or semi-incubation in reaching a solution. Given a recent experimental finding showing that an instructional strategy used to encourage children between the ages of 8 and 10 years to defocus their thinking before attempting a problem increased their ideational productivity (Howard-Jones and Murray, 2003), the above protocol shows a degree of forward thinking.

Individual C: Chelsea

Unlike Anne and Barbara, who are experienced mathematics problem solvers, it may be recalled that Individual C (Chelsea) is a relatively inexperienced Year 11 school student. In this interview Chelsea relies totally on rule based, analytical reasoning and is concerned with attempting to solve the problem in the so-called ‘correct way’. She appears to look for an algorithm to solve the problem, and lacks the confidence needed to step outside the traditional rule-based mathematical approach. Had Chelsea been able to do so it may have been more economical on her effort and time.

I don't know how I'm going to do this... I'll probably just try a few things... What if I did triangles? Is that all right? ...OK I'm thinking how I can make these two sections, cut in half to make four... but it's an odd shape? ... Is there like some sort of a rule that I have to use? ... No geometric rules? ... Just trying to think of that.

However, Chelsea does finally solve the problem analytically using trial and error reasoning. She retrospectively reports:

Once I had it into 12 squares and tried a few patterns, which didn't work out, then I finally found this (pointing to the solution)... Just trial and error, I just tried a whole lot of different sequences and just came to the right one.

Chelsea's total reliance on rule based reasoning is perhaps not surprising given the emphasis that school based mathematics curricula place on training students to think in this way. By contrast, it may be recalled that Anne, who stepped outside the traditional mathematics domain and in her own words “went global”, and Barbara, who defocused attention through an “emptying of the mind”, solved the problem relatively quickly. Both of these strategies were employed during visual-spatial reasoning, an approach Chelsea did not report.

Theme 2: On the Role of Feeling and Intuition in Listening to the ‘Self’

Individual D: David

In addition to the protocol extracts relating to the theme ‘The role of feeling and intuition in listening to the self’ obtained from Anne and Barbara, an interview conducted in an on-line mathematics enrichment program also provides material relevant to this theme.

Individual D (David) is a highly experienced mathematics teacher who possesses a talent for divining original ideas for mathematics questions such as those used in the Australian Mathematics Challenge, a national event conducted in mathematics problem solving.

Invited to discuss how he came up with creative ideas for particular problems David reports:

... I look at life through a mathematical glass – stoplights, rates of cordial concentration, the price of stamps, whatever comes up from the murk in my tortured mind.

I just kind of like numbers and the way they behave. There's order within their disorderliness. I can't help finding it interesting and sometimes the things I'm interested in interest the kids too.

... I noticed that 135 and 136 were a corrine pair¹ one night. $135=3^3 \times 5$ and $136=2^3 \times 17$. It was on my clock. I thought, “I bet that doesn't happen too often”. Then

¹ A corrine pair is a pair of consecutive integers with a prime factorisation of the same form.

I started fiddling around with other consecutive integer pairs and prime factorising them.

This protocol indicates that David uses associative forms of reasoning to assist in the development of creative ideas. He employs, in an automatic fashion, the operations of similarity and contiguity in generalising digits appearing on a clock as corrine pairs.

When questioned about finding his way in a problem task, David reports:

...some numbers feel prime to me. Some answers I get don't feel good and those ones usually aren't

Eventually you do have to sit down and flog out the answer formally though

In acknowledging the role of 'feeling' in the problem-finding context David demonstrates one way he evaluates the correctness of his intuitive insight and the importance of listening to the 'self'. However David finally tidies up the problem activity using a rule based approach, involving the formal documentation of ideas.

Theme Three: On the Interaction between Non-conscious and Conscious Reasoning

Individual E: Eddie

In addition to the protocols from Anne and Barbara revealing the involvement of semi-conscious or pre-conscious reasoning in the problem solving process, a second hand data study involving a professional mathematician was found to reveal relevant information.

Individual E, Eddie, is a university lecturer in mathematics who had been video taped solving six mathematics problems. The retrospective protocol of one of these six problems is reported. A copy of the reported problem is located in Figure 2



Suppose that each of five people know exactly one piece of information and all five pieces of information are different. Every time one person phones another the first person tells the second everything he knows while the second tells the first nothing. What is the minimum number of phone calls between pairs of people needed for everyone to know everything?

Figure 2. The telephone problem (investigated by Eddie)

In this particular interview Eddie had been asked to solve the problem (to which the solution was '8'). Initially Eddie came up with the answer '8' by intuitive means, but then with prompting by the interviewer endeavoured to justify his answer until he was confident '8' was the correct answer. Eddie reports:

... it was a case of the method that I suggested occurred almost sort of naturally as being the way one would go about the problem in an optimal fashion, and so when I got my initial "8" I was reasonably confident about it on an almost intuitive basis, because it just seemed to me the obvious way to do it. I then had to go back and think, "Right! How can I somehow formalise its optimality." ...It was in part a case of trying to determine why my intuitive feeling was my intuitive feeling, so now looking back on the problem, it's because, having thought about it, it was the realisation at some point someone has to first know all the information and so there is really two parts to the problem. There's first of all the collection in one spot of all the information and secondly the dissemination of that information to every one else so you can in fact optimise the two halves of the procedure.

Eddie's response would seem to imply that his initial thinking processes relied heavily on associative reasoning which, according to Sloman (1996), was consistent with the intuitive function. During this period the video showed long pauses of silence interspersed by the comment "Now I'm searching for inspiration". Such behaviour is compatible with thinking occurring in the non-verbal, visual spatial circuit of the brain. However, with the need to verify the solution, Eddie included the use of rule-based reasoning and the explanation was translated into two distinct steps. In the initial stage Eddie is unable to articulate how he obtained the answer of 8 indicative of pre-conscious awareness. This is followed by conscious awareness facilitated by the forced explanation of the solution.

It is interesting to observe that the professional mathematical problem solver (namely, Eddie) drew upon associative forms of reasoning almost immediately in solving a novel problem, before calling upon his rule based analytical reasoning to verify the solution. Each of the other individuals described above (except David), first began to solve the problem provided relying upon rule based rational reasoning before embracing associative, experiential forms. It is worthy of note therefore, that Chelsea the Grade 11 mathematics student appeared to shut out associative reasoning entirely, relying totally on an analytical approach. Such an observation, should it generalise to other students, is cause for concern and has implications for mathematics and educational curricula.

CONCLUSIONS

The protocols reported above indicate that the formation of a new idea has three aspects. First, preverbal and non-verbal processes (including spatial thinking but not exclusively so) are involved. Second, creativity may incorporate pre-conscious or non-conscious activity. Third, creativity gives rise to a feeling or intuition. Indeed the production of a new idea would appear to entail moving between thinking and feeling, and between focused and defocused states of attention.

Translation of Themes into Elements

Thus three elements emerge as critical to the formation of a conceptual framework of creative problem solving. These elements, consistent with documented research involve the:

- visual-spatial and linguistic circuits within the brain;
- conscious and non-conscious mental activity; and the
- generation of feeling in listening to the 'self' including that of intuition.

Brain imaging evidence has been used to locate two circuits involved in mathematical thinking (Dehaene et al., 1999). One circuit, used in processing approximate quantities, employs a region strong in visual-spatial processing. The other circuit, used in processing exact quantities, utilises a region strong in linguistic processing. It is theorised that mathematical intuition emerges from the interaction of these two brain circuits (Dehaene et al., 1999). Thus the interaction between visual-spatial and analytical reasoning observed in the above protocols is consistent with neuro-biological evidence related to visual-spatial and linguistic thinking and is embedded within the first element of the framework.

The second element detailing the interaction between conscious and non-conscious activity is also supported by documented research. In particular, cognitive psychology has identified two systems of reasoning (Epstein, 1994; Sloman, 1996). One of these, the rule based or rational system, is characterised by conscious activity. The other, an associative or experiential system, is characterised by non-conscious activity. Indeed Epstein (1994) proposed that creativity, among

other higher order functions, involved the complex processing of both the experiential and rational systems.

The third element on the generation of feeling in listening to the self is also supported by scientific research. In particular, neuro-scientific evidence indicates that certain processes related to emotion and feeling are indispensable to rational thinking (Damasio, 1994). Patients with lesions in a small frontal area of the brain, impairing the connection between reasoning and feeling, were unable to bring reasoning to any practical conclusion. Without feeling, such patients were unable to decide which of two rational alternatives was better (Damasio, 1994). This notion, that feeling is important in the creative problem solving process, as was evident in the protocols above, is embedded within the third element of the framework.

The Formation of a Conceptual Framework

This study proposes that creativity may emerge from the interactions arising between each of the three elements. These elements and their interactions are represented diagrammatically in Figure 3. The lower part of the figure displays the interactions arising among the elements themselves. The upper part of the figure displays the components of the stage model of creative problem solving, together with cycles of feedback theorised to exist between each of the stages within the creative process. These stages and their associated cycles of feedback have been superimposed onto the elements of the conceptual framework. A synergy results from the interactions arising among the critical elements of the framework and the stage processes and feedback cycles implicit in creative problem solving.

Among the elements of the framework, the interactions arising between the visual-spatial circuit and the linguistic circuit are thought to give rise to mathematical intuition (Dehaene et al., 1999). These interactions may be direct or indirect and involve either or both non-conscious and conscious paths of thinking. Similarly the interactions arising between non-conscious and conscious mental activity represented by 'self state one' and 'self state two' may provide the necessary cognitive space where learning can take place (Davis, 1996).

Central to the framework however, is the intuitive function. The generation of feeling within and between non-conscious and conscious activity (represented by 'self state one' and 'self state two') and between and within the visual-spatial and linguistic circuits serves to evaluate, monitor and filter a particular solution path. Feeling, as is revealed in the exploratory protocols, (refer Anne, Barbara and David) plays a significant role in crystallising possible solutions generated in the visual spatial circuit of the brain and is likely to be one of the body's internal communication mechanism particularly in instances of non-verbal reasoning. This suggestion of feeling serving an internal communication function is consistent with the neuroscience findings of Damasio (1994) and the work of Epstein (1998) in constructive thinking.

The Framework and its Implications for Teaching

Much mathematics instruction focuses primarily within the bottom right hand corner of the conceptual framework. Emphasis on linguistic and conscious processes tends to be the norm with students and teachers alike, solving problems that have been practised many times before.

While routine practice of skills may well enhance the student based repertoire of problem solving strategies, there is an increasing need, in an ever-changing technological world, for greater exposure to more novel and real life problems. Continued but balanced experience, in solving more novel problems should help provide the forum by which other forms of reasoning may be fostered, including the visual spatial and non-conscious elements of the self. Such experience encourages students to draw upon all of themselves in solving a problem and lead to greater fulfilment of their developing potential.

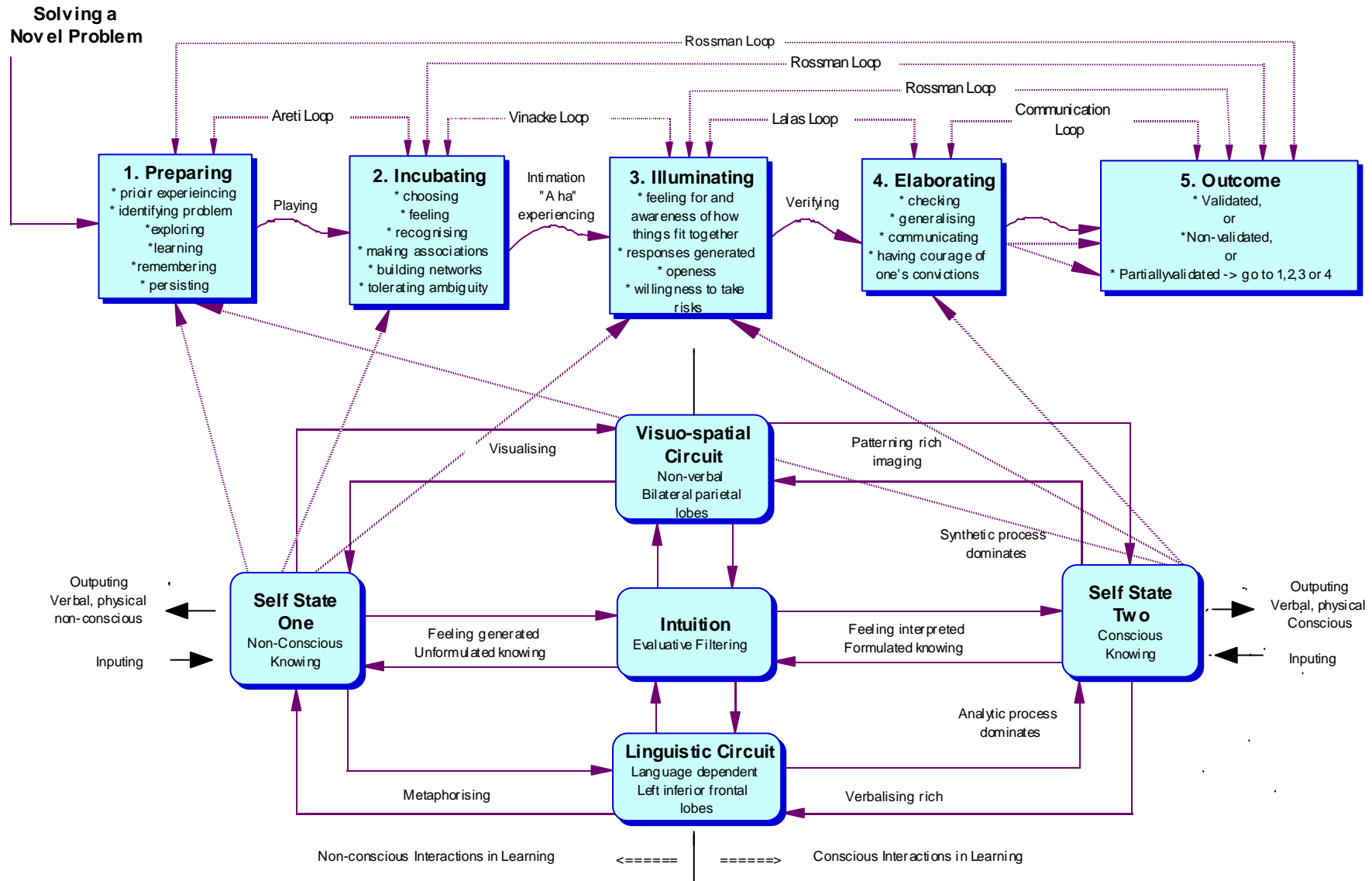


Figure 3. A conceptual framework: Listening to the 'self' in learning, creating dynamic interactions of flow

The exploratory protocols revealed that, for novel problem solving, feeling thinking and intuition play a significant role and are a necessary component of the creative process particularly in instances of visual spatial or non-verbal reasoning. The non-cognitive elements of feeling and intuition may be among the first steps in the path to solving a novel problem. The cognitive elements of rule based analytical thinking may then follow, playing some interactive role. But the complete sequence of reasoning remains to be determined and in all likelihood is far more complex than this preliminary explanation reveals.

CONCLUDING COMMENT

Creativity in this study has been found to revolve around the interactions of three critical elements. These are the visual-spatial and linguistic circuits of the brain, conscious and non-conscious mental activity and the generation of feeling in listening to the self. The vital component linking each element in the framework is the intuitive function made manifest through attention to feeling. Indeed feeling is the communicating link in the interactions arising between any or all of the elements within the framework. While feeling without action does not of itself constitute creativity, reflection as fostered by listening to the self in learning, not merely in cognitive but also in non-cognitive ways (as revealed by the proposed framework of creative problem solving) is more likely to result in a positive outcome.

In writing about the inseparable nature of feeling and reason, neuroscientist Damasio (1994, p.xiii) had this to say. "Feelings point us in the proper direction, take us to the appropriate place in a decision making space, where we can put the instruments of logic to good use". And furthermore he adds, "Educational systems might benefit from emphasising unequivocal connections between current feelings and predicted future outcomes" (Damasio, 1994, p.247).

In summary then this paper finds that increasing creative productivity will involve attending to feeling and reflecting on the world within. Indeed new ideas are heralded with a wellspring of feeling from within. The added value to be obtained in so doing is that both individual and collective rationality are likely to increase.

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REFERENCES

- Cropley, A. J. (1999). Definitions of creativity. In M. A. Runco and S. R. Pritzker (Eds.), *Encyclopedia of Creativity* (Vol. 1, pp. 511-524). San Diego: Academic Press.
- Cropley, A. J. (2001). *Creativity in Education and Learning: A Guide for Teachers and Educators*. London: Kogan Page.
- Damasio, A. R. (1994). *Descartes' Error: Emotion Reason and the Human Brain*. London: Papermac.
- Das, J. P. (2003). A look at intelligence as cognitive neuropsychological processes: Is Luria still relevant? *Japanese Journal of Special Education*, 40(6), 631-647.
- Davis, B. (1996). *Teaching Mathematics Toward a Sound Alternative*. New York, NY: Garland.
- Dehaene, S., Spelke, E., Pinel, P., Stanescu, R., and Tsivkin, S. (1999). Sources of mathematical thinking : Behavioural and brain-imaging evidence. *Science Magazine*, 284, 970-977.
- Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *American Psychologist*, 49(8), 709-724.

- Epstein, S. (1998). *Constructive Thinking the Key to Emotional Intelligence*. Westport, Connecticut: Praeger.
- Ericsson, K. A., and Simon, H. A. (1993). *Protocol Analysis: Verbal Reports as Data Revised Edition*. London, England: The Massachusetts Institute of Technology.
- Hadamard, J. (1945). *An Essay on the Psychology of Invention in the Mathematical Field*. Princeton, N.J.: Princeton University Press.
- Howard-Jones, P. A., and Murray, S. (2003). Ideational productivity, focus of attention and context. *Creativity Research Journal*, 15 (2 and 3), 153-166.
- Khandawalla, P. N. (1993). An exploratory investigation of divergent thinking through protocol analysis. *Creativity Research Journal*, 6(3), 241-259.
- Koberg, D., and Bagnall, J. (1976). The all new universal traveller: A soft-systems guide to creativity, problem solving and the process of reaching goals.
- Lubart, T. (2001). Models of the creative process: Past present and future. *Creativity Research Journal*, 13 (3 and 4), 295-308.
- Martindale, C. (1995). Creativity and connectionism. In S. M. Smith and T. B. Ward and R. A. Finke (Eds.), *The Creative Cognition Approach* (pp. 249-268). Cambridge, MA: The MIT Press.
- Mumford, M. D. (2003). Where have we been, where are we going? Taking stock in creativity research. *Creativity Research Journal*, 15 (2 and 3), 107-120.
- NACCCE. (1999). *All our Futures: Creativity, Culture and Education: Report to the Secretary of State for Education and Employment and the Secretary of State for Media and Sport by the National Advisory Committee on Creativity and Cultural Education*. London: DfEE.
- Richards, R. (1999). Everyday creativity. In M. A. Runco and S. R. Pritzker (Eds.), *Encyclopedia of Creativity* (Vol. 1, pp. 683 - 687). San Diego: Academic Press.
- Russ, S. (1993). *Affect and Creativity: The Role of Affect and Play in the Creative Process*. Hilldale, NJ: Lawrence Erlbaum Associates.
- Shaw, M. P. (1989). The eureka process: A structure for the creative experience in science and engineering. *Creativity Research Journal*, 2, 286-298.
- Simonton, D. K. (1988). *Scientific Genius: A Psychology of Science*. Cambridge: Cambridge University Press.
- Sloman, S. A. (1996). The empirical case for two systems of reasoning. *Psychological Bulletin*, 119(1), 3-22.
- Tank, D. W., and Hopfield, J. J. (1987). Collective computations in neuron like circuits. *Scientific American*, 257, 104-114.
- Wallas, C. (1926). *The Art of Thought*. New York: Harcourt Brace.

Achieving teacher education standards through a mathematics performance-based assessment: A case study of five Colorado preservice-teachers on field experience

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A range of factors has impinged on the provision of teacher education programs in the last decade. Largely emanating from governmental demands for increased accountability, these have included the setting of standards for student achievement, proof of program impact, and state and national testing. These legislative reforms and school district concerns initiated changes in field experience at a Western university and resulted in the introduction of performance-based assessments (PBA). During the final student teaching experience, preservice teachers were asked to teach mathematics to a group of students for a three-month period. Data analysis of pre and post tests revealed significant achievement gains for the elementary students. The preservice teachers' understanding of pedagogy and assessment evolved significantly as they experienced first-hand the impact of instructional choices on their students. Data analysis highlighted several main thematic connections including: (a) philosophy, attitudes and experiences, (b) knowledge, management and instruction, and (c) assessment and instruction.

Teacher education, standards, performance-based assessment, mathematics, elementary students

INTRODUCTION

As society becomes more complex, pressure for educational change comes from the business community, professional organisations, and, more recently, from government legislation (Becker and Jacob, 2000). Teacher education reform is inextricably interwoven with public school reform. One tool of reform has been the development of educational standards. Assessment of these standards has in turn led to state level tests in the United States.

Because teacher preparation programs inherit much of their culture from the standards and practices shaping life in our public schools, the politics of high-stakes testing has become increasingly influential in the decision-making processes associated with curriculum and instruction in undergraduate teacher preparation programs. (Brawdy and Egan, 2001, p.438)

As a result of legislation like Senate Bill 99-154 in Colorado, teacher licensure requirements were changed and university education programs would be judged on the basis of the performance of their preservice teachers or teacher candidates (TCs), as they were referred to at many universities. All Colorado universities, including Mountain University (MU), were entwined in the new teacher licensure standards and the necessity to adjust teacher education programs.

Emphasis has always been given to effective teaching practices during the internships of preservice teachers at MU. In general, effective teaching practices were selected according to

impact on student learning (McEwan, 2002). One approach to assessing preservice teacher teaching performance was the use of performance-based assessments (PBA). PBA developers integrated current pedagogical research data, university and partner school needs, and the Colorado teacher standards.

BACKGROUND

Mathematics Education Reforms

Reforms in mathematics education have been under discussion for many years. Researchers reinforced the importance of real understanding of mathematics, by emphasising the need for students to make connections between ideas, facts, and procedures based on previous knowledge and newly established relationships (Hiebert and Carpenter, 1992). Acknowledging students' previous experiences and creating meaningful opportunities for new mathematical connections to develop could lead to more complex understanding. Consequently, students are more likely to remember what they have learned and to transfer the knowledge to new problems (Hiebert et al., 1992). Unfortunately many elementary preservice teachers feared mathematics and were concerned about their adequacy as teachers of this discipline (Battista, 1986).

Despite increasing pleas for changing practice in mathematics education, many teacher education programs failed to conform to the suggested reforms (Graham, Li, and Curran, 2000). This was further exacerbated by the mathematics anxiety displayed by numerous preservice teachers (Battista, 1986). Preservice teachers need to experience personally good mathematics teaching methods and be given time to process their experiences.

Teacher education that is conducted in a setting that promotes investigation and inquiry into the problems of mathematics teaching seems to hold promise for assisting preservice teachers in becoming inquiring, reflective, mathematics teachers. (Mewborn, 1999, p.39)

The latter part of the twentieth century saw a shift from a purely scientific approach to teacher education to recognition of the art of teaching (Bryan, Abell, and Anderson, 1996). Studies indicated that preservice teachers, when exposed to reflective mathematics methodology in a supportive environment, could learn to manage learning environments effectively, develop sensitivity to students, and engage students in mathematics inquiry (Jaworski, 1992; Clock, 1999). Clock suggested that preservice teachers could learn effectively with small groups of students and needed to be given multiple opportunities to reflect on students' mathematical thinking.

Part of the teacher-education reform movement must involve a renewal of assessment processes. Clearly a changing preservice teacher education practice will necessitates an examination of assessment methods. Appropriate assessment of preservice teachers' readiness to begin teaching is an essential element of all programs.

Preservice Teacher Education Assessment

Traditional

Traditionally, assessment has been designed to compare how students performed relative to one another (Wolf and Reardon, 1996). According to Wilson (1995), teacher assessment has generally taken the form of multiple-choice tests and observational checklists. Licensure in most states has involved the successful completion of university courses and field experience, as well as some type of state-mandated competency tests. Assessments, such as the National Teacher Exam (NTE), tested content knowledge as well as pedagogical knowledge. Rich, Barikowski, and Boyd (1995) stated that while there was some evidence for content validity of the NTE, there was

virtually none in terms of predictive validity. In addition, traditional assessment tends to assume that a classroom is teacher-centered.

Because we are broadening and changing our conceptions of teaching and learning we must rethink the questions that frame teacher assessment. (Wilson, 1995, p.194)

The aim of preservice teacher assessment is to determine whether a preservice teacher has the kind of professional knowledge, ability, and ethics needed to teach effectively (Brookhart and Loudman, 1995). Competency tests are insufficient to examine content, pedagogy, curricular knowledge, and interpersonal skills, as well as an ability to work with students.

Authentic

According to Schalock, Schalock, Cowart, and Myton (1993), it was rare for teacher licensure programs to assess on the basis of student performance, and yet this was clearly an important aspect of teaching. It was essential for preservice teacher evaluation to emphasise the use of knowledge (Yarbrough, 1995). In addition, Pasch (1995) alluded to the importance of developmental assessment over time. Preservice teachers were developing as professionals and needed to be assessed accordingly. Many programs looked to the use of PBAs that allowed preservice teachers to show what they could do in authentic situations.

Student learning is the professional touchstone for both teachers and teacher educators, and the professional status of either will grow only when teachers are demonstrably able to nurture the kind and level of learning in students that is deemed essential for our nation at a particular point in time. (Schalock et al., 1993, p.108)

Impact of Preservice Teachers on Students

Mentoring of small groups

Studies have indicated that interventions by preservice teachers in small group tutoring could impact significantly on elementary students' reading levels (Hedrick, 1999). Mewborn (1999) found that small group tutoring in mathematics by preservice teachers could actually reveal information about elementary students' learning that was previously unknown by their classroom teachers. This was probably due to the individual attention given to students in the group over a sustained number of weeks. Students in Mewborn's study made gains in mathematics achievement.

CONCEPTUAL FRAMEWORK: PERFORMANCE BASED ASSESSMENTS

Structure of Performance-Based Assessments

Wilson (1995) indicated that preservice teacher assessment should have certain essential components. In particular, evidence of active student engagement and resultant achievement needed to be part of an effective assessment process. Teacher licensure demanded that preservice teachers demonstrated application of the knowledge learned in their university courses (Shalock et al., 1993). Many teacher education programs were moving to alternative assessment methods such as PBAs as a means to assess preservice teachers (Turner, 2002). PBAs allowed the development of preservice teachers over a period of time (Baron and Wolf, 1996).

According to Snyder, Elliott, Bhavnagri, and Boyer (1993-94), assessment should provide feedback to assist both the preservice teacher and the program as a whole. The use of PBAs promised to give important feedback to universities about their teacher education programs. In addition to assessment information, PBAs could assist in the development of effective teachers by allowing preservice teachers to align theory with practical experience.

According to Johnson, using performances in assessment implied a particular structure (1996). He described eight main parts of performance:

- a) involved a complex goal and requires good judgment;
- b) resulted in a whole that is more than the sum of the parts;
- c) was personalised by the student;
- d) allowed for refinement during the process, had known criteria, and gave many opportunities to demonstrate criteria;
- e) did not involve so-called 'pat responses' and indicated mastery of criteria;
- f) was judged according to impact, rather than the process used by the student;
- g) required appropriate adjustments when errors occurred; and
- h) resulted in student autonomy, where little assistance was required by completion

Rich et al. (1995) stated that while PBAs were promising, there were many measurement issues that remained unresolved. The reliability and validity of PBAs could be helped by using multiple sources of evidence. Some suggestions given by Rich et al. included the use of portfolios, reflective journals, and case studies. In order to satisfy these concerns and also maintain the integrity of the performance assessment, a lens for this study was based on Johnson's criteria with the addition of reflective journals that were kept by the participants.

This study was designed to examine the effect of an elementary mathematics PBA on preservice teacher and elementary student learning. Two main research questions addressed in this article.

- What do teacher candidates learn about pedagogy and assessment from the PBA?
- How are teacher candidate attitudes towards teaching mathematics affected by developing and implementing the lessons from the PBA assignment?

METHODS

Participants and Location

The preservice teachers who participated in this study were in their final internship in a partner school that they had worked in throughout their teacher education program. This particular PBA was only one part of their overall internship. The study was conducted at Mountain View School with five preservice teachers and 24 elementary students in Grades 2 and 5. The school was an alternative public urban school of choice available to students from pre-kindergarten through to twelfth grade and drawn from throughout the district. Parents, students, and teachers chose the school because of the emphasis on self-directed learning and active participation in the learning process in and out of the school setting. Students were organised in multi-aged groups based on interests, needs, and developmental levels. The Early Learning Center (ELC) catered for students in Grades K-2. Students in Grades 3-5 were members of the intermediate area (IA).

Structure

During this study, preservice teachers took total responsibility for the mathematics instruction of between four and seven elementary students. The preservice teachers worked with their groups of students on a daily basis for three months. In addition to mathematics, preservice teachers taught all subject areas to the whole class and this included a two-week solo block.

The following lists details the PBA requirements for each of the preservice teachers:

- administer CSAP-like tests to elementary students;
- grade the tests with clinical teachers;
- select students for the group with clinical teachers and the site coordinator;
- interview students;
- examine examples of students' work;
- write case studies of each student's mathematical strengths and weaknesses;
- determine individual and group goals;
- design instruction for the group;
- administer instruction;
- conduct ongoing assessment of students' achievement;
- administer CSAP-like tests after three months of instruction;
- grade tests;
- reinterview each student;
- write summaries of each student's progress during the three months; and
- write a summary of the PBA experience.

Interviews, on educational philosophy, pedagogical beliefs, and knowledge of student's learning were conducted with each preservice teacher at the beginning and end of the study. Throughout the instructional period, preservice teachers conducted ongoing assessment of student progress. Preservice teachers met in focus groups with their peers to express any concerns, discuss group progress, and seek advice concerning instructional queries preservice teachers also kept daily journals concerning all aspects of their individual mathematics groups. The journals included lesson plans, work samples, ongoing student progress information, student problems, and preservice teacher reflections.

Data

Both quantitative data, in the form of pretests and posttests for the elementary students, and qualitative data, in the form of interviews, focus groups, journals, observations, and artefacts were collected during the study. Test data were analysed and interpreted with the additional qualitative data concerning student achievement. Codes arose partly from the literature review and partly from emergent themes following an initial reading of all documents. Each document was then examined on the basis of the selected codes and coded accordingly.

Following this initial analysis, I used the model function to display visually the codes and their connections. This allowed me to see more clearly any relationships between the data. Documents were recoded as new codes emerged and were examined both vertically across all of the teacher candidates and horizontally for individual teacher candidates. Fontena and Frey (1994), who advised researchers to interpret both individual instances and an aggregation of instances, espoused this method. I conducted searches for relationships using groups of codes and participants. This led to some conclusions that could be generalised from the analysis.

In general, analysis was used both to filter and funnel data. Context and relevance determined the importance given to individual pieces of data. Each stage of analysis led to an aggregation of themes into main categories and ultimately allowed the research questions to be answered. In order to allow the reader to interpret the data, a quasi-statistical method was used to count the number of times particular themes were mentioned (Ratcliff, 2003).

RESULTS

Preservice Teacher Experiences

Each of the five preservice teacher participants had unique experiences over the three-month study. A summary of what each individual learned during the study is presented at the beginning of this results section.

Bethany

Although Bethany had always enjoyed mathematics, she was not confident about teaching it. The three month teaching experience gave her the opportunity to explore different strategies and to use a variety of manipulatives in a relatively “*safe environment*”. She developed confidence in her ability to teach mathematics effectively:

I have learned a lot about how to teach math because I had a really hard time...how to know where to get started, and once I got started, each day knowing where to go from there. So that's been a really nice thing for me.

In addition, Bethany's knowledge that children were at many different levels and had individual needs was reinforced. Over time, she began to see assessment and instruction as inextricably linked. Assessment of all kinds began to drive her instructional decisions.

Bob

Bob expressed appreciation for the teaching experience. He believed that he learned many things during the three months. He stated that it was important to determine what students' strengths were and then “*play to them*”. For example, he made wooden boxes because he observed the connection between hands-on learning and interest level within his group. He also observed:

I learned to let go of the control when the kids were doing things, like cutting wood, and just keeping a watchful eye on them.

Bob found that three of his group responded well to direct instruction for building skills, while the other one preferred manipulatives. After trying some peer instruction, he concluded that it was difficult for young children to teach one another. Given that Bob noted the session became a “*free for all*” it might be more of a management and structural problem than an inappropriate instructional method. He noted that he tried several activities that were unsuccessful and he would not use them again.

Jill

Jill discussed the importance of discerning students' strengths and weaknesses. She explained that every student had different learning styles and needs and, therefore, as a teacher she needed to “*tackle math from a wide variety of angles*”. Furthermore, she explained that students learnt mathematics most effectively when they connected with it.

In conclusion, she wrote the following:

I would say that I have grown a lot as an instructor during this math PBA. I learned about getting to know your students and their unique strengths and weaknesses, different learning styles, planning, instructing and assessing. I will take all of this knowledge and experience with me in the future when I will be teaching my own classroom!

Mary

Like all of the TCs, Mary learned many specific things about pedagogy, assessment, and management. She indicated that one of the most effective teaching strategies for the group was peer teaching. After starting with direct instruction, Mary discovered that only one or two students responded well, but saw the positive impact on all group members when using peer teaching. She found that those teaching had to think through the concepts more completely and they used language and techniques that made sense to their fellow students.

Mary discovered the importance of making the goals and outcomes clear to the students. Initially, she did not always explain at the beginning of lessons why activities were chosen, and felt that the students did not gain as much as they could have. When she began to explain expected outcomes and her reasons for choosing activities, the students responded very positively. They appeared to appreciate being “let in on the secret”.

Mary practised and learned much about using assessment effectively in teaching. She said that with experience, she became better able to recognise when students did or did not understand concepts. It also became clear that the students were often far more capable than they first appeared. In summary, Mary said the following:

The most important thing I have learned is to be constantly assessing kids as you go through a series of lessons. If you don't, you might think it all makes sense but you get to the end and do an assessment and find they didn't understand something at the beginning, and also to provide feedback.

Susan

As an extension to getting to know her students well, Susan indicated that she had learned to record anecdotal observations and informal conversations. For example, when a student understood better using visual aids, she made a note of this. She also made notes concerning students' attitudes and the circumstances involved.

To wrap up the day to day journal for the Math PBA, I'd like to share one revelation I had recently about teaching math, especially to a large group of students. I think that when you use one resource (such as Quest) for too many consecutive days, the types of activities (although fun and innovative at first) become a little mundane and ordinary. Quest is an amazing resource and I would use it as a primary resource for kids as a first year teacher. However, every few days, I think we should take a Marilyn Burns, or collaborative exploration to rejuvenate the atmosphere of learning. It makes such a difference in the ability and willingness for kids to be self-directed with free reign over their progress, and then it may be time to “bring them back in” for some direct instruction. It's kind of similar or an analogy to what you eat for breakfast. If you eat the same thing too many days in a row, you may burn out on it. You may need to switch up a bagel for a donut or vice versa.

She also discovered that, given the opportunity, students were capable of making good choices for themselves. For example, when given a choice of playing a math game or doing their workbooks, students chose appropriately according to their needs at that time. In general, Susan observed extremely positive results in terms of attitude and willingness to learn when students were part of the decision-making process.

Elementary Student Growth

Academic Achievement

The most important measurement of teacher effectiveness is impact on students. While achievement is the main focus, students' attitudes and dispositions should also be considered. What follows, is a brief discussion of changes in students during the study.

Positive changes in test scores were evident for all elementary students, as presented in Table 1. The mean increase in test scores was 28 per cent. The standard deviation of 16 was quite high, as increases actually varied from seven per cent up to 55 per cent. This difference, however, did not diminish the results, as in all cases students displayed an increase in test scores.

The relatively high variance was basically an indication of the heterogeneity of the students as well as a result of the small number of students (24) in the study. The real significance of the data is seen in the individual progress made by each of the students. Clearly, the group experience impacted positively on each student's mathematics test achievement.

Table 1. Total Test Scores, Variance and Standard Deviation

Test Categories	Mean	Variance	Standard Deviation
Pretest	51	435	21
Posttest	79	204	14
Change	28	247	16

Affective Growth

While there were many notable improvements in attitudes, the small group experience was not a panacea for change in all students. Given the many years of negativity, it would be unreasonable to expect a total reversal of attitudes in a few months. Complex factors worked together to influence attitudes and behaviour and it was impossible to separate them from one another. Despite an improvement in performance, some students remained unenthusiastic about mathematics activities.

Many students expressed a renewed interest and confidence in doing mathematics. A strong majority of students (92 per cent) displayed a definite improvement in attitude and confidence level. All of the younger students developed enthusiasm for mathematics during the course of the group experience. Bob (TC) wrote in his journal as follows:

By the end of our time, it was hard to contain their excitement. Do we have math group today? Some days I got to answer that question five or six times, interesting because there were only four kids in the group.

Back in the Class

As the study effectively finished when the groups disbanded, limited data was gathered about classroom re-entry. During the final focus group and latter journal entries, TCs made some observations about students' behaviour in the larger classroom groups. In addition, clinical teachers remarked on students' behaviour within the main class groups.

One observation centred on students' participation in classroom activities. Prior to the study most of the students endeavoured to be invisible, never volunteering answers. Following the group experience, numerous instances of student initiative in answering questions and in seeking visible roles were evident.

Students actually offered assistance to others in the class. Furthermore, their overall demeanour was significantly more positive. Many of the students showed a greater willingness to tackle difficult problems and to approach unknown situations.

Preservice Teacher Development

Attitudes, Philosophy and Experience

While the TCs' journeys were varied, the richness of the events made the pilgrimage invaluable for all. Prior to the study, the TCs were full of expectation and eager to learn more about teaching. Entwined with this was a reticence about taking total responsibility for a group of students.

In many ways, attitude and philosophy lay at the heart of the experience. In general, TCs began with instructional perspectives based on an evolving philosophy. Background experiences, university methodology, and classroom observation had influenced their pedagogical beliefs. Patterns emerged from the journals and interviews of a changing emphasis from rote learning and the basics to strong consideration of individual needs with a hands-on approach.

Initially, TCs spoke about the general need for differentiation and generally included visual, auditory, and kinaesthetic needs. Manipulatives, drill and practice, and basic skills were discussed in broad terms. Details were sparse and actual examples rare.

As the study progressed, TCs gained awareness of different factors that affected instructional choice. Bethany began to use modelling after seeing how effective it was. In addition, student choice of strategy encouraged self-advocacy and gave Bethany useful information concerning individual preferences. Finally, Bethany included hands-on activities with clear real world connections. She found that increased student engagement and better understanding resulted from this combination of instructional methods.

Jill worked very reflectively and continually autopsied her lessons. Through her search for the optimum instructional methods, Jill became adamant about the necessity for knowledge of each student's needs, learning preferences, and interests. As part of this process, she discovered her personal preference for hands-on learning and commented that "*math actually made sense*".

Susan noted the influence of student engagement on achieving success. She purposefully selected concrete activities such as games with real world connections. Over time, her students became more invested in mathematics and showed improved understanding.

Without doubt, the most significant shift was towards an emphasis on individualisation. Although some TCs had mentioned individual needs in their first interview, explanations lacked any substance. By completion of the study, TCs used more accurate and specific language in relation to pedagogy. Examples to verify their beliefs were given and it was clear that TCs understood the connections between theoretical pedagogical philosophies and actual students.

Use of Assessment

Assessment was arguably vital to all instruction and was been divided into two categories for this analysis: informal and formal. In addition, a count was made of the number of connections made between assessment and instruction. Table 2 compares assessment choices made by the ELC and IA groups.

Table 2. ELC and IA Assessment Comparison

Group Level	Formal	Informal	Instructional Connection
ELC	(3) 27%	(8) 73%	6
IA	(10) 21%	(37) 79%	16

Informal assessment dominated all groups. TCs used observation, student workbooks, discussion, and questions to determine a myriad of information concerning student understanding and progress. All TCs valued the details gained daily through informal data in their groups. They

spoke positively about the valuable anecdotal information gained from observations, conversations, and student work.

Formal assessment, though used less often, provided solid evidence about students' understanding and was also affirming for the students themselves.

Susan wrote: I graded the multiplication tests last night. I am pleased to say that each and every student increased their scores, some very substantially. Jane (her clinical teacher) was right, kids just need to identify the numbers that are hard (usually 7s, 8s, and 9s) and memorise them. Kids are extremely psyched to graph their improvement. I'm so glad that the folders have encouraged them to take ownership and pride in their improvement.

In the final focus group and interviews, all TCs discussed the importance of assessment. Data analysis revealed that Bob and Bethany were using informal assessment more than they specifically recognised. There seemed to be a tendency to avoid too much discussion of assessment in the lower grades; possibly because of the negative connections associated with over testing. In reality, all TCs (including Bob and Bethany) used multiple forms of assessment, much of which involved informal observations and discussions with their students.

When asked what he had learned during the PBA, Bob observed that assessment can take many different forms that it does not have to be a standard pencil and paper test. He was excited at being able to recognise students' understanding from various informal means:

It was exciting to see the light bulbs turn on when they could explain a concept to me. For me, I learned again to let go of the control when the kids were doing things, like cutting wood, and just keeping a watchful eye on them.

Bethany described the varied forms of assessment she used:

I was constantly assessing after I became more comfortable about what I was doing. Sometimes we were doing little hands-on projects and we would switch and use the white board, they would love and do some little problems like number sense. For example, like with the boxes, I wanted to see where they were after we did the number sense thing, let them fill in the boxes with the numbers that would come in next, and they would make up the rules and I was constantly assessing where they have gotten from the last time we had done that...that was informal...also always talking to them observing.

Mary responded as follows:

The most important thing I have learned is to be constantly assessing kids as you go through a series of lessons. If you don't, you might think it all makes sense but you get to the end and do an assessment and find they didn't understand something at the beginning, and also to provide feedback.

Management

Management issues frequently dominate a preservice teacher's time. The TCs in this study were no exception to this observation. Early journal entries and focus group discussions often centred on behavioural issues. Data indicated that management concerns were more significant at the beginning of the study and became more minor with time.

During the first focus group, doubts about management emerged. Bob spoke about some problems he was experiencing and added

I am concentrating on keeping the kids engaged for the 25 minutes that I get them.

Susan wrote this during late March:

I made the mistake of modelling a real life basketball tournament with real life teams, and there are many avid sports fans, and as we ploughed down through the tree diagram and called on certain attentive individuals to determine the winners of matches, it began to sound a lot like a Denver Nuggets game in our classroom. Cheers, screams, paper throwing, etc. Next time, I will definitely use teams that are invented so no one really cares who makes it to the final". She further stated: "It was difficult to get class started because of a high energy level. But after moving a couple of individuals around, things quickly settled down.

Concern over management issues declined for various reasons. First, over time, student confidence and, consequently, attitudes significantly improved. Second, TCs' knowledge of student needs resulted in more appropriate instructional choices and, consequently, a higher level of engagement. Finally, TCs developed better behaviour management skills and were able to deal with situations more effectively.

Towards the end of the study, TCs were more apt to mention specific strategies used during the day. For example, Susan recorded

Generally, kids stayed on task but I had to use proximity and moving around to reinforce this to keep kids moving in a productive direction.

After becoming more confident with behaviour management, TCs began to focus on other management areas and in particular time management. They soon discovered that activities took longer than planned. In addition, there were frustrations caused by extra school commitments that affected group members.

All TCs agreed that while planning was extremely important, so too was flexibility. Plans were often altered due to last minute responsibilities such as Colorado state-wide test supervision, school activities like community service, and individual interests such as music. In addition, individual needs as diagnosed by students' response to activities and through discussion in the groups, dictated frequent changes in instructional plans.

Implications

Benefits for Schools

Given the increasing demands for accountability in schools, it is important that preservice teachers contribute positively to schools during field experience. The cost of field experience is significant in terms of finance, time, and effort, particularly in a Professional Development School setting. Field experience must be mutually beneficial for the universities and schools.

Results of this study clearly show that preservice teachers can positively influence the achievement and attitudes of elementary school students. A number of these students were at risk for continued low achievement in mathematics. Progress made during the three-month study has the potential to improve students' mathematics performance for years to come.

Multiplication of this individual effect flows through to school test results. Schools unable to show improvement in test scores are threatened with loss of funding and closure. Any program that contributes to improved test scores is given full support in schools.

Although it is imperative that field experience is first and foremost for the development of preservice teachers, benefits to schools and their students cannot be ignored. Preservice teachers have always contributed to schools but supportive data has rarely been collected to provide

substantive evidence. It appears to be wise for teacher education programs to collect data more systematically concerning preservice teacher impact on schools during field experience.

Benefits for Teacher Education

The introduction of teacher standards needs to be viewed positively. Each of the requirements is clearly important and an appropriate skill for a beginning teacher. Firsthand experience with crucial aspects of teaching have allowed TCs to develop a more mature and realistic knowledge of pedagogy.

PBAs have the potential to provide valuable information to teacher educators by giving evidence of proficiency in teacher standards. This holistic approach fulfils the dual roles of both instructing and assessing preservice teachers. Observing performance in an authentic setting gives additional credence to the preservice teachers' knowledge and skills.

As preservice teachers observe first hand the impact of using particular teaching methods, they naturally incorporate the most effective methods into their teaching. It is not necessarily an abandonment of beliefs but rather a change in emphasis or modification of mathematics pedagogical philosophies. In general, preservice teachers conclude that a balanced approach with particular attention to individual needs is the most effective practice.

During the PBA, TCs were able to experiment safely with different aspects of pedagogy. Control of the small groups allowed TCs to implement varied instructional and assessment strategies. Adjustments were continually made according to the effectiveness of the chosen strategies. Having the ability to change goals and instructional methods provided TCs with what might be called a teaching laboratory.

In addition, TCs developed management skills without constant scrutiny of supervision. Differentiating for students based on individual learning and behaviour needs presented TCs with a microcosm of their future classes. As a result, they became more confident and well-prepared for their teaching careers.

Participation in a highly open-ended and extended teaching activity, such as the elementary mathematics performance based assessment (PBA), is quite empowering. The lessons learned about pedagogy through the PBA planted seeds that would continue to grow and develop. The pedagogical cycle of reflection engaged in by the TCs should encourage life long learning and development as teachers.

CONCLUSION

In order to ensure proficiency of standards and to maintain the integrity of teacher education programs, PBAs should be increasingly used. PBAs had both formative and summative assessment components. As a result, teacher educators were able to track performance and give feedback over time.

Although PBAs were quite time-consuming, they could be designed to incorporate multiple standards and experiences for preservice teachers. As responsibility for action is transferred to the preservice teachers, PBAs were an ideal bridge between teacher education and becoming certified teachers.

REFERENCES

- Baron, J.B. and Wolf, D.P. (1996). Editors' Preface. In J. Baron and D. Wolf (Eds.), *Performance-Based Student Assessment: Challenges and Possibilities*. Ninety-fifth yearbook of the National Society for the Study of Education, Part 1 (pp.ix-xiii). Chicago, IL: NSSE.

- Barrow, D. (1991). Critical reflection: A source of wonderful ideas for changing classroom practices. *Journal of Elementary Science Education*, 3 (2), 26-39.
- Battista, M.T. (1986). The relationship of mathematics anxiety and mathematical knowledge to the learning of mathematical pedagogy by preservice elementary teachers. *School Science and Mathematics*. 86, 10-19.
- Battista, M.T. (1999). The mathematical miseducation of America's youth: Ignoring research and scientific study in education. *Phi Delta Kappan*, 80, 424-433.
- Becker, J. and Jacob, B. (2000). The politics of California school mathematics: The anti-reform of 1997-1999. *Phi Delta Kappan*, 81, 529-537.
- Brawdy, P., and Egan, R. (2001). The ersatz phenomenon: Reclaiming authenticity in the mirrored halls of accountability. *Educational Studies (American Educational Studies Association)*. 32, 438-52.
- Bryan, L.A., Abell, S.K. and Anderson, M.A. (1996). Coaching reflective practice among preservice elementary science teachers. In P. Rubba, P. Keig, and J. Rye (Eds.), *Proceedings of the 1996 Annual International Conference of the Association for the Education of Teachers in Science*, (pp.397-411). (ERIC Reproduction Service No. ED 398 060).
- Brookhart, S. and Loudman, W. (1995). Perspective on teacher education assessment goals and their associated methods. In S. Soled (ed.), *Assessment, Testing and Evaluation in Teacher Education*, (pp.9-40). Norwood, NJ: Arbex Publishing.
- Clock, C. (1999). Learning to teach mathematics: Questioning, listening, and responding. *Educational Studies in Mathematics*, 37, 45-66.
- Graham, K.J., Li, Y. and Curran, B.J. (2000). Characteristics of mathematics teacher preparation programs in the United States: An exploratory study. *The Mathematics Educator*. 5, 5-31.
- Hedrick, W. (1999). Pre-service teachers tutoring 3rd, 4th, and 5th graders one-on-one within the school setting. *Reading Research and Instruction*, 38, 211-19.
- Hiebert, J., Carpenter, T., Fennema, E., Fuson, K., Human., Murray, H., Olivier, A. and Wearne, D. (1996). Problem solving as a basis for reform in curriculum and instruction: The case of mathematics. *Educational Researcher*, 25, 12-21.
- Hiebert, J. and Carpenter, T. (1992). Learning and teaching with understanding. In D. Grouws (Ed), *Handbook of Research on Mathematical Teaching and Learning*, (pp.65-100). New York: MacMillan.
- Jaworski, B. (1992). Mathematics teaching: What is it? *Journal for the Learning of Mathematics*, 12 (1), 8-14.
- Johnson, B. (1996). *The Performance Assessment Handbook (Vol. 2): Performances and Exhibitions. Designs from the Field and Guidelines for the Territory Ahead*. Larchmont, NY: Eycon Education.
- Mewborn, D.S. (1999). Reflective thinking among preservice elementary teachers. *Journal for Research in Mathematics Education*, 30, 316-341.
- McEwan, E. K. (2002). *10 Traits of Highly Effective Teachers*. Thousand Oaks, CA: Corwin Press.
- National Council for Teachers of Mathematics. (1998). *Mathematics Education Dialogues*, 1(1).
- Rich, C., Barcikowski, R. and Boyd, J. (1995). The assessment of preservice teachers. In S. Soled (Ed.), *Assessment, Testing and Evaluation in Teacher Education*, (pp.83-132). Norwood, NJ: Arbex Publishing.
- Schalock, H., Schalock, M., Cowart, B. and Myton, D. (1993). Extending teacher assessment beyond knowledge and skills: An emerging focus on teacher accomplishments. *Journal of Personnel Evaluation in Education*, 7, 105-33.
- Shulman, L. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57 (1), 1-22.

- Snyder, J., Elliott, S., Bhvanagri, N.P. and Boyer, J. (1993-94). Beyond assessment: University/school collaboration in portfolio review and the challenge to program improvement. *Action in Teacher Education*, 15(4), 55-60.
- Turner, N. (2002). *The Evolution of Portfolios in Teacher Education*. Retrieved April 8, 2003 from <http://www.usca.edu/essays/vol32002/turner.pdf>
- Wilson, S. (1995). Performance-based assessment of teachers. . In S. Soled (Ed.), *Assessment, Testing and Evaluation in Teacher Education*, (pp.189-219). Norwood, NJ: Arbex Publishing.
- Wolf, D. and Reardon, S. (1996). Access to excellence through new forms of student assessment. In J. Baron and D. Wolf (Eds.), *Performance-Based Student Assessment: Challenges and Possibilities*. Ninety-fifth yearbook of the National Society for the Study of Education, Part 1, (pp.1-31). Chicago, IL: NSSE.
- Yarbrough, D. (1995). Theoretical foundations of preservice teacher evaluation. In S. Soled (ed.), *Assessment, Testing and Evaluation in Teacher Education*, (pp.41-82). Norwood, NJ: Arbex Publishing.

The effect of prior experience with computers, statistical self-efficacy, and computer anxiety on students' achievement in an introductory statistics course: A partial least squares path analysis

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A Partial Least Squares Path Analysis technique was used to test the effect of students' prior experience with computers, statistical self-efficacy, and computer anxiety on their achievement in an introductory statistics course. Computer Anxiety Rating Scale and Current Statistics Self-Efficacy Scale were administered to a sample of 64 first-year university undergraduates (35 males and 29 females) enrolled in an introductory statistics course in a Faculty of Education. Achievement scores were obtained from students' records. Results of the study revealed that statistical self-efficacy was the most important predictor of students' achievement in statistics, followed by prior experience with computers and finally computer anxiety. In addition, statistical self-efficacy and prior experience with computers had an indirect effect on achievement in statistics through their effect on computer anxiety. Implications of these findings for teaching and learning statistics are discussed.

Prior experience, statistical self-efficacy, computer anxiety, achievement, statistics

INTRODUCTION

Success within the social science disciplines at the university level entails a thorough familiarity with modern statistical methods. Helping university students achieve mastery in statistics represents a major challenge for tertiary educators. Past research efforts have involved redesigning statistics courses (Moore, 1997), enhancing the relevance of statistics (Thompson, 1994), emphasising the importance of salient statistical concepts (Johnson, 1986), developing mathematical ability (Hong, 1999), and encouraging positive attitudes toward statistics (Hogg, 1991; Sorge, 2001).

It is likely that performance in statistics courses is affected by motivational factors such as anxiety and self-efficacy. In addition, prior experience with computers may also be crucial. When students enrol in a statistics course, they need to use computers to run different statistical analyses using a variety of software. Familiarity with computers may thus be seen as a positive or facilitative variable in helping students accommodate to the demands of a statistics course.

On the other hand, computer anxiety may contribute to the students' levels of concern and uncertainty, thereby reducing levels of academic achievement. Awang-Hashim, O'Neil, and Hocevar (2002), for example, found that state anxiety had a significant inverse relation with achievement in statistics. It would seem that anxious individuals devoted cognitive capacity to off-task efforts such as worrying about their performance and that with overloaded memory systems, a person was inclined to make errors (Darke, 1988; Friend, 1982).

Chua and Chen (1997, p.823) defined computer anxiety as "high anxious response towards interaction or anticipated interaction with electronic data processing systems." Maurer and

Simonson (1984) concluded that a person with computer anxiety would exhibit the following behaviours: (a) avoidance of computers, (b) excessive caution when using computers, (c) negative remarks toward computers and computing, and (d) attempts to shorten periods when computers were being used.

Hence, in terms of factors likely to be involved in students' success in a statistics course, it can be suggested that prior experience with computers would be helpful, while high levels of anxiety about computers would be unhelpful.

It is conceivable that the effects of prior experience with computers and computer anxiety on students' achievement in statistics are mediated by their self-efficacy. Meier (1985) applied Bandura's theory of self-efficacy to computer-based learning and confirmed that high levels of computer anxiety reduced levels of self-efficacy, which in turn lowered computer-based performance. Bandura (1982, p.122) defined self-efficacy as "how well one can execute courses of action required to deal with prospective situations." Self-efficacy was hypothesised to influence initiating behaviour, how much effort was applied to attain an outcome, and the level of persistence applied to the task in the face of difficulties and setbacks (Bandura, 1997).

However, it is also conceivable that the impact of self-efficacy on academic achievement is itself mediated by anxiety level. Zimmerman (1995) argued that self-efficacy beliefs aroused anxiety rather than the reverse. Tobias (1992) and Tobias and Everson (1997) indicated that anxiety interacted with metacognitive knowledge to affect performance, particularly on tasks that were more cognitively demanding. Thus, when other achievement motivational components (for example self-efficacy) were examined simultaneously, anxiety tended to play a mediational role in achievement.

The present study was conducted in the context of a first-year university statistics course. The following were investigated: (a) the extent to which students' achievement in statistics would be predicted from measures of their prior experience with computers, statistical self-efficacy, and computer anxiety; (b) whether students' computer anxiety would mediate the relationship between their statistical self-efficacy and achievement in statistics; (c) whether students' computer anxiety would mediate the relationship between their prior experience with computers and achievement in statistics; and (d) whether students' statistical self-efficacy would mediate the relationship between their prior experience with computers and achievement in statistics.

METHODS

Participants

Subjects of the present study included 64 first-year university undergraduates (35 males and 29 females) enrolled in an introductory statistics course in a Faculty of Education in 2004. The median age was 18.4 years. Participation was voluntary, and four students enrolled in the course declined to participate in data collection.

Measurements

Computer Anxiety Rating Scale (CARS)

The CARS (Heinssen, Glass, and Knight, 1987) is a 19-item scale that assesses the respondents' cognitions and feelings about their abilities related to the usage of computers. An example of items from the CARS includes "I am confident that I can learn computer skills."

Each item in the CARS was scored on a five-point Likert-type scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). The scoring of nine items (Items 2, 4, 5, 6, 7, 9, 10, 17, and 19) on the scale was reversed so that high total scores represented high anxiety. Scores ranged from 19

(low level of computer anxiety) to 99 (high level of computer anxiety). Within the current data set, the reliability index using Cronbach alpha was 0.67.

Current Statistics Self-Efficacy Scale (CSSES)

The CSSES (Finney and Schraw, 2003) is a 14-item scale that assesses the respondents' confidence in their ability to solve specific tasks related to statistics. An example of the CSSES includes "I can interpret the probability value (p-value) from a statistical procedure." Each item in the CSSES was scored on a five-point Likert-type scale ranging from 1 (No confidence at all) to 6 (Complete confidence). Scores ranged from 14 (low level of statistical self-efficacy) to 84 (high level of statistical self-efficacy). Within the current data set, the reliability index using Cronbach alpha was 0.65.

Procedures

The CARS and the CSSES were administered in the fourth week of the statistics class. In addition, participants responded to a question concerning their prior experience with computers on a five-point scale ranging from 1 (Slightly experienced) to 5 (Very experienced). Students were asked for a permission to obtain their achievement scores from their records. These scores were the course aggregated total score, that is, the sum of on-course assignments and examinations scores and were expressed as percentages.

PATH ANALYSIS

PLSPATH, a DOS based program, was developed by Sellin (1989) and was based on the Partial Least Squares (PLS) procedure introduced by Wold (1985). Sellin described PLS as a general technique for estimating path models involving latent constructs indirectly observed by multiple indicators. The PLS procedure was related conceptually to principal component analysis and regression analysis and it was argued to be appropriate for small sample sizes (Sellin and Keeves, 1997).

The PLS procedure calculates an estimate for each construct or latent variable, which is derived from corresponding observed or manifest variables, thus partitioning the hypothesised inner model into its component constructs. The PLS technique has been described as a soft-modelling approach and was argued to be useful in the investigation of causal-predictive analysis rather than confirmatory analysis (Sellin and Keeves, 1997). Keeves (1986) compared PLS with other structural equation modelling (SEM) approaches, such as LISREL, and concluded that PLS provided the most flexible and appropriate approach for analysis of data in the International Association for the Evaluation of Educational Achievement (IEA) project.

The model in the present study incorporates three types of constructs: (a) antecedents variables, which include students' prior experience with computers as an exogenous variable that is not influenced by other variables in the model; (b) mediator variables, which include students' computer anxiety and statistical self-efficacy; and (c) criterion variables, which include students' achievement in the statistics course as being predicted by the other variables in the model.

The main consideration guiding the development and refining of the model was based on a parsimonious attempt to build a concise and coherent model. Certain assumptions were set during the process of model development: (a) prior experience with computers was positively related to statistical self-efficacy and negatively related to computer anxiety; (b) statistical self-efficacy was negatively related to computer anxiety; and (c) achievement in statistics, as the criterion measure, was considered to be under the influence of all other variables in the model either directly or when mediated through other variables. The positive (+) and negative (-) effects of prior experience

with computers, statistical self-efficacy, and computer anxiety on achievement in statistics are presented in Figure 1.

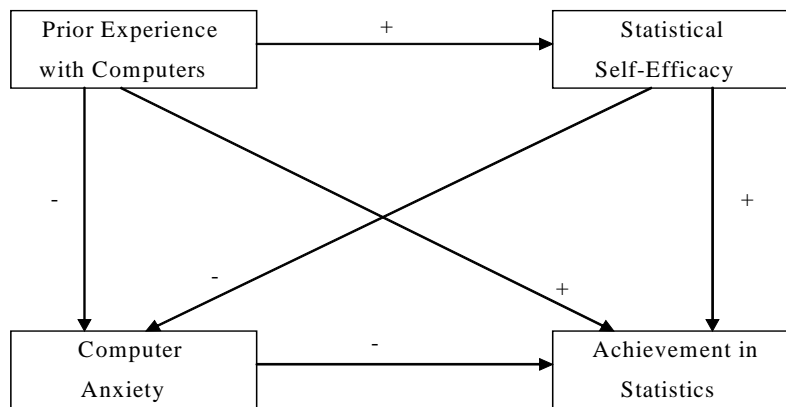


Figure 1. Hypothesised PLS path model

RESULTS

Initially, a matrix of Pearson product-moment correlation coefficients, presented in Table 1, among prior experience with computers, computer anxiety, statistical self-efficacy (predictors) and achievement in statistics (criterion) scores was calculated. Means and standard deviations were also estimated.

Table 1. Correlations and descriptive statistics of prior experience with computers, computer anxiety, statistical self-efficacy and achievement in statistics (N = 64)

Variables	1	2	3	4
1. Prior experience with computers	-			
2. Computer anxiety	- 0.59	-		
3. Statistical self-efficacy	0.25	- 0.67	-	
4. Achievement in statistics	.49	- 0.54	0.57	-
<i>M</i>	4.0	49.0	58.7	56.0
<i>SD</i>	1.8	20.0	25.5	20.0

Note: All reported correlations are significant, $p < 0.05$

It is noted from Table 1 that all variables are moderately or strongly correlated and the highest correlation is between computer anxiety and statistical self-efficacy ($r = -0.67$). Achievement in statistics has a positive relationship with statistical self-efficacy ($r = 0.57$) and prior experience with computers ($r = 0.49$), whereas it has a negative relationship with computer anxiety ($r = -0.54$). Prior experience with computers has a positive relationship with statistical self-efficacy ($r = 0.25$), whereas it has a negative relationship with computer anxiety ($r = -0.59$).

PLSPATH (Sellin, 1989) was used to calculate the standardised path coefficients (betas) and the corresponding jackknife estimates of the standard errors (SE). The SE for each standardised path coefficient is shown in brackets in Figure 2. The residuals or the disturbances are given by $\sqrt{1 - R^2}$ where R^2 is the squared multiple correlation coefficient for a certain latent variable.

Values of direct paths

Table 2 shows that with the exception of the path coefficient ($\beta = 0.25$), presented by a dashed line, from prior experience with computers to statistical self-efficacy, all the hypothesised direct paths are significant ($p < 0.05$). The jackknifing method (Sellin, 1989) was applied to estimate the jackknifing standard errors.

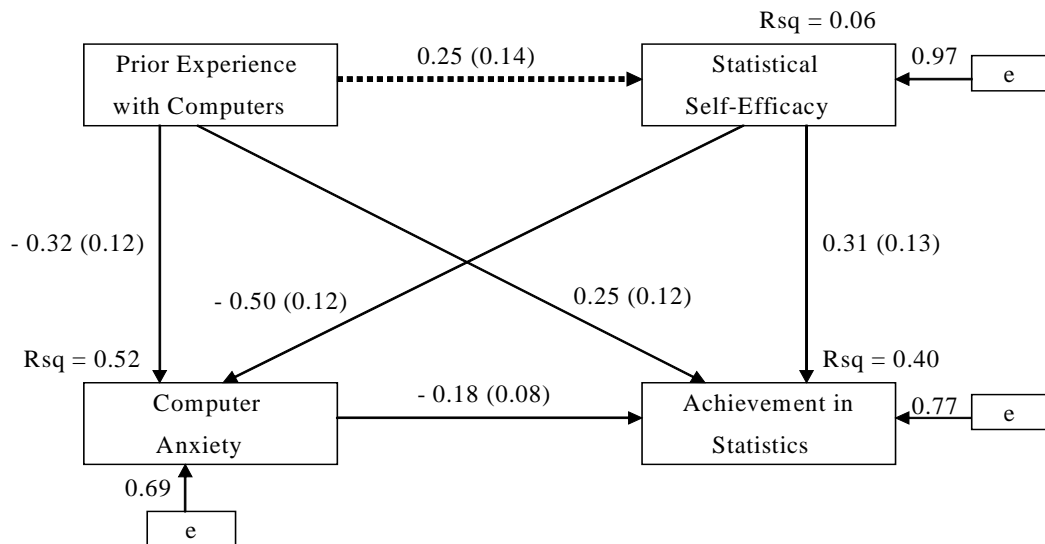


Figure 2. Initial PLS path model of the effect of prior experience with computers, computer anxiety, and statistical self-efficacy on achievement in statistics

As an accepted rule, a path coefficient is considered to be statistically significant when twice the corresponding jackknife estimate of the standard error is less than the value of the standardised direct path coefficient (β) (Falk and Miller, 1992; Sellin and Keeves, 1997). The factors with the single largest direct effect on achievement in statistics is statistical self-efficacy ($\beta = 0.31$), followed by prior experience with computers ($\beta = 0.25$) and computer anxiety ($\beta = -0.18$) with $R^2 = 0.40$ indicating that the model explains 40 per cent of the variance of achievement in statistics. Prior experience with computer ($\beta = -0.32$) and statistical self-efficacy ($\beta = -0.50$) are found to predict computer anxiety with $R^2 = 0.52$ indicating that those two variables explain 52 per cent of the variance of computer anxiety.

Values of indirect paths

Table 2 shows that prior experience with computers ($\beta = 0.06$) and statistical self-efficacy ($\beta = 0.09$) have positive indirect effects on achievement in statistics through their effects on computer anxiety. The total effect of a latent variable on another latent variable is calculated by adding the direct and the indirect effect of a certain latent variable in the model.

Refining the model

The modification of the model involves the trimming of all paths that do not contribute significantly to the variance explanation in a latent variable in order to obtain a parsimonious model. When the value of the standardised direct path coefficient is less than twice its corresponding jackknife estimate of the standard error, the path should be removed (Sellin and Keeves, 1997). Paths meeting this criterion were trimmed from the model. Since the value of the standardised path coefficient from prior experience with computers to statistical self-efficacy was less than twice its corresponding jackknife estimate of the standard error (SE), this path was removed by setting the value of the path to zero in the PLS PATH program trimming editor. Figure 3 shows the final model that consists of students' prior experience with computers and statistical self-efficacy as exogenous variables, computer anxiety as a mediator, and academic achievement in statistics as a criterion. The SE for each path coefficient is shown in brackets. The residuals or the disturbances are given by $\sqrt{1 - R^2}$ where R^2 is the squared multiple correlation coefficient for a certain latent variable.

Table 2. Jackknife results of PLS path model of the effect of prior experience with computers, computer anxiety, statistical self-efficacy on achievement in statistics (N = 64)

Paths	JknStd	Beta (β)	Indirect Effects	Total
To statistical self-efficacy ($R^2 = 0.06$)				
• Prior experience with computers	0.14	0.25	0.00	0.25
To computer anxiety ($R^2 = 0.52$)				
• Prior experience with computers	0.12	-0.32	0.00	-0.32
• Statistical self-efficacy	0.12	-0.50	0.00	-0.50
To achievement in statistics ($R^2 = 0.40$)				
• Prior experience with computers	0.12	0.25	0.06	0.31
• Statistical self-efficacy	0.13	0.31	0.09	0.40
• Computer anxiety	0.08	-0.18	0.00	-0.18

Note: JknStd = Jackknife standard error. All tests are two-tailed because of the nondirectional nature of the hypotheses. A value of 0.00 indicates that the value was not obtained.

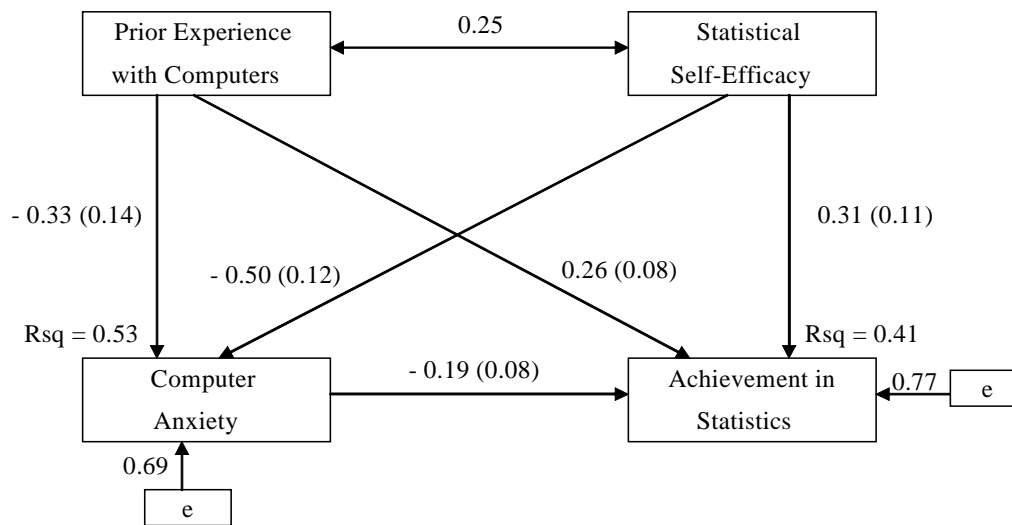


Figure 3. Re-estimated PLS path model of the effect of prior experience with computers, computer anxiety, statistical self-efficacy on achievement in statistics

Values of direct paths

Table 3 shows that all direct paths are statistically significant ($p < 0.05$) since twice the corresponding jackknife estimate of the standard error is less than the value of the standardised direct path coefficient (Falk and Miller, 1992; Sellin and Keeves, 1997). Statistical self-efficacy ($\beta = 0.31$) has the largest direct effect on achievement in statistics followed by prior experience with computers ($\beta = 0.26$) and computer anxiety ($\beta = -0.19$) with $R^2 = 0.41$ indicating that the model explains 41 per cent of the variance of achievement in statistics. Prior experience with computers ($\beta = -0.33$) and statistical self-efficacy ($\beta = -0.50$) were found to predict computer anxiety with $R^2 = 0.53$ indicating that those two variable explain 53 per cent of the variance of computer anxiety.

Values of indirect paths

Table 3 shows that prior experience with computers ($\beta = 0.06$) and statistical self-efficacy ($\beta = 0.1$) have positive indirect effects on achievement in statistics through their effect on computer anxiety. The total effect of a latent variable on another latent variable is calculated by adding the direct and the indirect effect of a certain latent variable in the model.

Table3. Jackknife results of a re-estimated PLS path model of the effect of prior experience with computers, computer anxiety, statistical self-efficacy on achievement in statistics (N = 64)

Paths	JknStd	Beta (β)	IndirectEffects	Total
To computer anxiety ($R^2 = 0.53$)				
• Prior experience with computers	0.14	- 0.33	0.00	- 0.33
• Statistical self-efficacy	0.12	- 0.50	0.00	- 0.50
To achievement in statistics ($R^2 = 0.41$)				
• Prior experience with computers	0.08	0.26	0.06	0.32
• Statistical self-efficacy	0.11	0.31	0.1	0.41
• Computer anxiety	0.08	- 0.19	0.00	- 0.19

Note: JknStd = Jackknife standard error. All tests are two-tailed because of the nondirectional nature of the hypotheses. A value of 0.00 indicates that the value was not obtained.

DISCUSSION

This study has used the path analysis program, PLSPATH, to test a casual model of the factors that affected students' achievement in an introductory statistics course. Findings of the study have shown that among the many factors that might contribute to students' achievement in statistics, statistical self-efficacy was the strongest. After considering students' computer anxiety and prior experience with computers, statistical self-efficacy remained a critical factor that affected directly students' achievement in statistics. Students who entered the statistics course with high levels of self-efficacy appeared to exhibit high scores on the overall course aggregate. These findings support Bandura's social learning theory and are consistent with the body of research implicating self-efficacy as a significant factor influencing academic achievement (Bandura, 1977, 1986, 1997; Schunk, 1995; Schunk and Pajares, 2002).

Besides the direct effect, the analysis showed that statistical self-efficacy could also influence achievement in statistics indirectly by reducing students' anxiety about computers. Computers have been recognised as important facilitators in statistics courses that helped students meet the requirement of such classes. Research on the psychological effect of technology has shown that computer anxiety might impair students' performance because anxious students devoted some level of their cognitive capacities to off-task effort such as worrying about their performance (Darke, 1988; Friend, 1982). The results suggest that feelings of competency in statistics can serve to counteract students' worries about using computers to meet the upcoming demands of their statistics course. These findings are supported by what other research studies indicated that anxiety interacted with metacognitive knowledge to affect performance, particularly on tasks that were more cognitively demanding such as mathematics and statistics. Thus, when other achievement motivational components (for example, self-efficacy) were examined simultaneously, anxiety tended to play a mediational role in achievement (Bandura, 1986; Tobias, 1992; Tobias and Everson, 1997).

Another important factor that was found to affect students' achievement in statistics was prior experience with computers. It was apparent that students' familiarity with computers assisted their performance in a statistics class that required the use of computers to run different statistical analyses using a variety of software. Furthermore, when students had experience with computers, they were more likely to be less anxious about using the computer as a statistical analysis tool. The current findings stand on line with those of Lolyd and Gressard (1984) who reported that students became less anxious once an initial trauma period passed through a prior experience (see also Howard and Smith, 1986; Glass and Knight, 1988).

In summary, the results of the PLS path analysis add further support to the notion that learning is a complex process, and that causal models can be developed to represent it. This study demonstrated the direct and indirect relationships between certain measurable factors and achievement in statistic. What the data also indicated, however, was that taking in consideration students' prior experience with computers and computer anxiety, the strongest predictive factor of achievement in learning statistics remained statistical self-efficacy.

REFERENCES

- Awang-Hashim, R., O'Neil, H.F. and Hocevar, D. (2002). Ethnicity, effort, self-efficacy, worry, and statistics achievement in Malaysia: A construct validation of the state-trait motivation model. *Educational Assessment*, 8, 341-364.
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioural change. *Psychological Review*, 84, 191-215.
- Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, 37, 122-147.
- Bandura, A. (1986). *Social Foundations of Thought and Action*. Englewood Cliffs NJ: Prentice-Hall.
- Bandura, A. (1997). *Self-efficacy: The Exercise of Control*. New York: Freeman.
- Chua, L., and Chen, T. (1997). A review on studies of computer anxiety in the 90s. In Z. Halim, T. Ottmann, and Z. Razak (Eds.) *Proceedings of the International Conference on Computer in Education* (pp.822-829). Sarawak: University Malaysia Sarawak.
- Darke, S. (1988). Effects of anxiety on inferential reasoning task performance. *Journal of Personality and Social Psychology*, 55, 499-505.
- Falk, F. and Miller N. (1992). *A Primer for Soft Modelling*. Akron, Ohio: University of Akron Press.
- Finney, J. and Schraw, G. (2003). Self-efficacy beliefs in college statistics courses. *Contemporary Educational Psychology*, 28, 161-186.
- Friend, E. (1982). Stress and Performance: Effects of subjective work load and time urgency. *Personal Psychology*, 35, 623-633.
- Glass, R. and Knight, A. (1988). Cognitive factors in computer anxiety. *Cognitive Theory and Research*, 12, 351-366.
- Heinssen, K., Glass, R. and Knight, A. (1987). Assessing computer anxiety: Development and validation of the computer anxiety rating scale. *Computers in Human Behaviour*, 3, 49-59.
- Hogg, R. (1991). Statistics education: Improvements are badly needed. *American Statistician*, 45, 342-343.
- Hong, H. (1999). Using storybooks to help young children make sense of mathematics. In J.V. Copley (Ed.) *Mathematics in the Early Years*, (pp.162-168). Reston, VA: National Council of Teachers of Mathematics.
- Howard, G. and Smith, R. (1986). Computer anxiety in management: Myth or reality? *Communications of the ACM*, 29, 161-165.
- Johnson, E. (1986). Demonstrating the central limit theorem. *Teaching of Psychology*, 13, 155-156.
- Keeves, J. (1986). Aspiration, motivation and achievement: Different methods of analysis and different results. *International Journal of Educational Research*, 10, 117-243.
- Loyd, H. and Gressard, C. (1984). Reliability and factorial validity of computer attitude scales. *Educational and Psychological Measurement*, 44, 501-505.
- Maurer, W. and Simonson, R. (1984). Development and validation of a measure of computer anxiety. Paper presented at the annual meeting of the Association for Educational Communications and Technology, Dallas, TX (ERIC Documentation Reproduction Service No. ED 243428).

- Meier, S. (1985) Computer aversion. *Computers in Human Behaviour*, 1, 171-179.
- Moore, M. (1997). New pedagogy and new content: The case of statistics. *International Statistical Review*, 65, 123-165.
- Schunk, D.H. (1995). Self-efficacy and education and instruction. In J.E. Maddux (Ed.), *Self-efficacy, Adaptation, and Adjustment: Theory, Research, and Application* (pp.281-303). New York: Plenum Press.
- Schunk, D.H. and Pajares, F. (2002). The development of academic self-efficacy. In A. Wigfield and J. Eccles (Eds.) *Development of Achievement Motivation* (pp.16-31). San Diego: Academic Press.
- Sellin, N. and Keeves, J. (1997). Path analysis with latent variables. In J.P. Keeves (Ed.) *Educational Research, Methodology, and Measurement: An International Handbook* (pp.633-640) Oxford: Pergamon.
- Sellin, N. (1989). *PLSPATH Version 3.01: Application Manual*. Hamburg, West Germany.
- Sorge, C. (2001). *Impact of Engineering Students' Attitudes on Achievement in Statistics: A Structural Equation Model Analysis*. Unpublished doctoral dissertation, University of New Mexico, Albuquerque.
- Thompson, B. (1994). Making data analysis realistic: Incorporating research into statistics courses. *Teaching of Psychology*, 21, 41-43.
- Tobias, S. (1992). The impact of test anxiety on cognition in school learning. In K.A. Hagtvet and B.T. Johnsen (Eds.), *Advances in Test Anxiety Research* (pp.18-31). Lisse, The Netherlands: Swets and Zeitlinger.
- Tobias, S. and Everson, T. (1997). Studying the relationship between affective and metacognitive variables. *Anxiety, Stress, and Coping*, 10, 59-81.
- Wold, H. (1985). Partial least squares. In S. Kotz and N.L. Johnson (Eds.), *Encyclopaedia of Statistical Sciences* (pp.581-591). New York: Wiley.
- Zimmerman, B.J. (1995). Self-efficacy and educational development. In A. Bandura (Ed.), *Self-Efficacy in Changing Societies* (pp.202-231). New York: Cambridge University Press.

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Most of ESL students have trouble with the articles

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The English article system presents many problems for non-native speakers of English, particularly when they do not have an equivalent structure in their first language. Different approaches to the teaching of articles have attempted to overcome this problem. By encouraging students to address the notion of countability and to identify specific uses of articles in English, the ESL teacher in this study was able to improve students' understanding of this difficult area and guide them to a more accurate usage of the English article system.

Articles, countability, definiteness, non-native speakers, teaching ESL

INTRODUCTION

In almost any piece of writing submitted by a non-native speaker of English, three things will often indicate that the writer is working in a second language: the choice of tense and aspect, the subject and verb agreements, and the use of articles (*the, a, an*). While verb problems can largely be overcome and the mistakes in agreements eliminated by careful proofreading, the problems with articles frequently remain. Since articles rank among the five most common words in the English language (Sinclair, 1991, cited in Master, 2002, p.332), errors in this area are highly noticeable to native speakers.

Given that Australian universities are experiencing an influx of international students who speak English as a second or even third language, it is imperative for academic advisors who specialise in TESL to understand the major language difficulties of these students. Since many of our international students come from Asian countries, this means that their most frequent language problem is in the area of articles. This study was prompted by the desire to address the language needs of Chinese L1 speakers, who formed the largest number of students in an ESL topic taught at a South Australian university in the second semester of 2004. It is an exploratory study, which aims to target a major language area that does not exist in Chinese (namely, the use of articles), and to develop an appropriate teaching method, central to which is the notion of countability. It is anticipated that this paper will inform both my own teaching and that of my centre, and will have implications for teachers of English to international students.

ENGLISH ARTICLES

The importance of using articles correctly

Articles in English are one of the key indicators of native speaker competence, and the ease with which native speakers use articles can lead them to ignore the complexities of the system and often be unaware of their importance to English syntax (Lipski, 1978, p.13). Hewson (1972, p.132) has called the English article system a “psychomechanism”, through which native speakers use articles correctly but unconsciously. Since errors in the use of articles generally do not impede communication, many learners may feel that the effort involved in learning the system correctly is not proportionate to the benefits accrued (Master, 1997, p.216). For academic writing, however, a

greater level of accuracy is required, and the correct article becomes an indication not only of mastery of the language but of exactness in thought and expression. As Master (1997, p.216) indicates, “imperfect control [of the use of articles] may . . . suggest imperfect knowledge”, leading to the perception that the writer of a university essay or academic paper does not have an adequate grasp of their subject.

According to Hewson (1972, p.131), “the definite and the indefinite article are among the ten most frequent words of English discourse”. Sinclair (1991, in Master, 2002, p.332) lists *the* as the most frequent word and *a* as the fifth most frequent. This frequency means that these two small words have a wide-ranging effect on speech styles and expression, and that proficiency in this system will provide non-native speakers with a perceptibly increased level of accuracy.

It has been suggested (Yamada and Matsuura, 1982, in Butler, 2002, p.452) that learners “use articles almost randomly”. Some teachers, indeed, believe that the system is so difficult to acquire that no rules can be taught (Krech and Driver, 1996). Master (1997, p.216), however, suggests that “formal instruction does have a positive effect”, and many teachers do indeed attempt to give rules for the use of articles. Swales and Feak (1994), for example, give a detailed review of article uses for non-native speakers of English engaged in academic writing. Such rules are nonetheless hard to formulate.

The English article system

One of the key factors in teaching articles is the notion of countability (Butler, 2002, p.475). In English, nouns may be divided into the categories of “countable” and “uncountable” (also called “count” and “noncount”). Countable nouns are those which may take a plural form (such as “tables” or “children”), while uncountable nouns (such as “mud” or “information”) cannot be made plural. It is important for students to realise that countability is a grammatical category and not a practical one. “Money”, for example, is countable when it is in a wallet but is not usually countable as a noun, although the form “moneys” is found in a business sense. This variability of forms constitutes a difficulty for the learner, especially with the increasing use of traditionally uncountable nouns, such as “knowledge” or “behaviour”, in the plural within many academic disciplines. Another difficulty is that some English nouns, such as “experience”, may be either countable or uncountable, according to their meaning. (We could contrast, for example, someone’s “experiences” while on holiday in China with the amount of “experience” they have had in using a difficult computer program.) A third difficulty for many non-native speakers of English is that some nouns may be made plural in their own languages but not in English. (*Informations*, for example, is correct in French.) Yet again, there is an increasing tendency for native speakers to make a noun countable by using it in a classificatory sense (Quirk and Greenbaum, 1973, p.61), omitting a container, so that they speak of “three coffees and two waters” instead of “three cups of coffee and two bottles of water”. While countability is fundamental, therefore, it is not an easy concept to quantify.

Identifying countability, then, is problematic for the learner. Yoon (1993, in Master, 1997, p.218) points out that Japanese speakers, for example, find it difficult to determine how native speakers of English regard nouns that may be countable or uncountable according to context. Indeed, Allen (1980, in Celce-Murcia and Larsen-Freeman, 1999, p.274) has suggested that there are eight different “levels of countability”. Most grammar books, however, present a more clear-cut distinction. Monolingual English dictionaries designed for native speakers do not provide information on countability, since so many variations are possible (Master, 2002, p.334). A learners’ dictionary of English, on the other hand, will give the countable or uncountable status of a noun and, usually, an example of its usage. In 2004, the five major English learners’ dictionaries all included the identification of a noun as countable or uncountable. This categorisation is not, however, without its problems (Landau, 1984, p.90). Nevertheless, a learners’ dictionary is a good

place for language students to start, and more students (and their teachers) should be aware of the value of English learners' dictionaries to enhance language skills.

Once a noun has been identified as countable or uncountable, the user must then decide whether an article is necessary. This means that the next criterion to determine is definiteness. Although other languages may contain definiteness, this may not be conveyed by the use of articles, as it is in English. Chinese, for example, although it does not have articles, has a notion of definiteness associated with a topic (Ramsey, 1987, p.66). Hawkins (1978, p.130) states that the definite article "tells the hearer . . . that the object referred to is a member of [a 'shared set'] and instructs him to find the right set and relate the referent to it". For the learner, this means that definiteness can be simply defined as "presumed known to the listener" (Bickerton, 1981, p.147). Liu and Gleason's study (2002, p.16) indicates that students may initially overuse the definite article, even following instruction on its use, but that this will eventually be remedied. Liu and Gleason (2002) state that the use of *the* may be generic or non-generic, and suggest that the non-generic uses are the most difficult for language learners, particularly in relation to what they term "cultural use" (p.5).

The indefinite article, *a* or *an*, is slightly less problematic for most students, since its use is restricted to singular, countable nouns. According to Bickerton (1981, p.147), "'indefinite' really means presumed unknown to the listener". It is thus used with nouns which have not been mentioned before, and with generic nouns. It may also be used with uncountable nouns (Master, 1997, p.225) for a "boundary-creating effect", as in "a high-grade steel" (a kind of steel which is of good quality). The problem for ESL students lies in identifying whether or not a noun is countable (Master, 1997, p.218) and whether it is being used in a countable or uncountable sense.

The zero article may also cause difficulties. Master (1997, p.221), for example, divides the zero article into two: the zero article and the null article. Zero articles are used before uncountables and plurals, such as "sand" ("There was sand everywhere") and "pebbles" ("Pebbles are found on beaches"). Null articles are used before singular countables ("Counting of the votes began later") and proper nouns. Since the null article is often used in scientific writing (as in "Use of this method implied...") it can present an additional problem to students. For the purposes of this study, "zero article" refers to both Master's "zero" article and "null" article, and is used to describe the situation in which a definite or indefinite article is not used.

In some situations, either a definite or an indefinite article may be possible. Definitions fit into this category. Hewson (1972, p.73) gives the following examples: "A table is a useful article of furniture" and "The table is a useful article of furniture". The first sentence he describes as "a typical representative example" and the second as "universal and general". A definite or indefinite article may also be used in the pattern Article + Noun + of, where the indefinite article is used for the first mention of something which is a singular occurrence or part of a whole, as in "a result of this" or "a grain of rice", but the definite article is used in most other occurrences of this pattern.

In the study which follows, a simple chart was presented to assist students to consider categories of countability and uncountability, as well as definiteness and non-definiteness (see Figure 1). The term "zero article" was used to cover all situations in which a definite or indefinite article is not used.

THE STUDY

Subjects

All the participants were in their first or second year of study at an Australian university and had already received several years of English instruction, either in their home country or at a language school in Australia. Two were postgraduates and the remainder were undergraduates. The research was conducted at the end of the second semester, meaning that all the students had been in

Australia for at least three months and had been required to write assignments in English during that time. Although language proficiency was not recorded in this study, a minimum overall IELTS score of 6 is a prerequisite for study at this university. All students were members of an ESL class at the university and had already received instruction in academic writing skills, vocabulary and grammar for three months prior to this research. Male and female participants were almost equally represented (M=23, F=18), and the students were mostly aged in their early twenties. Of the 41 participants, 31 were from a Chinese speaking background. The other participants had the following L1 background: Amharic (1), Arabic (2), Japanese (3), Khmer (1), Portuguese (1), Swedish (1) and Tagalog (1).

Method

The exercises in this study were designed to encourage students to formulate their own rules governing English article use. Although one student complained that he would rather be taught the rules than work them out for himself, others indicated that thinking through the possibilities had helped them to understand the use better. The results confirmed this. Because of the small sample size, the results are not conclusive, but they are indicative of an improvement in the students' use of articles. The exercise was conducted in the final class, and this timing may account for the relatively small improvement the students showed, since all the students were tired and many were resistant to further grammar teaching. Given the time constraints imposed on the course, however, it had not been possible to provide this session earlier.

The students were given two exercises to complete at the beginning of the session (see Appendix 1). The first exercise (Text 1) contained fifteen gaps that had to be filled either with a definite article, an indefinite article or no article at all. The gaps were separated by a minimum of two words and a maximum of 22 words. The second exercise (Text 2) comprised a short paragraph from which ten articles had been removed, at a maximum interval of 15 words and a minimum interval of two words. No gaps were shown, but students had to correctly identify the gaps and insert articles where appropriate. Both texts were taken from passages in *Making the Grade* (Hay, Bochner, and Dungey, 2002), a book of academic skills advice for university students, and were thus representative of a generic form of English that was not specific to any one discipline. The readability level of the texts was calculated at grade 10.3 on the Flesch-Kincaid scale. This was judged to be appropriate to university level students, and the students themselves indicated that the texts were of a suitable level when they gave an average of 4.09 on a scale from one to seven in answer to the question "Was the material too hard?". Although the first exercise was in a format familiar to all the students, the second exercise proved much more difficult. Thus, although 31 students completed the first exercise, only 23 completed the second exercise.

After the exercises had been completed, a lesson was conducted on the English article system. Students were first asked to explain the notions of countability and uncountability in regard to nouns. This proved unproblematic, with students correctly identifying the countable properties of words such as "table" and "chair" and the uncountable nature of words such as "information". They were then asked to identify what was meant by the concept of "definiteness". This was obviously harder, with students giving examples (such as "something which has been mentioned before"), but finding it difficult to put such an elusive notion into words. We finally arrived at the somewhat elastic description of "something which is known to both the hearer and the speaker". Having established the two concepts of countability and definiteness, the students were introduced to the "Choosing the right article" chart (see Figure 1) to help them decide whether or not a noun needed an article. It was reiterated that a singular, countable noun must have an article, if it is not preceded by another word such as a demonstrative or a possessive adjective.

Having become familiar with the articles chart, the students were then given a passage about the River Murray, in which the articles had been highlighted in bold font (see Appendix 2). Almost all

the articles in the first two paragraphs were definite articles; the third paragraph contained mostly indefinite articles; and the fourth paragraph contained examples of zero articles marked by an underlined space. Students had to be reminded that this fourth paragraph had no need for articles, since several of them tried to fill in the gaps, due, probably, to sheer force of habit. With the passage, the students were given a table to complete in order to identify the different uses of the articles in the passage (see Figure 1). The table was divided into three sections: the definite article, the indefinite article and the zero article. For the definite and zero articles, examples were taken from the passage and students were required to identify particular uses. For the indefinite article section, the uses were given and students were asked to find examples from the passage (see Appendix 3). The students worked in pairs to complete this part of the study.

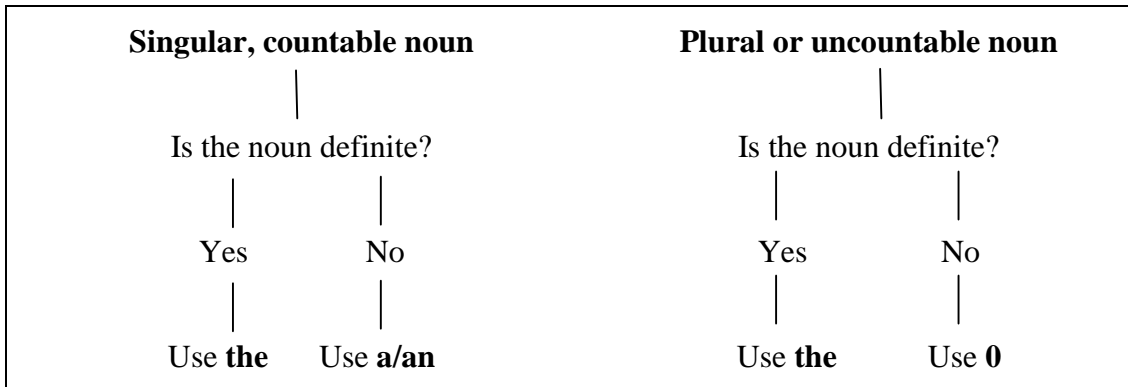


Figure 1: Choosing the right article

After 20 minutes, the results were discussed. A Student Learning Centre handout I had earlier compiled, with more complete information, was then given to the students, as well as an explanation about the uses of articles in definitions. Finally, the students were asked to complete the original exercise (Texts 1 and 2) again, on a separate sheet of paper, using the information they had just gained. The two exercises were then collected by a third party, and the participants were invited to complete a questionnaire on the effectiveness of the session. Correct answers to the exercises were then distributed (see Appendix 4).

FINDINGS

Although some students were resistant to the idea of learning more grammar, especially in an area in which they already felt themselves to be reasonably proficient, the exercises highlighted the fact that, even for advanced students of English, improvement in this area is possible. Owing to the small number of participants, findings are not conclusive, but they are indicative of the fact that this is an area of English which needs addressing and in which a difference can be made.

Both texts showed an improvement in accuracy. The correct answers for the gap-fill exercise, Text 1, rose from 80 per cent to 83 per cent. Text 2 accuracy rose from 43 per cent to 54 per cent. The results for Text 2 indicate that students had not only identified the correct article, but had correctly identified where an article was needed. In other words, they had established that a singular countable noun requires an article, and had then chosen that article correctly. This is an important result in that, while students are used to completing gap-fill exercises and can often identify the right article when prompted, it is harder for them to judge when an article is necessary if a gap is not indicated, so that their own writing is frequently lacking in articles. If they are able to identify the place for an article, they are at least half way towards correct usage.

In the first attempt at Text 2, students had made a total of 116 article insertions, 99 of which were correct. In the second attempt, 146 insertions were made, of which 121 were correct. Although

mistakes were made, it was generally not the placing of the article but the choice of article that was at fault. The only error made consistently in Text 2 was the insertion of *a* before the phrase “brief in-text references”. This was not corrected on the second attempt by any of the students. Moreover, four students who had not inserted an article here before the teaching session had inserted one after the lesson. This may have been due to careless reading of the noun phrase.

The changes made in the two texts after the lesson are indicative of a greater awareness of countability. Of the correct changes made, the most evident was the insertion of an article where none had been placed before. Thirty-five corrections were made from zero to *the*, 33 before singular countable nouns and two before plural countable nouns. Twelve corrections were made from zero to *a*. The total of 47 changes from zero to an article before a countable noun indicates that students had correctly reassessed the nouns for countability. Of the incorrect changes, the highest number was nine changes from *the* to zero. Two of these were made before “library’s resources” (Text 1), indicating that students had identified “resources” rather than “library” as the noun which needed a determiner. Another two were made at the end of Text 2, before the word “information”, showing that “information” was incorrectly thought to be uncountable and non-definite. On the whole, however, the insertion of articles suggests that students had effectively understood and applied the notion of countability.

Were a further similar study to be undertaken, it is suggested that more texts of both Types 1 and 2 be used. Student feedback indicated that more examples similar to those in the River Murray passage be given, and that the lesson be lengthened and perhaps taught over two sessions to allow consolidation of the information gained.

Limitations

Limitations to this study include the fact that this was the last session of the semester. Students were hurrying to complete assignments before their deadlines and were preparing for their exams. In addition, the small numbers in the samples do not provide enough data for wider generalisation.

Recommendations

This exercise was carried out in a single session, but it is suggested that a longitudinal study would show the lasting benefit of this method of teaching. Research involving different age groups would be fruitful, as would a comparison of the number of years students have spent in an English speaking country prior to doing the exercise. The use of several texts would allow a greater comparison of findings, and assessment of the readability levels of the texts would be helpful. In addition, information about the subject each student is studying would permit a comparison between the skills used, or possibly acquired, within specific disciplines.

CONCLUSION

From this study, it is apparent that the most effective element in the lesson was the reinforcement of the notion of countability. With greater use of learners’ dictionaries, students could more correctly identify when nouns are used countably or uncountably. The evidence presented here suggests that learners do not use articles “randomly”, as suggested by Yamada and Matsuura (1982, in Butler, 2002, p.452), but that they choose articles according to whether or not the noun is countable. The concept of definiteness is, however, more problematic. Nevertheless, it is possible, as Master (1997, p.216) claims, for teachers to make a positive contribution to learners’ knowledge in this important area.

REFERENCES

- Bickerton, D. (1981) *Roots of Language*. Ann Arbor: Karoma Publishers.
- Butler, Y.G. (2002) Second language learners' theories on the use of English articles. *Studies in Second Language Acquisition*, 24, 451-480.
- Celce-Murcia, M. and Larsen-Freeman, D. (1999) *The Grammar Book* (2nd ed.). Boston, MA: Heinle and Heinle.
- Hawkins, J.A. (1978) *Definiteness and Indefiniteness*. London: Croom Helm.
- Hay, I., Bochner, D. and Dungey, C. (2002) *Making the Grade* (2nd ed.). Melbourne: Oxford University Press.
- Hewson, J. (1972) *Article and Noun in English*. The Hague: Mouton.
- Krech, P. and Driver, K. (1996) Can articles be taught? [Online] www.umkc.edu/cad/nade/nadedocs/96conpap/kdcpap96.htm [2004, October 11].
- Landau, S.I. (1984) *Dictionaries: The Art and Craft of Lexicography*. New York: Scribner Press.
- Lipski, J.M. (1978) On the use of the indefinite article. *Hispania*, 61, 105-109.
- Liu, D. and Gleason, J.L. (2002) Acquisition of the article *the* by nonnative speakers of English. *Studies in Second Language Acquisition*, 24, 1-26.
- Master, P. (1997) The English article system: Acquisition, function, and pedagogy. *System*, 25 (2), 215-232.
- Master, P. (2002) Information structure and English article pedagogy. *System*, 30, 331-348.
- Quirk, R. and Greenbaum, S. (1973) *A University Grammar of English*. London: Longman.
- Ramsey, S.R. (1987) *The Languages of China*. Princeton, NJ: Princeton University Press.
- Swales, J.M. and Feak, C.B. (1994) *Academic Writing for Graduate Students*. Ann Arbor, Michigan: The University of Michigan Press.

APPENDIX 1

Text 1: Please complete the following exercise, using a/the/0 where appropriate.

(a) _____ library catalogue is (b) _____ key to (c) _____ library's resources. It gives you (d) _____ information about materials held in (e) _____ library, and (f) _____ details you need to locate them. All (g) _____ Australian and New Zealand university libraries have online or computerised catalogues. Most libraries have their catalogue terminals scattered throughout (h) _____ building. This is (i) _____ distinct advantage over the old card catalogues, which could only be in one location. Moreover, in many cases you can connect to (j) _____ computer catalogue from home if you have (k) _____ personal computer and (l) _____ modem. However, (m) _____ card catalogue is not quite extinct; some academic libraries still retain one for details of older material. (n) _____ oldest books may be on (o) _____ separate record.

Adapted from Hay, I. Bochner, D. and Dungey, C. (1997) *Making the Grade*. Sydney: Oxford University Press. p.35

/15

Text 2 Can you add articles where necessary in the following text?

Harvard referencing system has two essential components: brief in-text references noted throughout your work and comprehensive list of references at end of work. In-text reference gives date it was published, family name of author and page where information can be found.

Adapted from Hay, I. Bochner, D. and Dungey, C. (1997) *Making the Grade*. Sydney: Oxford University Press. p.155

/10

APPENDIX 2

I went to a lecture yesterday. **The** lecture was very interesting. It told us about **the** problems of **the** Murray, which is **the** longest river in Australia. **The** Murray is becoming very dry. According to **the** Friends of the Murray, we in **the** West have plenty of water, but we waste it on our European-style gardens. People in **the** Philippines and **the** Maldives do not have this problem, but the **British** in particular have always liked their rose gardens, which demand a lot of water. People who live near **the** Equator, and **the** rich in northern countries, like **the** Queen of England, have plenty of water and do not have problems with their gardens. Native plants are not so thirsty. **The** Sturt desert pea, which is **the** floral emblem of South Australia, grows in dry conditions.

In **the** 1990s **the** problems with the Murray became **the** principal focus of **the** group known as **the** Friends of the Murray. They distributed thousands of questionnaires, to see what people thought about **the** water problems. Most of **the** questionnaires were returned, but none of **the** answers showed that people were prepared to modify their gardens. Because **the** dollar was strong against **the** pound at **the** end of **the** 1990s, people felt that they had sufficient money to pay for **the** water needed to maintain their gardens.

People would sometimes water their gardens twice a day, using hundreds of litres of water an hour. The River Murray is not an inexhaustible resource. A litre of water may not cost a householder much, but thousands of litres all together make a big difference to the river. I am not a water engineer, but it is easy to understand that people cannot continue to use water at this rate.

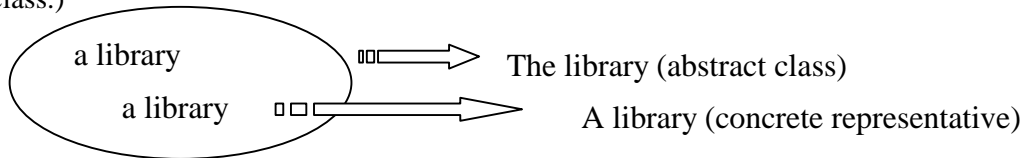
The mouth of the River Murray is becoming full of ___ mud. This ___ mud is bad for ___ water life and causes ___ difficulties for ___ water dwellers. ___ Fish that become exposed to these ___ conditions may die. ___ Australians must become aware of their ___ water usage and decrease it before it is too late. ___ Most researchers agree on this ___ point.

APPENDIX 3

	Use	Examples
The Definite Article	something already mentioned	the lecture; the problems with the Murray; the group known as...; the water problems the problems of; the floral emblem of; the end of the Murray; the Philippines; the Maldives the longest the Friends of the Murray the West; the British; the rich the Equator; the Queen of England
	an emblem, class or category	the Sturt desert pea the 1990s the principal most of the questionnaires; none of the answers the dollar; the pound the water needed to maintain their gardens
The Indefinite Article	a measurement or rate the first mention of a singular noun a singular measurement someone's job	
Zero Article		mud; water life; fish this mud; these conditions; their water usage; most researchers; this point Difficulties; water dwellers; Australians

Definitions can take a definite or an indefinite article:

The library is a place where you can find books. (Here, *library* means the entire class of places called *libraries*, not a specific library.) **A** library is a place where you can find books. (Here, *library* represents a class.)



APPENDIX 4: ANSWERS

Text 1

Your answers to this exercise will vary according to whether you have interpreted the passage as referring to a non-specific library (any library anywhere) or a specific library (such as the one you are in).

- a) **the** singular, countable noun; definite and unique; a category
a singular, countable noun; not definite (any catalogue is important)
- b) **the** singular, countable noun; definite and unique
a singular, countable noun; not definite (one of several keys)
- c) **a** singular, countable noun; not definite (we do not know which library, and it does not matter)
the singular, countable noun; the entire class of libraries
- d) **0** singular, uncountable noun; not definite
- e) **the** singular, countable noun; already referred to in the passage
a singular, countable noun; not definite (any library)
- f) **the** plural, countable noun; defined in the phrase (ie which details? The details you need...)
- g) **0** plural, countable noun; not definite or specific
the plural, countable noun; (the libraries in Australia and NZ)
- h) **the** singular, countable noun; definite (refers to one library building)
a singular, countable noun; indefinite (the library may have several buildings, but it is not important which one is referred to here)
- i) **a** singular, countable noun; not definite, not mentioned before
the singular, countable noun; (the advantage is distinct, and therefore unique)
- j) **the** singular, countable noun; already referred to in the passage
a singular, countable noun; (any catalogue)
- k) **a** singular, countable noun; not definite (could be any kind of PC)
- l) **a** singular, countable noun; not definite (could be any kind of modem)
- m) **the** singular, countable noun; acting as a whole category
- n) **the** singular, countable noun; definite; superlative
- o) **a** singular, countable noun; not definite, not mentioned before

Text 2

The Harvard referencing system has two essential components: brief in-text references noted throughout your work and **a** comprehensive list of references at **the** end of **the** work. **The** in-text reference gives **the** date it was published, **the** family name of **the** author and **the** page where **the** information can be found.

Vocational education and training in Australian schools: Issues for practitioners

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Originally a series of local initiatives, Vocational Education and Training (VET) in Schools is now largely driven by policy makers and politicians who, too frequently, fail to appreciate the challenges the reform poses to teachers, school managers and workplace coordinators. Research has identified perceptions of poor quality in training, difficulties in curriculum development, assessment and accreditation, lack of opportunities for workplace learning, inadequate delivery methodologies, sometimes profound cultural incompatibilities and resourcing issues as barriers to successful implementation. Recent research has clarified many of these issues and provided some pointers to their resolution. These challenges should not detract from the positive achievements of VET in Schools that include a range of benefits to students of a personal and vocational nature as well as a broader impact on school culture.

Vocational education and training (VET) in schools, Technical and vocational education and training (TVET), work based education, education policy, curriculum

INTRODUCTION

The most significant curricular and program innovation in Australian schools in the last quarter of the twentieth century has been the development and expansion of vocational education in schools. Initially a scattered initiative of individual schools to support students uninterested in higher education entry, Australia's experience of difficult economic circumstances in the late 1980s, involving the substantial collapse of the full time youth labour market, led managers of education systems at state and federal levels, and even more enthusiastically political leaders, to adopt vocational learning as the principal policy instrument for facilitating the transfer of youth from schooling to adult economic and social roles.

Similar pressures led to parallel responses in many countries, especially in Europe and North America, but in most cases governments in those jurisdictions were more cautious when introducing vocational programs in schools, more wary of replacing the broader goals of schooling with a narrow instrumental vision, and more concerned to develop bridges between vocational and general or academic education (Ryan, 1999; Stern, 1999).

In Australia, policymakers' enthusiasm, expressed through a range of institutional encouragements and special funding initiatives, led to a vigorous expansion of programs and participants. There are difficulties in collating data on VET in Schools, including a diversity of definitions vocational learning programs, but numbers in courses within the criteria of the Federal-State Ministerial Council on Employment, Education, Training and Youth Affairs' Framework rose from 60,000 in 1996 to 170,000 in 2001 (ANTA, 2002). The National Centre for Vocational Education Research (NCVER) identified 202,900 VET in Schools students in 2003 (NCVER, 2004).

From the mid-1990s to 2003, the cohort involved in VET in Schools programs increased from 16 per cent of the age group to 44 per cent (ANTA 2002, MCEETYA, 2003). School-based New Apprenticeships, that entailed a contract of employment with a workplace, have experienced more limited and geographically uneven growth, rising from 1500 students in 1998 to 7390 in 2002 (MCEETYA, 2003). Numbers grew strongly the following year, to 12,300, mostly (76 per cent) at sub-trade level, 40 per cent in retail traineeships (NCVER, 2004).

The present participation rate for VET in Schools of around the mid-40s per cent seems to have formed a plateau, but during the November 2004 election campaign the Federal Government announced a scheme of federally supported Technical Colleges which, it was claimed, would attract more students and redress a national shortage of trade skills.

The impressive growth in vocational learning programs has led Australian education systems to face many of the same issues as their European and North American counterparts. The initial urge was to secure large numbers of enrolments in vocational programs of almost any description, and concerns that these programs were too industry and skill specific for school students were dismissed by some authorities (Australian National Training Authority, ANTA Ministerial Council, 1998, p.1). Subsequently, there has been a growing acceptance of the European position that school pathways ideally should lead both to tertiary education entry and to employment (Durand-Drouhin et al., 1998; OECD, 2000).

Moreover, it has increasingly become clear that employers seek generalist more than vocational skills in potential employees, and that training in job specific skills is misplaced when:

...report after report tells us that what employers value most in young people are the individual-focused, not the industry- skills focused qualities. Interpersonal skills, communication skills, problem solving abilities, independence, initiative, punctuality, work ethic, teamwork skills, personal pride, courtesy – these are the traits that employers consistently indicate that they hope to have developed in schools. (Smith, 2000, p.7)

As a result, much of the evolution of VET in Schools since the mid-1990s has occurred as educators and policy makers have tried to develop bridges between vocational and general education (Barnett and Ryan, 2005). However, while policy makers and system-level managers have accepted the need for greater integration of vocational and general education (Polesel, 2001, p.327), there seems to have been little awareness at central level of the problems caused to VET in School practitioners (teachers, school managers, work experience coordinators and employer liaison personnel) by the rapid expansion of programs, the shifting emphasis from utilitarian to broader educational objectives, the ever more complex assessment and certification criteria, or the deepening demands on school infrastructure and professional development.

Adding to practitioner concerns, system managers have come to the conclusion that, since VET in Schools should now be treated as a mainstream program, special funding regimes, and supporting agencies, such as the Enterprise and Career Education Foundation (ECEP, which had provided valuable assistance in supporting the workplace learning components of VET in Schools and in building the cross-sector relationships that underpin it), are no longer needed (Barnett and Ryan, 2005).

Issues for Practitioners

Many of these changes take effect from the start of the 2005 school year, with the consequence that practitioners, who have for some time expressed alarm that the needs of teachers and coordinators in the field have been consistently overlooked (Currie and McCollow, 2002), must now deal with an expanding and changing program with notably diminished support. Although there has been a significant expansion in the research effort and knowledge base underpinning

VET in Schools initiatives since the NCVET first commissioned a review of research in 1997 (Ryan, 1997; Barnett and Ryan, 2005), too little attention has been paid by policy makers to the issues that face practitioners. This is in marked contrast to the intellectual effort devoted to central system issues, such as the need to reconcile and integrate conflicting assessment machinery and recognition protocols which apply to VET modules (assessed against industry standards) compared to senior school programs (assessed by more traditional academic criteria).

The NCVET over recent years has commissioned a suite of research activities into VET in Schools including an up-date of the 1997 review, supported by an interview program involving state VET in Schools managers. In the course of this research the problems facing practitioners emerged as a significant element in, and potential barrier to, the sustainability of vocational learning in schools as currently envisaged. The purpose of this paper is to outline and clarify those challenges, to indicate where research evidence provides direction for their resolution, and to highlight areas where concerns remain unsatisfied.

The paper outlines these practitioner concerns and practical challenges under the following headings:

- Perceptions of inferior quality,
- Issues in curriculum, assessment and certification,
- Approaches to workplace learning,
- Delivery,
- Cultural differences and partnering challenges, and
- Resourcing vocational learning.

QUALITY

A recurring feature of VET in Schools programs has been that the quality of the learning experience both in schools and in job placements has been questioned, often in ways that revealed a depth of mistrust and cultural difference between the parties, especially between school educators and industry representatives, but also within education (Barnett and Ryan, 2005).

Schools may deliver vocational subjects of their own devising if they fit within the curriculum and assessment frameworks determined by the state certification bodies, commonly known as Boards of Studies. However, there is strong pressure for vocational modules to receive not merely secondary schooling certification but also recognition on the same basis as adult vocational training. In order to achieve this, schools must either achieve acceptance as Registered Training Organisations (RTOs), eligible to provide training meeting the industry-backed standards of the Australian Quality Training Framework (AQTF), or combine with existing RTOs, either those in the private or community sectors, or the RTOs managed by State Governments, the Technical and Further Education (TAFE) Institutes.

In practice, certification of school vocational subjects to the industry standards purportedly guaranteed by the AQTF is often insufficient to convince employers about the standard achieved. It is not difficult to list industry complaints about the quality of learning outcomes from VET in Schools programs (see, for example, Currie and McCollow, 2002, pp.54-56). Similar sentiments have been expressed to the House of Representatives Inquiry into VET in Schools (for example, HIA, 2002; VACC, 2002). Essentially the industry view is that, "few schools have adequate staff, experience and facilities to deliver vocational programs to the level required in the standards" (VACC, 2002, p.5).

TAFE Directors have argued that schools were frequently unable to maintain the integrity of training quality systems and credibility with industry (TDA, 2002, pp.3-4), while Group Training

Organisations were dismissive of training achieved through institutional pathways, whether school or TAFE (GTA, 2002, p.7).

Despite substantial evidence that industry perceived significant quality problems in school delivered VET, the major finding of an investigation conducted by the Australian National Training Agency (ANTA) National Training Quality Council in February 2002 was that schools registered as RTOs were generally compliant with the AQTF (DEST, 2002). However, some of the responses made during the consultation phase of the investigation indicated potential problems for some schools in attempting to comply with the AQTF (ANTA, 2002). The Australian Industry Group, surveying its members for the House of Representatives Inquiry into VET in Schools, noted complaints about schools' attempts to deliver training package outcomes while failing to produce adequate achievement in general education, above all mathematics capability (Ghost, 2002). Moreover, they felt that schools should focus on future skill needs of the economy rather than following current labour market requirements.

An approach to VET in Schools that has a focus on generic work skills, may deliver more appropriate outcomes for industry into the future. A recent paper by the Australian Industry Group on skill needs for emerging technologies determined that significant skill sets required for employment in emerging industries do not yet exist, and consequently the generic skills and knowledge that underpin the capacity to efficiently and effectively embrace new technology skill sets are critical to the success of new industry in Australia. (Ghost, 2002, pp.62-63)

On the other hand, there are serious concerns about the quality of learning in the workplace, which is frequently a required and always a desirable element of VET in Schools. Some of this concern focuses on assessment practices, which are claimed to be superficial and mechanical. However, a larger issue is the lack of clarity and agreement on the purposes of work placements. Malley and collaborators reported that their case studies showed that while placement aims were generally met at the lower end of the skills continuum, policy assumed that placements should also provide for the upper end. Yet there was little evidence of extensive formal learning occurring only in the workplace (Malley et al., 2001a).

ANTA's response to quality issues in VET In Schools has been to propose more rigorous adherence to AQTF requirements (ANTA, 2002), but this assumed that the needs of school aged students did not differ from the vocational outcomes sought by young and older adult students already embarked on specific career training. As Currie and McCollow argue

VET in Schools is about such things as increasing student knowledge, motivation, self-esteem and self-awareness as well as providing specific employment related competencies. Valid judgement about the quality of VET in Schools programs would need to consider and weigh up the sometimes competing claims of the various agendas that are driving it. (Currie and McCollow, 2002, p.57)

Despite the considerable questioning of school capacity, the major national study of Quality in VET in Schools (KPA Consulting, 2004) found no evidence of lower or different standards in schools than for other RTOs, but noted that the difference in delivery and registration models created a confusing and complex picture.

ISSUES IN CURRICULUM, ASSESSMENT AND CERTIFICATION

Curriculum Design and Development

As the comment of the Australian Industry Group implied, too often discussions of VET in Schools spoke of quality in terms of industry specifications; it was useful that an industry body should emphasise that the quality of the student experience should be paramount. This

encompassed the whole educational experience, beginning with curriculum design and development and culminating in assessment, ranking and certification.

The evolution of curricula for vocational learning has resulted from the interplay of sometimes conflicting forces. Vocational learning innovations were originally largely local initiatives, sometimes facilitated by external catalysts such as the Dusseldorp Foundation. As vocational subjects gained in importance and popularity, however, it became necessary for them to be redeveloped in standard forms to ensure recognition in secondary credentialling systems, and sometimes to secure funding support. This development put at risk the spontaneity and experimentation which had been a strength of early programs (Ryan, 2002).

Although the intervention of State and Territory Boards of Studies promoted the standardisation of VET programs to some extent, from a national perspective great diversity remained, implying significantly different approaches in the purpose of VET in Schools around Australia. Differences were evident in:

- the number of modules available to students, with implications for the amount of credit transfer possible;
- variations in the extent to which the subject was seen as standard or additional; and
- whether the subject was listed on the secondary credential.

In 1998 the Federal-State Ministerial Council on Employment, Education and Youth Affairs (MCEETYA) agreed to involve the Australian Curriculum Assessment and Certification Authority (ACACA) in developing a national approach to the implementation of VET in Schools. The National Framework was the eventual outcome, along with a range of support resources (Malley et al., 2001a).

Despite benefits, the nationally consistent approach is not without its drawbacks. There is a risk that programs developed by individual schools, which are not designed to meet the standards of the Australian Qualifications Framework (AQF), but which do meet the identified needs of their students, can be stifled. Students who have benefited from the blurring of boundaries between VET and other school programs, such as community based learning, may be disadvantaged.

A further difficulty may arise in the case of academically less able students. While there remains an attitude in many schools that VET in Schools is best suited to the least academic (NWG, 2001, Part 4) it is in fact far from clear that vocational education best suits their learning style and educational needs. The Kirby report on senior secondary education in Victoria noted that VET in Schools might not be a good answer for many students with low educational achievement (Kirby, 2000).

Moreover, indefinitely expanding school options is not necessarily an enhancement of student opportunity. A strong body of evidence indicates that school subject choice is crucial for later life employment experience and that critical choices involve **academic** subjects, especially mathematics (Ball and Lamb, 1999; NCVER, 2000). Expanding the range of subjects available to school students may not enhance options if they do not lead to later study (NCVER, 2000).

Assessment, Tertiary Selection and Secondary Certification

According to the Ministerial Council [MCEETYA] National Working Group on the Recognition of VET in Schools:

All states and territories would claim that at least some VET in Schools programs contribute, in one way or another, to [their] tertiary admissions index. Most commonly, however, this occurs when the competencies are embedded in senior secondary certificate subjects that, in turn, count towards the calculation of the index. (NWG, 2001, p.13)

There are also arrangements in some states and territories that permit stand-alone VET courses to be included in the index, using graded (rather than competency-based) assessment as an option. Additionally, there are approaches that avoid the issue by employing alternative university admission schemes.

The National Working Group has undertaken considerable work on technical issues in developing graded assessments within competency assessed subjects. However, the issues involved are more than technical and it lists the following barriers:

- The difficulty of aligning statements of competency to the outcomes of university courses or other senior secondary subjects. This may reinforce the perceived incompatibility between the content of vocational education courses and university subjects and may contribute to inadequate recognition of student achievement.
- Perceptions about narrowness and lack of depth of knowledge and understanding in vocational courses.
- A desire to judge vocational courses on a terminology of equivalence rather than recognition of distinct value as another kind of education (NWG, 2001, pp.14-15).

At the school level, difficulties with the two systems of assessment persist. Not infrequently, students achieve successful assessments in the senior secondary qualification while not achieving competency in the AQTF assessment and vice versa (Spark, 1998; Currie and McCollow, 2002).

There are concerns also about the validity of workplace competency assessments. Most students undertake placements in workplaces lacking qualified and experienced assessors, with competencies being merely ticked off (Spark, 1998; Malley et al., 2001a). Employers complain that logbooks are complex, bureaucratic and time consuming (Malley et al., 2001a).

The National Working Group pointed to dilemmas in approaches to the inclusion of VET in university selection calculations. The embedding model, in which VET modules were contained within school subjects, tended to downplay the significance of the VET component. On the other hand, not all stand alone VET In Schools subjects counted for selection purposes. ANTA and the NSW Board of Vocational Education and Training have provided funding for further research on these issues (DEST, 2002).

Workplace Learning

School students place most value on vocational education that provides real workplace experience. However, this is not easily provided and the typical VET experience is school-based, albeit structured to achieve AQF competency-based requirements, with a small or simulated workplace component. The research evidence is clear that real work experience is the ideal means of incorporating vocational goals into school programs, enabling a transfer of specific learning to generalised competencies, and placing them in a broader educational framework. However, this rarely occurs in Australia (Ryan, 2002, pp.4-5). About half of VET in Schools enrolments are in subjects that are easily developed from traditional school curricula, for example, hospitality, office studies, information technology (Malley et al., 2001b).

The trade-off between depth and breadth in workplace experience continues to lean to breadth, with data showing increasing use of workplace training, but with a reduced number of hours involved; the most common experience is five days (Fullarton, 1998). About 40 per cent of VET in Schools programs have no workplace experience at all (Ryan, 2002). Although the number of VET in Schools programs entailing participation in workplace learning has been rising (DEST, 2002, p.58), average exposure is well short of ideal. Where it is included, work placement is more likely to be associated with general work experience than with structured workplace training and

assessment, that is, a planned work-based learning program associated with identified units of competency (KPA Consulting, 2004, p.59).

There is a shortfall of willing employers able to provide workplace placements. Unless significant changes are introduced, there are likely to be only marginal increases in the number of workplaces providing structured work placements (Malley et al., 2001b). The abolition of the Enterprise and Career Education Foundation will exacerbate this problem.

At a deeper level, there is a lack of appreciation of the real potential of workplace education, which is not excessively concerned with the gaining of specific workplace skills. Research supports the value of learning at and from work, not simply for vocational skills but for its contribution to general education (Ryan, 1997; Ryan, 2002). This research indicates that learning about abstract thought and symbolic manipulation follows from teaching meaningful practical content, and that work-based problem solving involves a combination of social, technological, material and symbolic resources (Sweet, 1993).

Current United States practice, for example, is based on using work-based learning as an integrating factor between vocational and academic pathways. Work-based learning ideally involves authenticity, academic rigour, applied learning, active explorations, adult connections and appropriate assessment practices as much suited to the academically talented as to those with vocational interests (Stern, 1999).

Culture and Partnering

The 1997 NCVER review commented that:

more important than the costs and logistical difficulties are the sometimes profound incompatibility between school and work cultures. Sometimes this emerges in practical matters like timetabling and organisation but also reflects fundamentally different outlooks on society and the position of the individual. (Ryan, 1997, pp.17-18)

The evidence from the literature suggests that cultural barriers remain between educators and employers and within schools but are diminishing as an issue. Earlier research found that many school VET programs were of low status and seen as a soft option. Where VET students undertake discrete courses and are segregated from other students, VET is sometimes marginalised (Spark, 1998). Currie and McCollow (2002) report complaints from academic teachers about timetabling problems and the funding requirements of additional professional development for VET teachers. Case studies indicate that academic teachers sometimes believe that students' broader education is disrupted (Green and Boylan, 2001).

Beyond these issues, many teachers remain unconvinced about the educational value of VET programs (Currie and McCollow, 2002) and some VET teachers complain of lack of support from principals or the school generally (Polesel et al., 2004). However, a recent study reported significant change in cultural attitudes within schools. The study was designed to investigate the place of VET in school policy and culture and sought information from 12 schools and six TAFE Institutes in three Eastern states. The data represented the views of more than 300 teachers, 1100 Year 11, and 400 exit Year 12 students. There was a majority perception that -

...VET plays an essential role in making the curriculum inclusive of a broader range of needs. VET was also viewed as a useful means of improving learning, giving many students a chance of success at school, some for the first time. (Polesel et al., 2004, p.7)

The study also found that cultural barriers, although they existed as outlined here, were less important to growth of VET programs than issues involving resources, the provision of infrastructure and training and the costs of delivering VET. While students were found less likely

to enrol in VET when they had university-oriented goals, negative perceptions of VET were given relatively little importance (Polesel et al., 2004, p.11).

Delivery

Delivering VET in Schools programs places unusual burdens on schools, their teachers and their students, because it entails working in environments – of adult learning with workplace disciplines and expectations – which are far from the normal experience of schools and their personnel. A simple example is timetabling, which features quite disproportionately in discussions about the practicalities of delivering VET programs. Lack of flexibility in school timetables is one of the most frequently identified problems in the field (Watson, 2000; Jung, et al., 2004; Barnett and Ryan, 2005).

Intended learning in VET is not specified in traditional curriculum or subject outlines, but in terms of Training Packages, which specify industry relevant outcomes to be achieved. Schools face particular challenges relating to flexibility and responsiveness in delivering Training Packages. Training Packages are reviewed and redeveloped every three years: schools find it difficult to adjust curriculum so quickly, to retrain teachers and develop new syllabuses (Barnett and Ryan, 2005).

Insufficient time allocated for practical training is a concern expressed by TAFE lecturers, school teachers and VET coordinators (Jung, et al., 2004, p.63), while in rural areas, there are concerns expressed about the time and distance involved in students participating in VET programs outside of the school (NCVER, 2000; Watson, 2000; Jung, et al., 2004).

Contentious issues which arise between schools and TAFE Institutes are not merely cultural but relate also to student learning. Because schools frequently prefer to deliver programs at least in part through registered training organisations, especially TAFE, or under auspicing arrangements with RTOs, rather than undertaking the expensive and convoluted audit processes entailed in registering as an RTO, it is necessary for school students to fit in to the climate of TAFE Institutes. This is often difficult.

- School students frequently are not able to work in an adult learning environment, as exists with TAFE (Jung, et al., 2004, p.66).
- Students often lack the numeracy and literacy skills required by TAFE providers (Jung, et al., 2004, pp.9-10).
- Students often lack the study skills and work habits needed to participate effectively in TAFE (Jung, et al., 2004, pp.9-10).
- TAFE staff question their capacity to meet the needs of younger students (Polesel et al., 2004).
- Partnering requires an input of time in building relationships and in ongoing liaising, and all this adds to time loads (Polesel et al., 2004).

Schools also face burdens in arranging for the work experience components of programs. Schools are dependent on the goodwill of local employers to provide work placements and on workplace supervisors to provide time and attention to students (Jung, et al., 2004, p.70). Therefore, partnering is of crucial significance to the success of VET programs in schools.

Resourcing Vocational Learning

The 1997 NCVER review noted the lack of systematic and detailed analysis of the resource implications of VET in Schools (Ryan, 1997) and this has remained true, although the Commonwealth has analytic work underway to assess the costs of VET programs in schools (DEST, 2003). Schools with VET programs needed to employ program coordinators, provide

professional development for teachers, develop learning materials and purchase services from TAFE or other RTOs, leading to considerable costs to schools (Schools Council, 1994). Many schools passed on costs to parents, especially where training was provided by TAFE or another non-school RTO; these fees have been as high as \$2 000 (Currie and McCollow, 2002, p.63). Research by Polesel et al. (2004) identified fees as a key barrier to student participation in school VET programs. There seems little doubt that VET in Schools is resource intensive and that this is a constraining factor throughout the life of VET programs.

Often, State or Federal Government assistance is given as start-up or seed funding, which seldom covers the full cost of programs and will end before the program does. It is clear that there are shortfalls between numbers of students funded by state sources and those actually participating (Malley et al., 2001a). There are restrictions by funding agencies on the use of funds for capital purposes, although this may be needed to meet industry standards (Spark, 1998; Keating et al., 1998).

MCEETYA has accepted that VET in Schools is more expensive than general education and surveys of schools show that most school managers and teachers believe that, if ANTA funding ceased as planned, States would not be able to provide the resources needed for a sustainable program (Currie and McCollow, 2002). The issue was clouded by insistence from some State and Federal Government funding agencies that VET in Schools should be no more costly than mainstream school programs, but this seemed to refer to simpler activities which were essentially renamings of traditional subjects. According to the DEST commissioned research, these simpler modules were cost neutral or entail a loading of no more than 1.01 or 1.02. Where additional support is provided, cost loading estimates rose as hours were purchased from providers and Structured Workplace Learning was added, to a 1.06 to 1.08 loading (DEST, 2003, Table 19, p.122).

Interviews reported in the recent NCVET research identified concerns among system managers that vocational education cost more than general education, and that this was not acknowledged in current funding models (Barnett and Ryan, 2005). Those interviewed expressed mixed views about the planned termination of ANTA seed funding, with some jurisdictions seeing this as a major issue while others took the opposite view, pointing out that States and Territories were already making substantial funding contributions to VET In Schools.

Other research continued to highlight the cost differences between VET in Schools and orthodox curricula, noting the following problems:

- the shortage of adequately trained teachers ;
- additional workloads associated with VET teaching – for example, increased paperwork, liaising with employers and TAFE;
- costs associated with training teachers to meet AQTF compliance – including time release for industrial experience;
- providing adequate facilities for delivering VET within the school;
- the costs of purchasing RTO services; and
- fees charged to students act as a barrier to participation (Polesel et al., 2004).

While many of the costs incurred in maintaining VET in School programs were measured in dollar terms, as the 1997 NCVET review pointed out it was important to bear in mind that the primary resource required was human:

The burdens placed on individual employers and teachers and school administrators by work-related education are considerable and may limit the extent to which initiatives

can be applied...The fundamental resource issue, therefore, is the continued readiness of both employers and teachers to participate in learning partnerships. (Ryan, 1997, p.18)

RESPONDING TO THE CHALLENGES

Despite the enormous range and significance of the challenges involved, the increased uptake of VET programs in schools suggests that their benefits outweigh the difficulties. Systems across Australia have taken up this challenge, developing a range of structural reforms designed to create smoother links between the education and training sectors and expand the range of learning opportunities for students (Barnett and Ryan, 2005). Increasingly, systems are meeting the need to respond not only to national training packages and university entrance criteria, but are also providing for locally designed courses that retain these benefits. Many jurisdictions have made changes that move away from centralised to local delivery of VET programs (Barnett and Ryan, 2005).

Benefits to Students

Schools and state systems persist with VET in Schools programs, not only because of their politically appealing character, but because of real if not unqualified benefits to students, benefits which recent research has increasingly been able to identify and in many cases quantify.

One early study, reporting on students who were in Years 11 and 12 in 1991-93, found that vocational students were less likely to go to university than non-vocational classmates (Malley et al., 2001a), but a number of later investigations have suggested that school VET provided an effective pathway to later study, with higher proportions of school VET students continuing on to post-school VET studies (Ball and Lamb, 1999; Fullarton, 2001).

Promising results have come from five years' destination data involving Victorian VET In Schools graduates:

In broad terms, over half of the leaving cohort are consistently going on to further study either at a university or a TAFE institute, with the majority of these students choosing to continue their schooling at TAFE....Labour market transitions, too, have been effective, with high rates of transition to full-time employment, and apprenticeships and traineeships. (Polesel, 2001, p.331)

Of the total 1998 Year 12 cohort:

- 28 per cent entered post-school VET,
- 22 per cent university,
- 18 per cent New Apprenticeships,
- 14 per cent were in full -time work,
- 7 per cent were in part-time work,
- 4 per cent returned to school,
- 6 per cent were unemployed. (Polesel, 2001, p.332)

Polesel noted that, controlling for achievement, the relative outcomes for the VET group were more impressive, with a greater transfer to further study for academically weak students than for their non-VET in Schools counterparts. On the other hand, academically stronger VET in Schools students were less likely to transfer to university, but more likely to undertake further study in TAFE (Polesel, 2001, p.332). It was noted that an increasing proportion of VET in Schools graduates were enrolling at university, with 80 per cent reporting that they were coping well (NWG, 2001, p.30).

Small scale studies of specific groups have shown mixed results for rural students (Bell, Kilpatrick and Kilpatrick, 2001; NCVER, 2002) while private school students, in a small pilot study, reported little influence from their VET experience (Lambert and Stahlik, 2002). Outcomes for indigenous students were insufficiently reported but there were some small scale successes (for example, Bennett and Edwards, 2002) and the opportunities provided have been praised by advocacy bodies (ACACA, 2002). There have also been promising outcomes from small scale programs for the disabled (Barnett, 2002).

Studies of employment outcomes indicated that school VET programs were associated with higher employment levels (Johns et al., 2004), particularly full time employment (Fullarton, 2001), and the link between school VET and employment has been found to increase beyond the first year after leaving school (Johns et al., 2004, p.11). Work placements have been associated with positive employment outcomes (ECEP, 2002a).

A range of studies show that benefits to students abound in relation to confidence, maturity, independence, improved motivation and reduced absenteeism (Malley et al., 2001a, 2001b; Barnett and Ryan, 2005).

A major study by Polesel et al. (2004) identified a range of benefits and an increasing legitimization associated with school VET programs. Their findings were based on the views of over 300 teachers, 1100 Year 11 and 400 Year 12 exit students in three Australian States:

For most [teachers], VET plays an essential role in managing diversity, in improving learning and in securing a range of good outcomes for school leavers.... Among students too, VET is seen as providing opportunities and pathways which are essential.... The feedback from TAFE staff seems to confirm these views. There is an acknowledgment that schools and students are beginning to view VET (and consequently TAFE itself) in a more favourable light. (Polesel et al., 2004, p.12)

VET was regarded as playing an essential role in improving learning, and making the curriculum more inclusive. Teachers were generally very positive about the role and effectiveness of VET programs, and many saw a particular value for students who were interested in technology or business and for students with only average academic ability. Moreover, VET school programs were receiving increasing recognition for their equity benefits (Polesel et al., 2004).

Teachers valued work placement for its role in increasing student self-confidence, and endorsed the creation of linkages between schools and TAFE and employers (Polesel et al., 2004). Students regarded school VET programs as providing the opportunity to widen career options, to obtain valuable workplace experience and to obtain a VET qualification. More than half enrolled to enhance access to part time work. Work placement was seen as increasing their self-confidence, and contributing to more general learning, while facilitating entry to future employment (Teese et al., 1997; KPA Consulting: 2004; Polesel et al., 2004).

Meeting The Challenges

In order to ensure that VET in Schools programs were sustained and able to build on these successes, it was important that policy makers continued to respond with adequate administrative and resource support. However, it was also vital that practitioners committed to continuous improvement. For example, there was a need for better collaboration between the VET/TAFE and school sectors to avoid duplication of resources (Polesel et al., 2004).

A vital issue was the resolution of timetabling issues. The integration of VET programs into mainstream school programs should enable timetabling to be aligned with the main timetable, avoiding the need for students and teachers to attend during school holidays, and to be more responsive to employer needs:

Unless schools are prepared to restructure school timetables so that VET studies and workplace training become mainstream programs, and schedules do not preclude students from also participating fully in their other general study programs, then students who undertake VET programs will continue to be penalised....Moreover, if [they] have experienced difficulties in the past with academic programs, then it seems unreasonable and naïve to expect that they have the capacity, maturity, motivation and time-management skills to be able to juggle three different sets of time commitments. (Jung, et al., 2004, p.70)

There was a need for schools to develop partnerships with training providers who had the expertise and experience to deliver VET programs which they lacked, or where they lacked the necessary resources, curriculum materials and equipment (Jung, et al., 2004, p.64). At system level, there was a need to free curricula from the narrow constraints of training packages, that is to supplement the current range of training package qualifications with additional more broadly based qualifications that are designed specifically for young people who have not yet entered the workforce to enter the workforce (rather than for those already in the workforce), and to develop this collaboratively between school and VET system accreditation authorities (KPA Consulting, 2004, p.61).

There was also a need for special attention to school-based New Apprenticeships (SBNAs), especially as the new federal Technical Colleges were rolled out. At present, SBNAs are among the less successful VET in Schools programs. Studies of school-based New Apprenticeships have indicated that the work experience of SBNA students was little different from that of other students (NCVER, 2002). Overall, a national evaluation of SBNAs indicated that outcomes were more varied than might be expected and that employment was not necessarily the next step for all young people. As the evaluation noted, however, data were at present very inadequate (Smith and Wilson, 2002).

One important reform was to extend the time available for students in SBNAs to participate in off-the-job training, (Jung, et al., 2004, p.63). Formalisation of articulation and credit transfer arrangements between schools and further training institutions was seen as an effective strategy for ensuring that SBNAs led smoothly into post-school apprenticeships and traineeship pathways and should be further developed (Jung, et al., 2004 p.64).

More Comprehensive Reform

While the research indicated a substantial action list for policy makers and practitioners, the need for much practical activity should not distract from the possibility of using the growth of VET in Schools for more comprehensive school reform. Malley and collaborators claimed that there was no evidence that VET in Schools programs have assisted the major objective of encouraging increased school retention rather than providing a wider range of options for continuing students (Malley et al., 2001a). While this has been disputed, it would seem clear that to move beyond the present plateau would require more comprehensive reform to institutional form and structures as well as to curriculum and programs (Selby-Smith, 2002, p.28).

Many young people found their school environments stifling and lacking in enjoyment (Slade and Trent, 2000). Teese found that a third of lower achieving boys see school as a prison, a place of negative confinement (Teese, 2000, p.5). A successful VET in Schools program might exacerbate rather than assuage these negative feelings, as one of the most consistent findings from the research was the pleasure students find from being treated as adults in their work experience and the contrast they made with their school environments (Smith and Green, 2001). As Wiltshire has commented:

The reasons for the popularity of VET in Schools are not hard to find. They are closely related to the malaise which has struck young people all over the world over the past two decades. They are looking for relevance, hope and meaning. (Wiltshire 1999, p.26)

One suggestion for dealing with this angst is the further development of senior colleges, in which VET in Schools is a normal part of the experience. Related to this is the need to end the frequent marginalisation of VET in Schools programs by making it clear that there are challenging options available for all student ability levels and designing curricula and programs to this end. The experience of the United States is a useful model. There, the 1917 Hughes Act had established vocational education as a separate stream. In 1994 the new School to Work Opportunities Act reversed almost 80 years of practice, in large measure because of complaints from employers that vocational graduates lacked the academic knowledge and thinking skills needed to participate in the newly emerging economy, characterised by constant change. The idea of the new Act is to move beyond vocational pathways to career majors available to all students, including the academically talented (Stern, 1999).

Finally, there is the option of the Full Service School. Although the term is less commonly employed in Australia than in the United States, there are suggestions in the literature that vocational learning programs need to be accompanied by a repertoire of wider student services. During 1999 and 2000, the then Department of Employment Training and Youth Affairs (DETYA) implemented the 'Full Service Schools' project (FSS). This aimed to encourage young people under 18 years of age to return to or remain at school until the end of Year 12 so that successful transition to further education, training or employment could be facilitated. National evaluation of the program (DETYA, 2001) found that it had made a significant impact on young people said to be at risk, with key success factors being school-community relationships, developing a culture of innovation and enterprise, flexibility in curriculum design and delivery and the quality of student-teacher relationships.

Reviewing a number of case studies, the Enterprise and Career Education Foundation (ECEF) argued for drawing together a range of services in local partnership arrangements. These would include programs linked to the labour market, enterprise education programs and entrepreneurial activities, career guidance, counselling and advice services, the placement of teachers in industry and the training of industry personnel to deliver their aspects of programs, vocational learning activities, career and transition management support designed and driven by local partnerships (ECEF, 2002b, p.50).

Spring and Syrmas (2002) also saw the provision of student support services, especially comprehensive career advice linked to job opportunities supported by IT systems, as integral to the further development of vocational learning in schools. Special attention to broader service availability might be required in rural or remote areas. The National Council of Independent Schools' Associations (NCISA), reflecting the experience of its members' schools, argued that future development of VET In Schools would require

... much greater collaboration between government and non-government agencies across a range of portfolios (education and training, health, welfare, community services etc) that provide services to young people. NCISA considers that access to these support services should be considered an entitlement for students requiring these services, regardless of the school sector attended. (NCISA, 2002, p.i)

CONCLUSION

As the VET in Schools innovation has grown, so has the supporting knowledge base derived from research. This has allowed for the evolution of more evidence-based policy and some practical concerns, especially in certification and recognition, have received intensive attention. Overall,

though, the concerns of practitioners in the field have received inadequate attention even while questions of sustainability have become more pronounced.

The expanded knowledge base has lessons for practice as well as policy, but it is not clear that assistance to practitioners is yet a major goal of system managers. VET in Schools modules are here to stay, but one form in which they may survive is through only slight modifications to traditional school subjects, taught within the cost constraints of mainstream subjects, with minimal exposure to the real world of work and certainly without the structured workplace learning opportunities which are potentially the program's greatest strength.

This would be a pity. Work is fundamental to human experience, to cultures and societies as well as to economies. VET in Schools provides an opening to bring that key well-spring of human creativity into the educational experience of young people. It should be available in as great a diversity as can be managed to all students, the academically able as much as those who need alternative options.

REFERENCES

- ACACA (Australasian Committee of Chief Executive Officers of Curriculum, Assessment and Certification Authorities) (2002) *Submission to the House of Representatives Standing Committee Inquiry into Vocational Education in Schools*. Canberra: Parliament of Australia.
- ANTA (Australian National Training Authority) (2002) *Submission to the House of Representatives Standing Committee Inquiry into Vocational Education in Schools*. Brisbane: Australian National Training Authority.
- ANTA Ministerial Council (1998) *Principles and framework for new apprenticeships for school students*. Brisbane: Australian National Training Authority.
- Ball, K. and Lamb, S. (1999) *Curriculum and Careers: the education and labour market consequences of year 12 subject choice*, LSAY Research Report no.12. Melbourne: Australian Council for Educational Research.
- Barnett, K. (2002) *Creating Viable Pathways to Vocational Education and Employment for Students with a Disability: the ECEF Lighthouse Initiative Evaluation Report*. Sydney: Enterprise Career Education Foundation. [Online] www.ecef.com.au
- Barnett, K. and Ryan, R.J. (2005, in press) *Lessons and Challenges: Vocational Education in Schools: Research Overview*. Adelaide: National Centre for Vocational Education Research.
- Bennett, A. and Edwards, H. (2002) VET on the Airwaves over South Australia. *Vocal*, 4.
- Currie, W. and McCollow, J. (2002) *Vocational Education and Training in Public Schools: Enhancing Student Career Options*. Sydney: Australian Education Union.
- DEST (Department of Education, Science and Training) (2002) *Submission to the House of Representatives Standing Committee Inquiry into Vocational Education in Schools*. Canberra: DEST.
- DEST (Department of Education, Science and Training) (2003) *The Cost of VET in Schools: An Analysis of the Costs of Delivering VET in Schools including an Analysis of Cost Efficiencies*. Final Report, June 2003. Canberra: DEST.
- DETYA (Department of Education, Training and Youth Affairs) (2001) *National Evaluation Report: Full Service Schools Program 1999 and 2000*. [Online] www.dest.gov.au/schools/publications/2001/fss/evaluation.pdf
- Durand-Drouhin, M., McKenzie P. and Sweet, R. (1998) Opening pathways to education and work. *OECD Observer*, 214, October-November.
- ECEF (2002a) *Destinations 2000*. Sydney: Enterprise and Career Education Foundation.
- ECEF (2002b) *Submission to the House of Representatives Standing Committee Inquiry into Vocational Education in Schools*. Canberra: Parliament of Australia.

- Fullarton, S. (2001) *VET in Schools: Participation and Pathways*. Longitudinal Surveys of Australian Youth (LSAY) Research Report No 21. Melbourne: Australian Council for Educational Research.
- Ghost, S. (2002) VET in Schools: the needs of industry. *Unicorn*, 28 (3).
- Green, A. and Boylan, C. (2001) *Vocational Education: Voices From the Field*. 10th National Vocational Education and Training Research Conference, Deakin University, July 2001.
- GTA (Group Training Australia) (2002) Submission to the House of Representatives Standing Committee Inquiry into Vocational Education in Schools. Canberra: Parliament of Australia.
- HIA (Housing Industry Association) (2002) *Submission to the House of Representatives Standing Committee Inquiry into Vocational Education in Schools*. Canberra, Parliament of Australia.
- Johns, S., Kilpatrick, S., Loechel, B. and Prescott, L. (2004) *Pathways from Rural Schools: Does School VET Make a Difference?* Adelaide: National Centre for Vocational Education Research.
- Jung, T-H., Misko, J., Lee, K., Dawe, S., Yee Hong, S. and Lee, K-C. (2004). *Effective Measures For school-to-work transition in the vocational education system: Lessons from Australia and Korea*. Leabrook: NCVER. [Online] http://www.ncver.edu.au/research/core/cp02_03.pdf
- Keating, J., Kell, P., Lynch, G. and Freeman, B. (1998) *VET in Schools Delivery Analysis: Report to Professional and Leadership Development Centre*. Melbourne: RMIT.
- Kirby, P. (Chair) (2000) *Ministerial Review of Post-compulsory Education in Victoria*, Melbourne: Government of Victoria.
- KPA Consulting (2004) *Review of the Implementation of the AQTF Standards*. Brisbane: Australia National Training Authority.
- Lambert, H. and Stehlik, T. (2002) *School-based Vocational Studies and the Transition to Further Education and Employment: Report of a Pilot Study into the Destinations of Independent School Graduates*. Proceedings of the 10th annual conference on Post Compulsory Education and Training, Gold Coast, 2002.
- Malley, J., Keating, J., Robinson, L. and Hawke, G. (2001a) *The Quest for a Working Blueprint: VET in Australian Schools, Vol 1*. Adelaide: National Centre for Vocational Education Research.
- Malley, J., Keating, J., Robinson, L. and Hawke, G. (2001b) *The Quest for a Working Blueprint: VET in Australian Schools, Vol 2*. Adelaide: National Centre for Vocational Education Research. [Online] www.ncver.edu.au
- MCEETYA (2003) *The Growth of VET in Schools Programs: A National Overview*.
- NCISA (National Council of Independent Schools' Associations' Australia) (2002) *Submission to the House of Representatives Standing Committee Inquiry into Vocational Education in Schools*. Canberra: Parliament of Australia.
- NCVER (2000) *A Focus on VET In Schools*. Adelaide: National Centre for Vocational Education Research.
- NCVER (2004) *Australian Vocational Education and Training Statistics: VET in Schools, 2003*. Adelaide: National Centre for Vocational Education Research.
- NWG (National Working Group on the Recognition of VET in Schools) (2001) *Expanding Opportunities for Youth*. Sydney: Department of Education and Training.
- OECD (2000) *From Initial Education to Working Life: Making Transitions Work*. Paris: Organisation for Economic Cooperation and Development.
- Polesel, J. (2001) Vocational education and training in schools in Victoria: an appraisal six years down the track. *Journal of Vocational Education and Training*, 53 (2).
- Polesel, J., Helme, S., Davies, M., Teese, R., Nicholas, T. and Vickers, M. (2004) *VET in Schools: Culture, Policy and the Employment and Training Impact*. Adelaide: National Centre for Vocational Education Research.

- Ryan, P. (1999) The school to work transition twenty years on: issues, evidence and conundrums. In *Preparing Youth for the 21st Century*. Paris: Organisation for Economic Cooperation and Development.
- Ryan, R.J. (1997) *Vocational Education in Schools*. Adelaide: National Centre for Vocational Education Research.
- Ryan, R.J. (2002) Making VET in Schools work: A review of policy and practice in the implementation of vocational education and training in Australian schools. *Journal of Educational Enquiry*, 3 (1).
- Selby-Smith, C. (2002) A Stock-take of the Economics of Vocational Education in Australia: some implications for career development. *Australian Journal of Career Development*, 11 (2) Winter.
- Slade, M. and Trent, F. (2000) Are they the same? A project to examine success among adolescent males in secondary and tertiary education. Paper presented to the Australian Association for Research in Education Conference, Sydney.
- Smith, E. and Green, A. (2001) *School Students Learning from their Paid and Unpaid work*. Adelaide: National Centre for Vocational Education Research.
- Smith, E. and Wilson, L. (2002) *Learning and Training in School based New Apprenticeships*. Adelaide: National Centre for Vocational Education Research.
- Smith, L. (2000) VET in Schools: it's not just a training agenda. *Vocal*, 2.
- Spark, M. (1998) *Vocational Education and Training in Senior Secondary Schools*. Sydney: Vocational Education and Assessment Centre.
- Spring, G. and Syrmas, J. (2002) What's in a Name: the meaning of vocational in changing times. *Unicorn*, 28 (3).
- Stern, D. (1999) Improving pathways in the United States from high school to college and career. In *Preparing Youth for the 20th Century*, Paris, Organisation for Economic Cooperation and Development.
- Sweet, R. (1993) Learning in the Workplace: A policy perspective. *Australian TAFE Teacher*, 27 (2).
- TDA (TAFE Directors Australia) (2002) *Submission to the House of Representatives Standing Committee Inquiry into Vocational Education in Schools*. Canberra, Parliament of Australia.
- Teese, R., Davies, M. and Ryan, C. (1997) *Work Placement Experience: The Student Perspective*. Melbourne: Educational Outcomes Unit, University of Melbourne.
- Teese, R. (2000) Academic culture and economic self interest: The case for VET in Schools. *Vocal*, 2.
- VACC (Victorian Automobile Chamber of Commerce) (2002) *Submission to the House of Representatives Standing Committee Inquiry into Vocational Education in Schools*. Canberra: Parliament of Australia.
- Watson, S. (2002) Education for tradesmen: VET and the NSW principal. *Vocal*, 2.
- Wiltshire, K. (1999) Good work at school. *Australian Training Review*, 29.

Professional socialisation of valuers: What the literature and professional bodies offers

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Professional socialisation refers to the acquisition of values, attitudes, skills and knowledge pertaining to a professional subculture. This paper reviews the literature about professional socialisation and the dimensions that contribute to the process and definition of professional socialisation. This literature analysis is undertaken of cognate professions because there is no direct literature relating to valuers. The summary of the legislative requirements within Australia and the membership requirements of professional valuation bodies are examined to determine if these include elements of professional socialisation from a real world perspective.

Valuers, professional socialisation, property education, tertiary education, appraisers

INTRODUCTION

In everyday life we can often pick out a teacher, scientist or an engineer by the attitudes, habits and values that are displayed. How did these values, habits or attitudes develop? Were they present initially and, as such, did individuals choose a profession that matched or accommodated these characteristics? Did the university teaching process foster these characteristics through the content taught, was it the way that it was taught or were they developed during induction into the firm when the professionals started their career? The question is when, where and also how and why have professionals developed appropriate values and attitudes as part of their professional skills? The function of these characteristics is to ensure individuals operate in a professional manner and do not make mistakes or poor judgments when under pressure. They can also be important for an individual to advance in their profession.

DEFINING PROFESSIONAL SOCIALISATION

Weidman, Twale and Stein (2001, p.4) define socialisation in a broad sense as “the process by which persons acquire the knowledge, skills, and disposition that makes them more or less effective members of society”.

Higher education is a first step where the individual starts the process of professional socialisation. The dilemma is whether individuals choose the profession that suites their personal characteristics and interests or whether other elements in society influence this process and to what extent. Individuals can choose the profession according to their ability and interests, but social dimensions like financial reward, prestige and status of professions play important roles in selection. Motivations that drive individuals to select professions vary. Individuals may be driven by the high status of some professions in society like the old established professions of law and medicine. The rewards that are related with some professional practice may motivate some individuals to select that type of profession. The intrinsic interest for the subject matter, or the mission associated with it may also motivate individuals to select a profession. The role these

societal dimensions play in the selection process for the future professional is dependent on the individual characteristics.

The education process shapes professional socialisation. The education process consists of the formal parts, such as the required knowledge necessary to practice as a professional. This is usually prescribed by the education institute in conjunction with the professional body. There is also an informal part of professional education that is taking place unconsciously through the process of leaning and participation.

This informal part of professional education, which cannot be separated from the formal parts, is responsible for the development of professional behaviour, attitudes and values. Through the process of learning prescribed knowledge, the student also learns about appropriate professional behaviour and attitudes. Individuals are developing professional values that guide their behaviours and define their sense of belonging to a professional group. The prescribed knowledge consists of the theoretical body of knowledge, methods and technology. The interaction of all these elements produces some professional language. Professional language has three basic functions:

- shortening the communication between members of the profession because the professional words assume the theory or theories related to them,
- easing the recognition amongst professionals and thus encourage group identification, and
- keeping the distance between client and professional.

The Socialisation Model

The conceptual model utilised in this study is that presented by Weidman, Twale and Stein (2001), which has a central or core socialisation role provided by universities. The model has four other components of professional socialisation: prospective students (background, pre-disposition), professional communities (practitioners, associations), personal communities (family, friends and employers) and novice professional practitioners.

The ultimate outcome from this model is the professional who has been transformed with respect to self-image, attitudes and thinking processes. Upon graduation, valuation graduates embark on two more socialisation processes, one into the organisation that employs them and the second into the profession. The model is not linear, it is interactive and it explains the socialisation processes that are taking place in the university, and how the professional organisations and personal environment influence that process. The model is limited because it neglects the other societal dimensions that influence professional socialisation, over which neither professional bodies nor universities can exert control.

Social status and prestige of the professions, and financial rewards associated with the professional practice are some examples of societal dimensions. Recognition of certain professions in society contributes to social status and prestige. Some professions have high recognition as people have regular contact with them, and would include doctors, teachers and professors. Some are less recognised, as their role is further removed from everyday activity, such as engineers, planners and valuers. The level of development of some professions is demonstrated by the existence of academic programs in all major educational institutions, which generally require more years of education and higher levels of specialisation. All these factors contribute to the socialisation process.

Rewards related to professional practice are also a dimension in the socialisation process. Higher salaries related with some practices serve as a motivation factor for students and make the socialisation process easier. The market situation for professionals also has an influence. Studying for a profession that has high demand in the market is more stimulating than studying for a

profession that has low demand or is oversupplied. All of these affect the socialisation process and a professional's identification with their future role.

One dimension that is particularly important for a new profession is state legislation and the laws that regulate the professions or license them. Professional monopoly means that only individuals with required higher education, and maybe some period of practice, can operate as professionals and serve the public with their expertise. The most important step for every profession is the formal recognition and provision of legislation for professional practice. This is significant, first because it is recognition that there is demand for certain knowledge expertise and the need for it to be formally sanctioned in the law. Second, that this demand requires higher education qualifications to ensure the client-public gets the proper expertise. Once this happens, new professions are legalised and the professional language starts to enter everyday life.

Socialisation in Various Professions

Professional socialisation research is available for many fields: nursing, pharmacy, teaching, MBAs and law. However, the literature is very sparse when we look for socialisation in the field of business and there is no specific literature on socialisation of valuers. There is some literature that examines organisational socialisation and its effects on graduates. These include Anderson-Gough, Grey and Robson (1998) who examine the organisational and professional socialisation of trainee chartered accountants and Kelly (1994) who examined the organisational socialisation of lawyers within small to large legal firms in the United States.

There is, however, a range of published writing on competency and essential skills for business. These identify a range of qualities or competencies for a business graduate but are quiet on the issue of socialisation. Literature related to business graduate skills includes BHERT (1993), Curtin Business School (1999a, 1999b) and Moy (1999). There is also literature pertaining to requirements for valuers. Page (2000) discussed how graduate qualities were being introduced into university degrees and Page and Kupke (2001) outlined how internationalisation as a graduate quality was integrated into the property degree.

The following is a brief review of the socialisation literature for various professions.

Business and Law

The socialisation literature on business and law is sparse, with many of the recent studies written by Schleef who undertook her PhD on the socialisation of elites in the United States (Schleef, 1997). Schleef (1998) compared the impact of socialisation on graduate law students and graduate business students. She categorised their attitudes and beliefs at the beginning and during their studies to identify any changes. She found that the graduates had changed their view of the world by the second year of their program. She did, however, also note that they did not come out of business and law school completely moulded into something they were not when they came in (Schleef, 1998).

Schleef (1998, p.628) notes that students absorb cues on how to talk, cut their hair and dress or wear makeup. They relearn how to express their values and goals in order to conform to norms with school culture as well as within the wider profession.

Egan (1989) argues that professional socialisation is not necessarily good. In reviewing socialisation of graduate students, Egan (1989) indicates that the self-concept can be destroyed if the socialisation process is not consistent with the students' previous experience. Egan advocates a number of strategies to support first year graduate students so they maintain confidence, perform and do not drop out.

Schleef (1997) suggests that there were two broad types of business school. There were schools that fostered intense loyalty and cooperation and whose graduates would go to companies that emphasise managerial teamwork. The second type of school encouraged individual achievement and their graduates would seek jobs that reward solitary performance.

With the shortage of formalised studies on business and law students' socialisation, Schleef (1997) used as a default the autobiographical accounts of business people and lawyers to obtain an understanding of the socialisation that occurred and how this occurred at business and law schools.

The case method encouraged short-term thinking because it set us up to analyse and solve a problem without having to account for the impact of our decisions ... Did Harvard business school, with its emphasis on eight hundred cases and short-term solutions cause an over-reliance on short-term objectives in the biggest US companies and Wall Street investment houses? Or was it that this was the way that business was structured and thus Harvard, being closely tied to business, followed suit? (Henry, cited in Schleef, 1997, pp.11-12).

Schleef (1997, p.12) summarises that the central theme of business and law schools is "the construction of rationality, emphasising abstract, neutral, and non-emotional ways to think about solving problems". Students are taught to make decisions in terms of self-interest and economic outcomes, whilst emotional responses are devalued. The case method teaching also suggests that teaching pedagogy can influence socialisation.

Schleef (2001) reviews the socialisation of law students. Law students were socialised into "thinking like a lawyer" using the Socratic Method, which is a form of question and answer system unique to law schools. Students learn the importance of form over content by sounding authoritative, even if they do not know what they are talking about (Schleef, 2001, p.73). Law students are socialised to distance themselves from clients, to consider matters of justice and precedent rather than the context of current relationships and not to take emotional or personal matters into account when deciding cases. This style is described as more consistent with a male approach than a female approach and the findings are that differences in thinking are not just a gender issue with some women liking the adversarial approach. Though there were different approaches, gender itself was not the only variable that related to the acquisition of professional knowledge.

Siegel, Blank and Rigsby (1991) investigated the relationship between the educational institutions involved in accounting and the subsequent professional development of auditors. The research focused on turnover and time to promotion following graduation. Results indicate that graduates from professional schools of accounting were promoted faster to senior and manager level when compared with accredited or non-accredited accounting programs. The study also reported a lower turnover of graduates from professional accounting schools. The results showed greater difference in the longer term, indicating that the effects of professional socialisation are more likely to show up later than earlier.

Pharmacy

A number of studies review the responses to changes in pharmacy teaching that were being driven by a need to change the profession. In 1990, the American Association of Colleges of Pharmacy Commission recommended a number of changes to pharmacy programs. The changes include socialisation and professionalisation of students including communication abilities and professional ethics (Carter, Brunson, Hatfield and Valuck, 2000). The commission also recommended that graduates should have a contextual awareness of the role of pharmacy in the

health care system and that graduates were instilled with a professional identity and pride in the profession. They also indicated that socialisation be integrated throughout the curriculum.

In 1999, the University Of Colorado Health Sciences Center School of Pharmacy introduced a two-week orientation course to address some of these concerns. Topics discussed included roles of faculty, responsibilities of different types of pharmacists, time management, active learning strategies, pharmaceutical care and drug misadventure. Carter, et al., (2000) reported a highlight of the orientation course for many students was the white coat ceremony at the end, which symbolised their progression into the professional program. The evidence from student feedback, and anecdotally from the faculty, was that students started their program with a more professional attitude.

MacKinnon, McAllister and Anderson (2001) reported on the development, implementation and associated outcomes of a 30 week introductory practice course at Midwestern University College of Pharmacy, Glendale in the United States. They found that the introductory practice experiences were valuable in the early professionalisation of pharmacy students.

These pharmacy studies clearly showed that students benefited from efforts to socialise them by providing an understanding of professional practice.

Veterinary Science

Heath, Lynch-Blosse and Lanyon (1996) undertook a longitudinal study of students during their veterinary science studies and post graduation (second year). Students from the Queensland School of Veterinary Science were interviewed when they entered their program (1985 or 1986), in their fifth year (1989 or 1990) and their second year of work. The study found that views on role and status of veterinarians remained stable.

The authors made the point that socialisation in becoming a vet started early, with people having an interest in animals and developing skills in handling animals. The importance of these characteristics declined during the study. It was found there was an increased perception of the importance of interpersonal skills, communication skills and the capacity to work hard. Decreases in the perceived importance of honesty, integrity, dedication and prevention of cruelty were also reported. Attitudes hardened over time in relation to costs of treatment, non-payment of fees and availability out of hours. Some attitudes also changed during the study. These included the appearance of confidence, ability to diagnose accurately and quickly and capacity for meticulous attention to detail. The study also noted the importance of staff-student interaction in informal settings and saw this as important in developing future collaborative relationships.

Role of Field Experience in Professional Development

The novice professional must be capable of doing and not just knowing. This can be undertaken within the university program of study or after the program, with supervised work, before becoming a fully recognised professional.

Dunn, Ehrich, Mylonas and Hansford (2000), compared the perceptions of students undertaking three distinctly different undergraduate field experiences. They reviewed the results with respect to role integration, confidence and altruism. Their findings were that the practicum was a rewarding learning experience that served an important role in understanding and fulfilling the role of professional.

Nesler, Hanner, Melburg and McGowan (2001), reported on work by Saarman, which concluded that socialisation occurs both as a function of the education process and experience in the workplace. Evidence varied as to whether the socialisation occurred through the classroom or with previous and concurrent experience.

PROPERTY RESEARCH LITERATURE

Behavioural Property Research Literature

Property can be viewed from different perspectives and the two dominant models have been the finance or economics approach and the construction or bricks and mortar approach. Diaz during the last decade has developed an alternative approach, which has been described as behavioural property research or behavioural paradigm.

Diaz (1993) developed an activities model of property, which included both economic activity and resource allocation. Diaz argued that economic activity was human behaviour and that by using a behavioural approach we could abandon the economic constructs of infallible man and efficient markets.

The behavioural studies of the last decade concentrated on biases introduced into the valuation processes by the use of heuristics in decision making. These were built from the 1972 work of Newell and Simon, which was quoted extensively in Diaz, Gallimore and Levy's (2002) work.

Heuristics could be defined as rules or patterns (or 'rules of thumb'), which helped to reduce the complexity of decision making. The four main heuristics used in problem solving were the Representative, Availability, Anchoring and adjustment heuristics, Positively.

While it has been summarised that these were all used in the decision making process to determine a value, the research has concentrated on the anchoring and adjustment heuristics. The following authors have all made contributions to this research: Black and Diaz (1996), Diaz (1997), Diaz and Hansz (1997, 2001), Diaz and Wolverton (1998), Gallimore (1994, 1996), Gallimore and Wolverton (1997, 2000) and Hardin (1998). The main finding was that behaviourally, individuals were biased and that this affected decision making. Training to prevent or minimise mistakes was required and education of valuers should include an understanding of behavioural approaches to challenge the rational economic person approach that was assumed to underpin people's decision making.

Property Education

The literature on property education (also known as real estate education) is currently dominated by debate on how to ensure students understand and are prepared to work in a global property market. The growth of real estate knowledge and the disciplines that students need to be aware of has created the dilemma of what to leave out, rather than what to put in a degree. Roulac (2002) and Shi-Ming (2001) reinforce this dilemma. Roulac's (2002) work was significant in that it was the lead chapter in the book edited by Schultze entitled *Real Estate Education throughout the World: Past, Present and Future*. The book included chapters with perspectives from 35 countries. Schultze (2000) illustrated the dilemma of breadth with a house of real estate economics. The house consisted of a foundation of business administration supported by interdisciplinary studies and economics, law, regional planning, architecture and engineering.

The two pillars of typological and institutional aspects included:

- typological aspects – commercial properties, residential properties, industrial properties and special properties; and
- institutional aspects – developers, investors, construction companies, finance institutions, service companies and users.

The pillars in turn supported management aspects such as strategic, functional and phase specific aspects (Schultze 2002).

Roulac (2002) advocated that to be effective in property an individual must simultaneously provide perspectives of historian, behaviourist, global citizen, urban planner, geographer, business strategist, futurist, political economist and information specialist. Clearly no graduate would graduate from a property program with all these perspectives or knowledge of all these areas in the House of Real Estate Economics.

Apart from current real estate knowledge, students needed general business knowledge and skills such as how to learn, acquire knowledge, solve problems and be prepared for lifelong learning. Universities also had institutional requirements for graduates, for example, the University of South Australia currently requires all graduates to have seven graduate qualities (Page, 2000) and only one of these relates to knowledge.

Page (2000) and Page and Kupke (2001) examined the implications of the graduate qualities approach in relation to property education. The major implications were for those designing and delivering courses. The student would be unlikely to separate out the course aspects that develop knowledge, skills, values or attitudes as these would, in many cases, be addressed simultaneously.

Professional Body Membership Requirements for Valuers

A summary of the requirements for full membership for five professional bodies covering valuers is presented in Table 1. The professional bodies summarised have been chosen on the basis that they all had relevance for University of South Australia valuation students. These included the United Kingdom-based Royal Institute of Chartered Surveyors (RICS) and the United States-based Appraisal Institute (AI), which were both trying to cover and capture members outside their home countries. The other professional bodies, which were predominantly aimed at representing local professionals, include; Hong Kong Institute of Surveyors (HKIS), Singapore Institute of Surveyors and Valuers (SISV) and the Australian Property Institute (API).

For the purposes of this review the contents of Table 1 have mainly been prepared from publicly available materials presented on the web sites of the professional bodies. The members-only materials have not been reviewed for this paper.

The summarised information in Table 1 shows that the professional bodies are trying to socialise their new members and maintain the professional socialisation of existing members. The competency document for RICS (2003a, 2003b) provided a very complete picture of the values, skills and knowledge that a valuer should have as a minimum. Of the five professional bodies reviewed, RICS and HKIS would appear to offer the most structured socialisation process that incorporated values, skills, knowledge and attitudes.

Regulatory Framework Applicable to Valuers in Australia

In Australia, each state, except Victoria and the two territories, regulates the licensing, registration and practice of valuation by valuers. The regulations specify the requirements that a valuer must comply with to become registered or licensed, the conduct expected and required of valuers and other matters associated with the practice of land. There is no legislation governing valuation practice in Victoria, the Australian Capital Territory and the Northern Territory and as such anyone can act as a valuer in these jurisdictions. The legislation is summarised in Table 2.

The regulations covering who can value land changed in the mid 1980s in response to Australian Competition Policy. In some states, the licensing of valuers was replaced with a negative licensing system. This means that if an individual has appropriate qualifications they can act as a Valuer unless prevented from doing so. The prevention would arise from proven failure to perform. The regulatory framework identifies knowledge and skill requirements and provides guidance based on values and attitudes about who is not allowed to practice.

Table 1. Summary of membership requirements

Membership requirements	Professional Body				
	RICS	AI	HKIS	SISV	API
Accredited Qualifications	3 year degree	4 year degree (post 1.1.2004)	3 year degree	3 year course	3 year degree
Minimum age	Not specified	Not specified	21 years of age	21 years of age	Not specified
Post-course experience	<p>Individuals require 2 yr experience that must include:</p> <ul style="list-style-type: none"> e-diary of work experience e-log book of time spent on competencies 48 hours Prof Dev training per annum 3000 word summary of experience, end 1st yr completion of a short assessable course dealing with ethical issues 1500 word summary of experience (final year) 3000 word report on a project that the individual has been involved in 10 minute presentation on critical analysis of the project report answer questions on presentation and professional capabilities at an interview a lifelong learning plan (not assessable) 	<p>Individuals must:</p> <ul style="list-style-type: none"> undertake Advanced Residential Forum and Narrative Writing course or Report Writing and Valuation Analysis be an associate member of good standing for minimum of 12 months must submit a list of appraisal work after completing 2000 hours (maximum of 1500 hours per annum credit) for a SRA [residential valuer only] member and 3000 hours for MAI members [valuer of all property types]. 	<p>Individuals must:</p> <ul style="list-style-type: none"> have 2 years experience with minimum of 100 hours undertaking valuation work, 100 hours in another field and 100 hours in one or more fields maintain a diary of work experience and log book of time spent on competencies undertake 40 hr structured learning and education write 3000 word summary of experience at end of first year write 3500 summary of experience, training and structured learning make 10 min presentation on project pass an Ass of Professional Competence undertake a professional interview 	<p>Individuals must:</p> <ul style="list-style-type: none"> have 2 years experience, which must be under supervision of a member with no less than 7 years experience pass an exam keep a log book for minimum of 24 months and must submit the log book every 6 months for inspection attend an interview conducted by an assessment panel 	<p>Individuals must:</p> <ul style="list-style-type: none"> have 2 year experience provide documentary evidence of involvement in profession undertake a professional interview covering expertise in particular field, understanding of professional responsibilities and Code of Professional Practice Standards and professional development.
Required competencies	<ul style="list-style-type: none"> A full listing of competencies, which graduates must acquire, is available from the RICS web site (RICS 2003a). The breadth is illustrated by the following subset: Customer Care, Law, Environmental Awareness, Health and Safety, Self Management, Information Technology, Team working, Oral Communication 	<ul style="list-style-type: none"> Not specified 	<ul style="list-style-type: none"> Lists tasks to be undertaken during experience and minimum time for key skills 	<ul style="list-style-type: none"> Not specified 	<ul style="list-style-type: none"> Not specified
Membership maintenance					
Ethics	<ul style="list-style-type: none"> Strongly recommended to comply with Guidance Notes on Prof Ethics 	<ul style="list-style-type: none"> Comply with Code of Ethics and Standards of Professional Conduct Maintain status of good moral character 	<ul style="list-style-type: none"> Comply with Rules of Conduct 	<ul style="list-style-type: none"> Comply with ethics outlined in Constitution and Bye Laws 	<ul style="list-style-type: none"> Conform to Rules of Conduct
Character					
Valuation standards	<ul style="list-style-type: none"> Value in accordance with The Red Book (RICS 2003b) 		<ul style="list-style-type: none"> Comply with standards of Professional Appraisal Practice 		<ul style="list-style-type: none"> Comply with standards or professional practices
Compulsory courses		<ul style="list-style-type: none"> Standards of Professional Practice course once every five years 	<ul style="list-style-type: none"> Not specified 	<ul style="list-style-type: none"> Not specified 	<ul style="list-style-type: none"> Undertake Risk Management Module every 3 years
Professional Development (PD)	<ul style="list-style-type: none"> 60 hours over 3 year with minimum 10 hours in a year From 2004, must develop learning objectives in advance and provide evaluation of effectiveness 	<ul style="list-style-type: none"> Valuations must contain statement that individual has/has not maintained continuing professional educational requirement 100 hours over 5 years 	<ul style="list-style-type: none"> 60 hour over a 3 year period 	<ul style="list-style-type: none"> 60 hour over a 3 year period 	<ul style="list-style-type: none"> 20 hour of continuing professional development per year

Table 2. Summary of legislative requirements for valuers

State	Legislative requirements	
	Character	Qualifications
NSW	<ul style="list-style-type: none"> • Good character 	<ul style="list-style-type: none"> • Approved study, or • Gained experience under guidance of registered valuer
WA	<ul style="list-style-type: none"> • Good character and repute • Competent 	<ul style="list-style-type: none"> • Prescribed education, and • Practical experience during past 2 yrs or not less than 4 in past 10 yrs
SA	<ul style="list-style-type: none"> • Not specified 	<ul style="list-style-type: none"> • Education qualities of a type acknowledged by the Commission
TAS	<ul style="list-style-type: none"> • Good fame and character 	<ul style="list-style-type: none"> • Prescribed study, and • Hold certificate of competency
QLD	<ul style="list-style-type: none"> • Good fame and character • Fit and proper person 	<ul style="list-style-type: none"> • Certificate of competence issues by prescribed institute of valuers, or • Sufficient experience over a period of five years, after commencement of an approved course of study

DISCUSSION

The literature reinforces the transformation that occurs in the professional socialisation process. Graduates have not only obtained technical skills but have also changed their values and how they think. The professional socialisation means they think like, look like and have values of their respective profession. Schleef (1998) noted that this extended as far as absorbing cues on how to talk, cut their hair or wear makeup. Schleef gave other examples on changing to thinking and the development of ways to remove emotion from problem solving.

Egan (1989) and others also pointed out that the socialisation process was about shifting individuals thinking where they already had a predisposition for this. Further, he indicated that the self-construct could be destroyed if the socialisation process was not consistent with the students' previous experience. It was in this situation that it was important to provide support. The work of Siegel, Blank and Rigsby (1991) showed that the socialisation influence had longer term impacts with graduates from professional schools of accounting being promoted faster to senior and manager level when compared with accredited or non-accredited accounting programs.

The pharmacy studies reinforced the importance of the socialisation process and that it could not be left to the end of the study program. It was important to start the identify process from the start and this would result in students being more applied to their studies. Carter et al., (2000) reported on the University of Colorado Health Sciences Centre School of Pharmacy orientation program in which students received their white coat at the end of the period. This signified they had started their socialisation into pharmacy.

Field experience also had an impact on the socialisation process, but there were cautions in the literature. Unless there was positive support from all players, it had limited benefits. The supposition quoted by Schleef (1997) was that the case study method that had encouraged short term thinking to solve problems without having to account for the impact of decisions could be the reason big companies rely too much on short-term solutions.

The literature would suggest that university experience and field experience had an influence on the professional socialisation of valuers, though the relative value of each period was unknown. The work of Nesler et al., (2001) showed that these other influences could have a greater impact on socialisation than the influence of the campus experience.

Overall, the literature confirmed that the socialisation process was important, impacts for a long time and needs to start early. These aspects of socialisation needed to be considered in any future work on the socialisation of valuers.

The Weidman model provided the key influences on professional socialisation. The model highlighted the parties that had a role in professional socialisation and reinforced the complexity

of understanding these influences on the individual and the ultimate success or otherwise of the individual experiencing socialisation. This complexity was further reinforced by the other professional socialisation literature, which suggested that the only way to obtain a good understanding of professional socialisation was to take a large sample longitudinal study that started before the university program, identified changes through the socialisation process and then followed the graduates into their first jobs and later their senior jobs. Such a study would need a minimum of four to five years longer than the time required to undertake the qualification and the requirement to start before a university program is commenced made it unrealistic and unattainable. For this reason, some of the studies reviewed only gave glimpses of what was required in the socialisation process.

This study does not pretend to have covered all areas of professional socialisation in sufficient detail to draw many conclusions. It appears to be the first study focusing specifically on professional socialisation of valuers and in this respect is only a starting point to ask more serious questions. One area for further study that needs to be undertaken is an examination of the socialisation process from the graduates' perspective. Clearly it is of interest to gain an understanding of when a graduate believes they become a valuer: when they graduate, or when they gain full membership of a professional body or at a later stage? Also how they believe this process could be improved. Another study area is to ask the academics who teach students studying valuation what role and influence they believe they have on the socialisation of students into the professional valuation role. This can be broadened to look at what else academics believe they can and wish to do to influence the professional socialisation of students.

The development of a Graduate Quality framework at University of South Australia, and the requirement for staff to attend to this in course development and delivery, is an example of the imposition of a further level of complexity for academic staff, as the framework encompasses aspects of values and attitudes as well as knowledge and skills.

The professional bodies want a controlling influence in the university socialisation process through the accreditation processes and future partnership models. The concerns of these bodies are, however, about the quality of inputs (students and staff) and the knowledge and skills delivered. There is very little debate on values and attitudes or on the socialisation process. The professional bodies clearly see the universities finishing their role when the students graduate and at this stage these bodies do not see or plan a role for the universities after graduation. Other professions, such as accounting, utilise universities to deliver professional development education after undergraduate education.

CONCLUSIONS

The socialisation of professions is a significant issue for the property profession, providing the knowledge, skills, values and attitudes for an individual to operate. Universities have a role in socialisation that has a long reaching impact on a professionals' career. The legislative and professional bodies' membership requirements have a major influence on professional socialisation. These requirements have changed in response to failures in the past and there is global pressure to develop consistent methods and standards of operation. The University of South Australia has an opportunity to review its property program and to re-examine what it provides to commencing students. There is clearly a difficulty in deciding what to leave out of courses and what could be provided in postgraduate study or professional development courses run in conjunction with the profession.

REFERENCES

- Anderson-Gough, F., Grey, C. and Robson, K. (1998) *Making up Accountants: The Organizational and Professional Socialisation of Trainee Chartered Accountants*. Aldershot: Ashgate.
- BHERT (1993) *Graduating to the Workplace: Business Students' Views About Their Education*. BHERT, Burwood, Victoria, Commissioned Report No. 3.
- Black, R. and Diaz, J. (1996) The use of information versus asking price in the real property negotiation process. *Journal of Property Research*, 13 (4), 287-297.
- Carter, B.L., Brunson, B.J., Hatfield, C.L. and Valuck, R.J. (2000) Description of an introductory course designed to socialize pharmacy students. *American Journal of Pharmaceutical Education*, 64, 166-173.
- Curtin Business School (1999a) *Integrated Professional Skills Project*. Curtin Business School, Report of the Phase One Task Force, [Online] <http://cea.curtin.edu.au/ATN/curtinatn.html> [2004 September 15]
- Curtin Business School (1999b) What are professional skills? [Online] <http://www.cbs.curtin.edu.au/business/student-resources/learning-at-cbs/professional-skills-project/what-are-professional-skills> [2003 August 28]
- Diaz, J. (1993) Science, engineering and the discipline of real estate. *Journal of Real Estate Research Literature*, 1 (2), 183-195.
- Diaz, J. (1997) An investigation into the impact of previous expert value estimates on appraisal judgement. *Journal of Real Estate Research*, 13 (1), 57-66.
- Diaz, J. and Hansz, J. A. (1997) How valuers use the value opinion of others. *Journal of Property Valuation and Investment*, 15 (3), 256 - 260.
- Diaz, J. and Hansz, J. A. (2001) The use of reference points in valuation judgement. *Journal of Property Research*, 18 (2), 141-148.
- Diaz, J. and Wolverson M. L. (1998) A longitudinal examination of the appraisal smoothing hypothesis. *Real Estate Economics*, 26, (2), 349-358.
- Diaz, J., Gallimore, P. and Levy, D. (2002) Residential Valuation behaviour in the United States, the United Kingdom and New Zealand. *Journal of Property Research*, 19 (4), 313-326.
- Dunn, S.V., Ehrich, L., Mylonas, A. and Hansford, B.C. (2000) Students' perceptions of field experience in professional development: A comparative study. *Journal of Nursing Education*, 39 (9), 393-400.
- Egan, J.M. (1989) Graduate school and the self: A theoretical view of some negative effects of professional socialisation. *Teaching Sociology*, 17 (2), 200-208.
- Gallimore, P. (1994) Aspects of information processing in valuation judgement and choice. *Journal of Property Research*, 11 (2), 97-110.
- Gallimore, P. (1996) Confirmation bias in the valuation process: a test for corroborating evidence. *Journal of Property Research*, 13 (4), 261-273.
- Gallimore, P. and Wolverson, M. (1997) Price-knowledge-induced bias: A cross-cultural comparison. *Journal of Property Valuation and Investment*, 15 (3), 261-273.
- Gallimore, P. and Wolverson, M. (2000) The objective in valuation: A study of the influence of client feedback. *Journal of Property Research*, 17 (1), 47-57.
- Hardin III, W.G. (1998) Behavioural research as an academic pursuit: lessons from other disciplines and implications for real estate. In *RICS The Cutting Edge 1998*. RICS, [Online] <http://rics.foundation.org/publish/document.asp?did=2441> [2003, October 23]
- Heath, T.J., Lynch-Blosse, M. and Lanyon, A. (1996) A longitudinal study of veterinary students and recent graduates 2: Views of the veterinary profession. *Australian Veterinary Journal*, 74 (4), 297-300.
- Kelly, M.J. (1994) *Lives of Lawyers: Journeys in the Organizations of Practice*. The University of Michigan Press.

- MacKinnon III, G.E., McAllister, D.K. and Anderson, S.C. (2001) Introductory practice experience: An opportunity for early professionalisation. *American Journal of Pharmaceutical Education*, 65, 247-253.
- Moy, J. (1999) *The Impact of Generic Competencies on Workplace Performance: Review of Research*. NCVER: Leabrook.
- Nesler, M.S., Hanner, M.B., Melburg, V. and McGowan, S. (2001) Professional socialisation of Baccalaureate nursing students: can students in distance nursing programs become socialized? *Journal of Nursing Education*, 40 (7), 293-302.
- Page, G.M. (2000) Graduate qualities. In *Proceedings 6th Pacific Rim Real Estate Society Conference*, 22-24 January 2000, Sydney.
- Page, G.M. and Kupke, V. (2001) Graduate quality approach to property education. In *Proceedings 7th Pacific Rim Real Estate Society Conference*, 22-24 January 2001, Adelaide.
- RICS (2003a) APC/ATC requirements and competencies: assessment of professional competence and assessment of technical competence. [Online] http://www.rics.org.au/downloads/apc_act_requirements_and_competencies_guide.pdf [2003, September 24].
- RICS (2003b) *RICS Appraisal And Valuation Standards: The Red Book*. RICS.
- Roulac, S.E. (2002) Requisite knowledge for effective property involvements in the global context. In K.W. Schulte (ed), *Real Estate Education Throughout the World: Past, Present and Future*. Research Issues in Real Estate, 7. Boston: Kluwer.
- Schleef, D. (1997), Elites in training: Accommodation and resistance to professional socialisation in law and business school. Dissertation for Doctor of Philosophy, Northwestern University, Evanston, Illinois.
- Schleef, D. (1998) Empty ethics and reasonable responsibility: vocabularies of motive among law and business students. *Law and Social Inquiry*, 22 (3), 619-650.
- Schleef, D. (2001) Thinking like a lawyer: Gender differences in the production of professional knowledge. *Gender Issues*, 19 (2), 69-87.
- Siegel, P.H., Blank, M.M. and Rigsby, J.T. (1991) Socialisation of the accounting professional: Evidence of the effect of educational structure on subsequent auditor retention and advancement. *Accounting, Auditing and Accountability Journal*, 4 (4), 58-70.
- Shi-Ming, Y. (2001) New paradigms in real estate education. *Pacific Rim Property Real Estate Journal*, 7 (2), 79-88.
- Schulte, K.W. (ed) (2002) *Real Estate Education Throughout the World: Past, Present and Future*. Research issues in Real Estate, 7. Boston: Kluwer.
- Weidman, J.C., Twale, D.J. and Stein, E.L. (2001) Socialisation of graduate and professional students in higher education. *ASHE-ERIC Higher Education Report*, 28 (3), San Francisco, Wiley Interscience.

The gifted: Identity construction through the practice of gifted education

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Over the past two decades in Australia, the field of gifted education has expanded considerably. The term 'giftedness' has effectively entered mainstream discourse. The field of gifted education, which nowadays operates as a compensatory function of mass education, is comprised of groups of people who broadly share in the concept of giftedness but contest, through discourse, its meanings and practices. This paper explores the politics of 'identity construction' through gifted practice. Social constructionism was used in the study theoretically and methodologically, to underpin discourse analysis and the life history approach to research. This paper aims to delineate the study generally, and to shed light on its findings. It explores history, arguing that gifted education, despite prevailing claims to inclusivity, sustains competition and individualism and subverts the social function of education.

Giftedness, social constructionism, life history, discourse analysis, identity

INTRODUCTION

South Australia's first policy on gifted education was passed in 1979: *The Education of Intellectually Gifted Children* (South Australia Education Department, 1979). Despite a conspicuous title, which cast the gifted child as a discrete category, the policy objective was relatively mild in comparison with its successors. It stated simply that gifted children were "students with individual differences that needed to be catered for within existing schools by regular teachers" (Braggett, 1985, p.113). Around that time no significant programs had been created for gifted children within schools and little had occurred to define, coordinate or disseminate gifted education practices (Vialle and Geake, 2002). According to some writers, the egalitarian socio-political ethos of the 1970s and 1980s had initially provided an unreceptive context for gifted education in Australia (Krisjansen and Lapins, 2001; Ryan, 1994). This was reflected in the South Australian Education Department's early social democratic views on gifted education, which affirmed that "it is inappropriate to refer to a discrete, unvarying category or group called 'the gifted' since such a presumption would lead to applications that were both 'rigid and divisive'" (South Australia Education Department, 1987, pp.7-8).

Since then, however, gifted education has grown into a prominent educational movement with special programs, competitions, organisations, schools, as well as accelerated pathways through education being established to provide for the unique needs of gifted children. It is popularly understood as a strategy that caters for individuals, is believed to solve problems related to student underachievement and disengagement, and is regarded as a necessary intervention for certain children 'at risk' of behavioural and emotional disorder (Rimm, 2003; Silverman, 1997).

The Significance of Critical Investigation

In South Australia the most recent inquiry into The Education of Gifted Children (Senate Inquiry, October 2001), has produced 20 recommendations that collectively bid to strengthen the State's growing gifted network in a number of strategic ways. These include the development of a consistent policy that encourages suitable acceleration for the gifted; ability grouping options as a means of meeting the needs of the gifted; more flexible university entry and study options for the gifted; and the requirement, as a condition of employment, that newly graduated teachers have at least a semester unit on the special needs of gifted children in their degrees (Senate Enquiry, October 2001).

Pending the abovementioned recommendations, which affect all levels of education in South Australia, this paper engages a critical modality: the possibility of questioning gifted education in the here and now. Why has support for gifted education recently burgeoned; to what extent does gifted education, as a compensatory function of mainstream education, either challenge or support hegemonic power relations; how might gifted education preclude other, possibly marginalised ways of acting in the world; furthermore, when adhering to gifted terminology and practice, what are the belief systems to which we are, by *de facto*, adhering? In short, what are the social justice implications of the gifted category for all children?

The South Australian Education Department's views on gifted education have shifted dramatically since the 1980s. Nevertheless, several writers raise the viewpoint that gifted education in Australia and abroad offers a narrow and fundamentally inequitable form of education (Carey, 1994; Krisjansen and Lapins, 2001; Margolin, 1994; Oakes et al., 1997; Poynting and Noble, 1996; Ryan, 1994; Sapon-Shevin, 1994; Staiger, 2004).

By mapping the cultural power relations that have produced the movement over the past century, I seek to conceptualise the field by illuminating and questioning gifted education's commonsense beliefs. Using social constructionism as a lens, I contend that 'commonsense' frequently works in favour of society's relatively powerful groups. Thus the aim of this paper is to open out a space within which South Australia's contemporary government of gifted children may be viewed critically. The ensuing section explains the study in general, followed by a historical exploration from which conclusions are brought to light.

THE STUDY

The study aimed to draw informed conclusions about gifted education's orientation to social justice by conceptualising its prevailing discourse politically. In order to develop a robust image, the field was conceptualised in two ways: a historical look at gifted education since the turn of the century through an exploration of policy and literature, and the analysis of life history interviews with three gifted education practitioners. During the latter, each participant was viewed as a political being whose subject position in society offered a discrete window onto the field at large.

Educational movements can similarly be viewed politically by assessing their prevailing beliefs. These are practised through curriculum and student management, and allow students to take up certain subject positions and not others. Thus, the identities formed by educational movements are equally political and ultimately impinge upon the construction of society at large. By asking the central question of how the field of gifted education constructs the gifted student, the study simultaneously asks: how does the field operate; what are its beliefs; what manner of society does it seek to construct; and, therefore, what are its far reaching implications?

The study itself was located within a political framework aligned with the theoretical assumptions of social constructionism: the promotion of a critical approach; a critical stance against taken-for-granted knowledge such as hegemonic or essentialist claims to truth; acknowledgement of the

cultural and historic contingency of knowledge; as well as the political implications that connect knowledge and practice, and the social contexts that connect education to the wider world. It was a reflection of social constructionism that my location as a researcher should be acknowledged. Part reason for this was to suggest that all research endeavours and all beliefs are positioned. Thus the aim of the study was presented as a search, not for truth, “but for any usefulness that the researcher’s ‘reading’ of a phenomenon might have in bringing about change for those who need it” (Burr, 1995, p.162). The study’s conclusions, therefore, were not seen to be exempt from the so-called ‘critical stance’ they brought to bear on the field of gifted education, but were acknowledged as social constructions themselves. The conclusions raised in this paper are likewise presented to stimulate discussion, to give voice to marginalised groups and to draw from the critical perspective useful information for future policy and practice.

Curricular Justice

In order to conceptualise the idea of ‘education and social justice’ in this article, I succinctly outline three political orientations to situate more explicitly the study and field under analysis: Connell’s ‘curricular justice’, the ‘liberal perspective’, and the ‘new economism’. These perspectives are delineated so that informed conclusions can be made whilst allowing for a scope of viewpoints.

Connell (1993) explains that curriculum is hegemonic when it marginalises other ways of organising knowledge, is integrated with the structure of power in educational institutions, and occupies the high cultural ground, defining most people’s commonsense views of what learning ought to be. From these observations he develops a standpoint that asks that schools consider the interests of the ‘least advantaged’. This means acknowledging social contexts – such as class and race – and recognising that a focus on the individual alone precludes the opportunity to address existing social inequalities. The standpoint of the least advantaged also means developing curricula and accepting that knowledge can be organised in ways other than the mainstream hegemonic curriculum.

Connell therefore advocated a fundamental reconstruction of the mainstream curriculum and rejected separate-and-different compensatory education schemes. He argued that compensatory schemes focused predominantly on individual needs but in so doing ‘they leave the currently hegemonic curriculum in place’ (Connell, 1993, p.44). Connell advocated greater student participation as a mechanism for achieving an education experience based upon ‘common schooling’. This notion argued that in order to facilitate broad community involvement in social life, and to enhance the process of democracy, students needed to be actively involved in the school community. He argued:

To be active participants in such decision-making requires a range of knowledge and skills (including the skill of getting more knowledge). This range is required for *all* citizens ... You cannot have a democracy in which some ‘citizens’ only receive decisions made by others ... this criterion rules out selection, competitive assessment, streaming and classifying mechanisms in schooling while the common curriculum is in operation, since such mechanisms differentiate offerings and therefore advantage some citizens over others. (Connell, 1993, p.46)

Connell also advocated that students and educators should become aware of the historical production of (in)equality. This meant developing awareness of the processes in which we participated to reproduce social relationships. In terms of power relations, Connell’s framework suggested that the privileged step out from the mainstream to meet with so-called ‘difference’ on the terms of the marginalised; he advocated a destabilisation of hegemony in order to equalise social power relations to work toward greater equality of access to power.

Owing to Connell's acknowledgment of history, the attention he paid to social power relations, and the scope his proposed framework allowed for broad contextual thinking, 'curricular justice' most closely articulated with the study's social constructionist standpoint.

Liberal Perspective

The liberal perspective contends that education reduces social inequality by developing the capacities of the individual. Liberal educational policies have in the past produced child-centred curricula and compensatory education schemes. Compensatory schemes are those that are added to the existing mainstream curriculum to cater for the needs of disadvantaged groups.

Kemmis et al.(1998) affirm that the liberal view seeks:

To develop a sense of the good, true and beautiful in every child ... It takes an individualistic perspective on social philosophy, and sees the development of autonomous persons as the aim of education ... It is 'liberal' in the sense that it sees education as the liberation of persons by reason, both individually (through development of reasoning) and socially (through democratic processes of reasoned debate). (Kemmis et al., 1998, pp.140-141)

In terms of social power relations, the liberal perspective typically invites the 'marginalised' to be compensated within the realms of the mainstream, on the terms of the privileged, and without destabilising society's hegemonic centre. Thus, education in liberal democratic societies, such as mainstream Australia, is about the development of the individual (McWilliam, 1999). The belief in Western liberal democratic societies is that children are, by nature, incomplete; that they will reach adult fruition and become autonomous, fully functioning citizens if, through a universal path of development, their unique needs are met (McWilliam, 1999). Gifted education is strongly directed toward the developmental needs of the individual. The remaking of Gifted Education and individualism has coincided over the past decade or so.

The New Economism

The so-called 'new economism' in education was of concern in Australia during the 1980s and 1990s. A number of political changes to education were made at a time that was seen to "return [education] to a concern with standards and an emphasis on training future members for the workforce" (Haralambos et al., 1996, p.272). The policies that issued from that period were predicated on government sentiments that blamed the education system for rising unemployment and failing to produce "appropriately skilled and motivated young workers".

According to Hattam (1999), one of the school cultures that accompanied the new economism was what he called a "stuck culture". A "stuck school culture" is not likely to celebrate difference; teaching from this perspective is either individualistic or balkanised; the stuck school is likely to hold a deficit view of students; and will allow its teaching agendas to be driven from outside by accepting the social conditions which have accompanied the marketisation of schooling (Hattam, 1999). These conditions have resulted in:

The muting of social justice discourse ... neoliberal governments retreat to a 'blaming the victim' position by marshalling such arguments as the need for freedom of speech. The empirical evidence however, overwhelmingly supports the view that the outcomes of schooling are still very much skewed in favour of those who are already advantaged in society. The already disadvantaged or disenfranchised continue not to be served well by the schooling system and the present confluence of reforms is only making things worse. (Hattam, 1999, p.251)

The scope presented by these three positions on education and social justice was used in the study to conceptualise gifted education both politically and historically.

METHODOLOGY

Data Collection

In order to invite life history participants, information sheets which outlined the study and the requirements for participation were posted through the Department of Education and Children's Services (DECS), as well as the Gifted and Talented Children's Association of South Australia (GTCASA). Three volunteers responded: two from the independent, and one from the public schooling sector. There are a small number of elite schools in Adelaide that employ in-house coordinators to direct pull-out programs for gifted children. The first two participants occupied these roles. The third participant had taught at a number of state schools. Her involvement, contrary to the other participants, was brought about less intentionally and more compliantly by way of the state's 'Students of High Intellectual Potential' (SHIP¹) program.

The latter proved enlightening in terms of conceptualising the rise of gifted education in South Australia in recent years. It has been argued by critics of the gifted movement in Australia that the SHIP initiative – which was initiated around the same time as other gifted education schemes nationwide – signified a radical swing away from the nation's more social democratic provisions; that it stood to deny “the well documented socio-cultural determinants of intellectual development” (Ryan, 1994, p.11); and finally, that SHIP was a direct example of non-democratic decision-making, for it was decided amid non-consensual negotiations (Ryan, 1994). These contentions were taken into consideration when contextualising the third participant's life history data against the study's historical backdrop.

Given the voluntary nature of recruitment, the participants' so-called 'subject positions' were unplanned and thus the study's findings flowed uniquely from the life history transcripts, literature and policy documents combined. Owing to the combination of both public and independent school participation, ethics approval to run interviews was required from several sources: the Flinders University Social and Behavioural Research Ethics Committee, DECS, all three participants, and their school principals. The actual research was conducted on three separate occasions, with participants giving, on average, three hours of their time. The life stories were recorded and later transcribed. In the latter part of each interview, participants were invited to talk specifically about their approach to gifted education. Discourse analysis was then used to consider all collected data.

Discourse Analysis

Discourse analysis is neither a straightforward nor easily defined undertaking; different researchers develop different methods. The method that was used in the study reflected a range of

¹ SHIP: Students with High Intellectual Potential was, and still is, a secondary school program which was launched in South Australia in 1993; the SHIP Task Force had been developed two years earlier. The scheme was implemented in response to lobbying by parents and teachers who believed gifted children were disenfranchised by the education system. SHIP was established within three focus schools and designed to train and develop teachers in the identification and management of gifted students. The aims of the program were to ensconce gifted teaching practices into the mainstream schooling system, to establish giftedness and the 'needs' of gifted children as common to the broader community, and to increase eventually the use and acceptance of gifted education beliefs and strategies across the State. (Skabe, 1996: online).

documented approaches², which were blended to consider how the field constructs the gifted student? How the field operates? Each life history was approached with the same general question in mind: how did this person come to be a ‘gifted teacher’, and what could the overarching story of their life reveal about gifted education today?

After transcribing the taped interview (on the whole, verbatim), the complete story was read through and the data were rewritten into a coherent, chronological whole, in order to develop an awareness of the history as a narrative account (Hatch and Wisniewski, 1995, p.15). As a developmental account, the major epochs that defined the person’s life were marked out and conceptualised according to prevailing discourses. “The subject positions [that were] offered by different discourses, and the identity and political implications of these” (Burr, 1995, p.166), were thus reflected upon.

When considering the identities either taken up or rejected throughout the narrative, participants were viewed as social agents exercising the power available to them. In order to define them as political beings and to determine their available power, the participants’ contexts were considered, for people are understood in relation to others as well as in relation to their environment. Thus, the subject as an emergent political being was continually considered in light of her present subject position within the field of gifted education. Once located in her overall life story, the participant was then located as a more or less powerful subject position within the socio-historic framework of gifted education.

The intersection between theory and method

Social constructionism offers a distinct theoretical and methodological base for research – a means of interrogating social practices to unearth the ways in which power works unevenly as a capillary force throughout society, frequently with the result that some groups are marginalised more than others. Power, in this framework, can be thought of in close relation to wealth and class and to the ability that various social identities have in exercising control over their own lives and the lives of others. Meadmore (1999) writes:

Powerful people ... inform and influence discourses. Because we are produced by such discourses, say for example, those of social class, gender or ethnicity, some people have more input at the level of ideas than others. (Meadmore, 1999, p.58)

In this way, the subject positions of each life history participant – their variant statuses within the field of gifted education – were considered in terms of their input at the powerful level of ideas. In terms of taking a critical stance toward, for example, essentialist claims to truth, social constructionism allowed the study to look beyond gifted education’s core beliefs – such as the reification of intelligence, or the stance that giftedness is a psychological reality (Silverman, 1994). Instead, these commonsense truths were questioned for their historical origins as well as their contemporary articulations with power structures beyond the field of education.

² Brown’s ‘Identity claims analysis: a strategy for the interpretation of life history accounts’ (1994); Burr’s ‘An introduction to social constructionism’ (1995); Rosenwald and Ochberg’s ‘Storied lives: the cultural politics of self-understanding’ (1992); and Hatch and Wisniewski’s ‘Life history and narrative’ (1995), were consulted when developing a discourse analysis format.

The theoretical assumptions which were mentioned above³ thus bear out social constructionism as a research methodology for they portend critical practice: the practice, for example, of considering the cultural and historical specificity of knowledge.

HISTORY

Mass compulsory education, though it was predicated in part on sentiment and in accordance with a belief in equality of opportunity for all children to access education, was in many ways neither equal to nor beneficial for all (Germov, 1998; Hatton and Elliot, 1998; Heitmeyer, 2001; Kyle, 1999; Woods, 1998). Modelled on an upper-class British template that favoured some and not others, from the outset Education has always been implicated in the reproduction of an uneven class system (Lovat, 2001; Meadmore, 1999).

The IQ test, first invented by Frenchman Alfred Binet, was translated into English by American psychologist Howard Terman in 1916 (Margolin, 1994). Before then, the impetus to measure had already emerged, represented by various mental capacity tests, with the first tests of mental capacity, or intelligence, being measured according to head size and body type (Oakes et al., 1997). Psychologists in Western society readily accepted the IQ test as a more valid and reliable way of measuring intelligence, and explored its applications. Early industrialised society was motivated by an impetus to measure and grade human capacities (Margolin, 1994), to become more competitive, more efficient in the global marketplace. In this way, the impetus to measure eventually led to IQ testing in schools, which both drove and adhered to the pervasive commonsense belief that intelligence was innate and fixed, an understanding that was decontextualised “from the unequal conditions of society” (Oakes et al., 1997).

The unfair social contexts that had largely been overlooked up until the middle of the twentieth century were eventually recognised owing to the rise of several social movements in Western civilisation (Oakes et al., 1997; Lovat, 2001). As a result, Terman’s IQ research was criticised for racial bias and for maintaining unjust social arrangements. During the 1980s, education increasingly became seen as a solution to poverty, and more interest was directed toward society’s marginalised groups. It was around this time that the notion of giftedness, intelligence and ability were re-engineered, and thus terminology such as ‘disadvantaged’, ‘context sensitivity’ and ‘inclusiveness’ were injected into gifted literature and policy, and the gifted movement re-emerged.

Though significantly simplified here, the study’s historical exploration of literature and policy unearthed a wealth of contextual information, later raised in conclusion.

Life History

Throughout each of the life histories, the prevailing discourses which shaped the participants’ political location and discrete understandings of the world were mapped. These so-called ‘identity maps’ eventually provided a picture, an understanding as to why and how each participant chose to become a gifted practitioner. The life histories also enlightened the political character of the field that was represented by each participant.

My first interviewee, was raised as a privileged, Anglo-Australian member of society amid a multicultural setting. Aspects of her childhood and passage through life accounted for her contemporary position as a gifted professional, and the scope of that perspective. Her elite and

³ The promotion of a critical approach; a critical stance against taken-for-granted knowledge such as hegemonic or essentialist claims to truth; acknowledgement of the cultural and historic contingency of knowledge; as well as the political implications that connect knowledge and practice, and the social contexts that connect education to the wider world.

competitive liberal education; the onus that was placed upon her to gain multiple tertiary credentials; her family's religious beliefs in innate human capacities; added with her experiences of child-rearing, worked together in complex ways to offer Erica⁴ certain subject positions and not others, which resulted in a stance toward education that allowed for certain perspectives and not others.

As a privileged child, Erica's understanding of her multicultural hometown environment was specific and exposed a partial view of the world. According to Erica, her hometown was inclusive and virtuous – values that Erica saw reflected in the 'world-class' school that she attended. Her childhood subject position did not allow for a view of the uneven and inequitable social conditions that characterised her hometown, which sustained a cultural divide between immigrants and the hegemonic elite, and which resulted in the marginalisation of whole sections of the community. The political viewpoint that Erica developed throughout her life history, and which was evidenced by way of her beliefs and practices, was eventually reflected in her contemporary professional capacity. By unpacking Erica's life history, the study was able to garner a more robust understanding of the field of gifted education.

The same process was undertaken with participants 2 and 3: one, a policy-writer at an elite private boys' college, and a powerful member of South Australia's complex gifted education network; the other, a far less powerful public school practitioner who was, in her own words, obligated as part of her job to undertake gifted practice. As a staff member at a SHIP school when the program was instigated in the 1990s, Jenny stated: "Well we had to, we had no choice, we were told to do it."

In all three life histories, themes emerged which together accounted for the ways in which gifted education achieves rule and sustains its practices. Gifted education emerged as an attractive option for all three women: whether through the pressures of a competitive class-bracket, in which multiple tertiary credentials paralleled with acceptance; as a means of positively categorising their own children in accordance with prevailing notions about normality; to access a more powerful subject position in the face of deteriorating domestic conditions; or to maintain employment within an increasingly competitive job market.

All three women spoke, as teachers, about parental pressures. In the most acute scenario, shared by Kath, the tag of 'gifted' emerged as a form of competitively sought-after cultural capital, which was reflected in the way parents would buy their children into gifted classes. In Kath's words, "all hell broke loose" when the selection process for gifted classes was initiated. In both Kath and Erica's schools, elite, high-fee paying sites, the popularity of the classes had burgeoned and become problematic. Both women spoke about the need to alter the pre-requisites for admission.

Given that IQ testing, alone, is no longer accepted within the field as an adequate measure of giftedness, the gamut of testing procedures that have replaced it, along with the eclectic description of giftedness that has opened out space for more children to be included, has resulted in dispute as to where categorical lines should be drawn. Yet, the tenets that uphold gifted practice – the drive for testing and for homogenous groupings – have necessitated division. Both Kath and Erica revealed the strain that imposed upon the elite gifted teacher, who was left, in an autocratic manner, to regulate dividing lines, and by extension, to regulate educational outcomes.

Kath and Erica represented powerful subject positions. The windows onto gifted education that they opened revealed a system of school governance that categorises and divides individuals, generates dissent and competition among wider society, and, by necessity, overlooks marginalised social groups. Jenny, in contrast, represented a less powerful subject position, but one that, by *de facto*, served to support Kath and Erica. Jenny's story showed how gifted education entered the

⁴ Participant names were changed.

mainstream discourse at a time when the New Economism had compressed and narrowed public school teachers' options for acting. Jenny had little choice but to conform to gifted practice. At the same time, the inclusive terminology that helped gifted education gain a foothold in the early 1980s, provided teachers like Jenny with reason to believe their pedagogic practices were indeed [in her words] "damn good for all kids". Any latent concerns that Jenny – as a member of the public teaching fraternity – had about exclusionary teaching practices, were obscured by the benefits that gifted education seemed to impart: in short, professional development in gifted education had allowed Jenny to secure two tenures during periods of increased competition within the mainstream job market. In her own words, training in gifted practice has been a real "feather in her cap" when it comes to securing employment.

CONCLUSION

Gifted education operates through a set of core beliefs and practices, which are dispersed through a composite network which stretches across all levels of the education system and connects South Australia with other states and gifted networks abroad. I argue that the gifted education network was established in South Australia by appealing to the egalitarian ethos of the 1980s, and quickly expanded throughout the 1990s as a result of marketing ploys and appeals to the economy (nurturing our national assets) which fundamentally undermine equal outcomes for all children.

The disparity between gifted education's claims to equality and the uneven social outcomes it produces, are located in its core beliefs. I argue that these beliefs advantage children who, by way of class status and socio-cultural privileges, are predisposed to display greater proficiency in all subject domains, especially those that yield the greatest market-value. At the same time, gifted education's core beliefs encourage divisive practices, which separate the student populace into homogenous groups thereby supporting society's hegemonic power relations: the top two or five percent of elite students are united and promoted through the education system and beyond, while the majority are dispersed toward less valuable subject positions in the marketplace.

Instead of addressing existing social inequalities directly, gifted education supports hegemonic power relations by adhering to the following: (a) an essential belief that intelligence and ability are biological objects which can be measured along a culturally determined scale of normality and which, despite context, are considered to be superior in some people and not others; (b) a belief that children are incomplete, and that they possess individualised needs which must be met if adult fruition is to occur; and (c) gifted education also puts forward the idea that social justice can be achieved through equality of opportunity, yet fails to address the fundamental and historic productions of inequality.

The practices which stem from these beliefs are (a) testing; (b) labelling children according to results; (c) organising children into homogenous groupings; (d) teaching to the individual; and (e) fast-tracking elite individuals through the education system and into the tertiary sector.

In terms of its relationship with social contexts, gifted education's prevailing political character is evidenced both by way of its individualised practices and support for equality of opportunity, as well as its expansion within particular historical epochs. In particular, the development of the New Economism in Australia has seen gifted education strengthen. However, during periods when the national interest has been focused upon social rather than fiscal matters, support for gifted education has waned. In response to the latter, a marked shift occurred in the language that was used to construct the gifted student: terms such as 'inclusion' and 'disadvantage' were injected into policy.

Gifted education, it would seem, has managed to sustain its practices and thereby construct a particular version of the gifted child by appealing to both liberal sentimentality and neoliberal mentality by framing the gifted child as a marginalised individual, and by marketing purportedly

inclusive teaching practices. By simultaneously framing the gifted child as a national asset, by presenting an individualised curriculum amid competitive times, and by meshing with top-down impositions on curriculum without subverting hegemonic power relations, gifted education has harmonised with both liberal-minded practitioners as well as a neoliberal political context.

In terms of social justice, and the question as to whether or not gifted education caters for all children, the research data bears out gifted education in alignment with neoliberal (new economist) politics, while espousing a liberal orientation to education. The implications of this position, for all children, equates to the dominance of some over others. Gifted education imparts individualising practices which support hegemonic power structures by discrediting difference and allowing for only a partial view of the world. That means those students who reign from cultures such as the 'least advantaged' are forced to either assimilate with the hegemonic centre or remain marginalised. By focusing on the decontextualised and innate capacities of the individual, gifted education takes up a stance which deflects attention from disparate social contexts, thereby maintaining hegemonic power relations.

From the viewpoint of the child, it would appear from the study's findings that gifted and non-gifted children alike are in some respects marginalised by the practices of gifted education. Clearly, the non-gifted child is schooled with a tacit awareness of 'lack' in relation to their gifted counterparts. The gifted system appears to filter the non-gifted through the schooling system and toward an appropriate social role with the implicit proviso they deserve to be there, whatever role that may embody within the uneven class system.

The gifted child, on the other hand, is offered a privileged subject position that is in some respects equally fragile. In today's language, the gifted child is different and elite, born to provide for tomorrow's nation. Nevertheless, they are also framed by the prevailing discourse to be at-risk of emotional disorders, plagued by their own genius, vulnerable, despondent, complex, intense, and in need of homogeneity to survive. For both children, indeed all of society, gifted education's separation and compartmentalisation of the human terrain constructs a disjointed social reality, one in which individuals are led to believe that socially constructed differences are innate differences and in which interaction between groups is closed down. Nevertheless, communication at large, it would seem, is needed within Education, indeed among people, if social justice for all is to be achieved.

REFERENCES

- Braggett, E. (Ed) (1985a) *Education of Gifted and Talented Children: Australian Provision*. Commonwealth Schools Commission: Canberra.
- Brown, D. (1994) Identity claims analysis: a strategy for the interpretation of life history accounts. Paper presented at the Biography and Society Sessions, International Sociological Association Congress, Beifeld, Germany, July.
- Burr, V. (1995) *An Introduction to Social Construction*, London: Routledge.
- Carey, M. (1994) New fashioned apartheid? *Education Links*, 47, 18-22.
- Connell, R.W. (1993) *Schools and Social Justice*. Toronto: Our Schools, Our Selves Education Foundation.
- DECS (1996a) *Policy Statement: Gifted Children and Students*. Public Affairs Unit: South Australia.
- DECS, (1999/2000). *SACSA Framework*. DECS publishing. [Online] <http://www.sacsa.sa.edu.au> [24/3/04].
- Faraday, A. and Plummer, K. (1979) Doing life histories. *Sociological Review*. 27(4), 773-798.
- Germov, J. (1998) A class above the rest? In J. Allen (Ed) *Sociology of Education: Possibilities and Practices*, (pp.217-231). Katoomba: Social Science Press.

- Gifted and Talented Children's Association of South Australia (2004) GTCASA [Online] <http://www.gtcasa.asn.au/> [20/8/04].
- Haralambos, M. et al.(1996) *Sociology: Themes and Perspectives. Australian Edition*. Melbourne: Addison Wesley Longman.
- Hatch, J.A. and Wisniewski, R. (Eds)(1995) *Life History and Narrative*. London: The Falmer Press.
- Hattam, R. (1999) School reform and 'Howards Way'. In J. Spoehr (Ed) *Beyond the Contract State: Ideas for Social and Economic Renewal in South Australia*, (pp.244-265). South Australia: Wakefield Press.
- Hatton, E. and Elliot, R. (1998) Social justice and the provision of education. In E. Hatton (Ed) *Understanding Education* (2nd Ed), (pp.67-78). Sydney: Harcourt Brace.
- Heitmeyer, D. (2001) The issue is not black and white: aboriginality in education. In J. Allen, (Ed) *Sociology of Education: Possibilities and Practices*, (pp.211-232). Katoomba: Social Science Press.
- IGNITE (2004) IGNITE website [Online] <http://www.igniteprogram.com/> [20/9/04].
- Kemmis, S., Cole, P. and Suggett, D. (1998) Orientations to curriculum. In E. Hatton (Ed) *Understanding Teaching* (2nd Ed), (pp.139-146). Sydney: Harcourt Brace.
- Krisjansen, I. and Lapins, B. (2001) Gifted education in South Australia: The emerging student aristocracy. *Discourse: Studies in the Cultural Politics of Education*, 22, 49-66.
- Kyle, N. (1999) Reconstructing childhood. In D. Meadmore, B. Burnett and P. O'Brien (Eds) *Understanding Education: Contexts and Agendas for the New Millennium*, (pp.18-25). Australia: Prentice Hall.
- Lovat, T. (2001) What can we learn about yesterday, today and tomorrow?: Tracking social movements through critical curriculum analysis. In J. Allen, (Ed) *Sociology of Education: Possibilities and Practices*, (pp.88-106). Katoomba: Social Science Press.
- Margolin, L. (1994) *Goodness Personified: The Emergence of Gifted Children*. New York: Aldine De Gruyter.
- McCann, M. and Brunt, J. (1996) Gifted and Talented Students: A Brief Overview of Some Key Issues. Unpublished paper, Flinders University: Adelaide.
- McCann, M. and Henderson, L. (2004) Curriculum Differentiation and school provision for gifted students. EDSP 9015 Gifted education study notes. Flinders University: Adelaide.
- McWilliam, E. (1999) Individuality in education. In D. Meadmore, B. Burnett and P. O'Brien (Eds) *Understanding Education: Contexts and Agendas for the New Millennium*, (pp.26-31). Australia: Prentice Hall.
- McWilliam, E. (1999) The enterprising school. In D. Meadmore, B. Burnett and P. O'Brien (Eds) *Understanding Education: Contexts and Agendas for the New Millennium*, (pp.99-105). Australia: Prentice Hall.
- Meadmore, D. (1999) Mapping the landscape. In D. Meadmore, B. Burnett and P. O'Brien (Eds) *Understanding Education: Contexts and Agendas for the New Millennium*, (pp. 1-10). Australia: Prentice Hall.
- Meredyith, D. (1998) Corporatising education. In M. Dean and B. Hindess (Eds) *Governing Australia: Studies in Contemporary Rationalities of Government*, (pp.20-46). Australia: Cambridge University Press.
- Oakes, J., Wells, A.S., Jones, M. and Datnow, A. (1997) Detracking: the social construction of ability, cultural politics, and resistance to reform. *Teachers College Review*, 98(3), 482-510.
- Poynting, S. and Noble, G. (1996) Racism and the "common sense" of "learning styles". *Education Links*, 51, 16-19.
- Rimm, S. (2003) Underachievement: a national epidemic. In N. Colangelo and G. Davis (Eds) *Handbook of Gifted Education*, (3rd ed.). Boston, MA: Allyn and Bacon.

- Rosenwald, G.C. and Ochberg, R.L. (Eds) (1992) *Storied Lives: The Cultural Politics of Self-Understanding*, London: Yale University Press.
- Ryan, B. (1994) The new elitism: educational accountability as potential power. *Education Links*, 47, 8-11.
- Sapon-Shevin, M. (1994) *Playing Favourites: Gifted Education and the Disruption of Community*. New York: State University of New York Press.
- Sharp, R. (1998) Social class, policy and teaching. In E. Hatton (ed) *Understanding Teaching* (2nd edn), (pp.247-57). Sydney: Harcourt Brace.
- Silverman, L. (1994) *Asynchrony*. Gifted Development Centre. [Online] <http://www.gifteddevelopment.com/Articles/Asynchrony.html> [20/8/04].
- Silverman, L. (1997) Through the lens of giftedness. Paper presented to the 12th World Conference, Seattle, Washington: Aug 1, 1997.
- Silverman, L. (2003) Gifted development centre: A service for the institute for the study of advanced development. [Online] <http://www.gifteddevelopment.com/> [20/8/04].
- Staiger, A. (2004) Whiteness as giftedness: Racial formation at an urban high school. *Social Problems*, 51(2), 161-181.
- State Senate Inquiry (1988) *The Report of the Senate Select Committee on the Education of Gifted and Talented Children*. Parliament of Australia. [Online] <http://www.aph.gov.au/senate/committee> [30/8/04].
- State Senate Inquiry (2001) *The Report of the Senate Select Committee on the Education of Gifted and Talented Children*. Parliament of Australia. [Online] <http://www.aph.gov.au/senate/committee> [30/8/04].
- Vialle, W. and Geake, J. (Eds)(2002) *The Gifted Enigma: A Collection of Articles*. Victoria: Hawker Brownlow Education.
- Webb, J., Schirato, T. and Danaher, G. (2002) *Understanding Bourdieu*. Sydney: Allen and Unwin.
- Woods, D. (1998) Racism, reconciliation, rights: the 3Rs of indigenous education in Australia today. *The Australian Educational Researcher*, 25(1), 53-70.

Schooling, multiculturalism and cultural identity: Case study of Japanese senior school students in a secondary school in South Australia

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This article reports a case study about the process experienced by Japanese International students (JIs) in a suburban high school. The study examined the relation between schooling, multiculturalism and cultural identity. The research explored cultural identity as the outcome of contest: an ideological struggle over values, practices and cultural identity. The major findings of the study were that JIs negotiated new cultural identities in the process of facing difficulties of language, cultural understanding and racism as barriers. In the light of these difficulties three recommendations were made to educational policy makers. This research offers schools and educational policy makers ways to meet better the educational and cultural needs of students in the International Student Program (ISP). Also it contributes to a greater understanding of the contested relation between schooling, multiculturalism and cultural identity in contemporary Australian society.

Schooling, multiculturalism, cultural identity, qualitative methods

INTRODUCTION

My motive for choosing the theme for this research study was from my own experiences in life in Australia. The object of this study is to investigate the relation between schooling, multiculturalism and cultural identity. It focuses on the experiences of Japanese students who came to Australia to study abroad. Through a case study of one Adelaide suburban high school and its ISP, the contested idea of multiculturalism and the dynamics involved in the construction of cultural identity are explored.

In many ways, this study is as much about myself (the researcher), as it is about the researched (the Japanese students). I was born and grew up in a rural industrial city 80kms north of Tokyo. Just like other Japanese girls at that time I was brought up in a traditional way. My parents were very strict in keeping Japanese tradition alive in me. This included religion, customs and other cultural practices related to food and manners. While these still run strong and deep in me, I am different today. I no longer identify myself as a Japanese woman in a traditional sense. I am more multicultural.

My father died before I was 12 years of age. This was a very significant event in my life. I recall that from that point I learned that a life came only once and I wanted to make the most of my life. For me, this meant challenging some of the traditional ways of doing things my parents had worked hard to instil to me. This, of course, did not mean rejecting all Japanese culture as I knew it, but opening myself to other cultures.

I came to live and work as a teacher in Australia. I did not come as a tourist. I came as someone who wanted to experience other cultures: other ways of doing things and other ways of living.

During my early days in Australia, I missed Japanese food, Japanese language and a familiar way of living. However, as time went by, I started to enjoy Australian cultural practices like barbeques and what I saw as a more casual, so-called 'Aussie' way of living. Importantly, at the same time, I maintained some aspects of Japanese culture. My increasing comfort with an Australian way of life did not come at the expense of my Japanese culture.

Since I came to Australia I have been teaching Japanese language to Australian students in state secondary schools. During this time I have noticed greater cultural and linguistic diversity in South Australian secondary schools. For example, in the mid 1970s the students I taught were mainly from Anglo-Celtic and Southern European backgrounds. By the early 1980s I saw more Asian students in the schools in which I taught.

The school where I conducted a survey has an International student program (ISP) that is designed to provide opportunities for overseas students to study at identified state schools. I teach Japanese language to both JIs (Japanese International students) and Australian born students. Most JIs choose to study Japanese language.

While I worked as a teacher in a secondary school since I came to Australia, and particularly since I started to teach JIs, multiculturalism has been an interesting issue. My investigative mind has increased as time passed by and I decided to explore the issue. The investigation and exploration in studies were a huge challenge to me. I acknowledge the consistent encouragement and valuable suggestions of Mr Grant Banfield throughout my preparation and the writing of the research work.

AIM AND FOCUS OF THE STUDY

The focus of this study is on JIs who were enrolled in the school where I conducted a survey. This group was chosen because of their previously limited exposure to Australian culture. As the students came to Australia without their parents, it provided a unique opportunity to research and study the role of schooling in the making of cultural identity.

In addition, it provided an opportunity to consider the extent to which schooling can inculcate multicultural values in young people. However, as is shown, the idea of 'multiculturalism' itself is contested and problematic. The notion that 'multiculturalism' is a singular set of ideas and practices or the idea that the making of cultural identity is a simple process akin to changing one's clothes is fraught with difficulties.

These are things I knew intuitively before this study. I knew them as a Japanese woman who came to a new country and had to negotiate her way through new cultural worlds. I knew them as a teacher of Japanese students. I saw my students struggling (just as I did) with language, cultural understanding and, at times, racism. Our common cultural background and our similar experiences helped forge important bonds between us. As a teacher, this placed me in a unique position to understand and empathise. As a researcher, those common bonds provided a base from which I could interpret the experiences of, and empathise with, the Japanese students.

SIGNIFICANCE OF THE STUDY

This study is important for two reasons. First, by documenting how schools actively contribute to the making of cultural identity, this research may offer schools and educational policy makers ways to meet better the educational and cultural needs of ISP students. Secondly, its broader significance lies in its contribution to a greater understanding of the contested relation between schooling and multiculturalism in contemporary Australian society.

The research work begins with a consideration of the key concepts that underpin it: multiculturalism, ideology, and cultural identity. By taking a socially critical view of ideology,

multiculturalism is described as the outcome of struggle over values, practices and cultural identity.

METHOD

In this research the qualitative case study method is employed. The case study in this research is an example of Stake's instrumental approach, focusing on students' everyday lives at one school. Typical of qualitative case studies, it provides an example of real people in real situations that, hopefully, enables readers to situate everyday events within broader social and historical dynamics (Cohen et al. 2000, p.181).

According to Burns, qualitative forms of investigation tend to be based on a recognition of the importance of the subjective, experiential lifeworld of human beings (1997, p.11). By focusing on the everyday lives of JIs at the school where I taught, my study provided examples of real struggles in their life. During the process of the study, JIs and I quickly established mutual understanding and trust because I spoke the same language, had the same cultural background and lived in the same environment at school as they did. As a result their attitude was open and their expressions were frank. In this close relationship I was able to study the role of schooling in the making of cultural identity.

This qualitative case study was complemented by participant observation and interviews by applying triangulation methods to strengthen the trustworthiness of the data. Triangulation involves using two or more methods of data collection in the study of some aspect of human behaviour to improve data trustworthiness (Burns 1997, p.324). Triangulation techniques attempt to map out, or explain more fully, the richness and complexity of human behaviour by studying it from more than one standpoint and, in so doing, by making use of both quantitative and qualitative data (Cohen et al. 2000, p.112).

In this case study, I selected the site of a school at which the participants attended and where I was a teacher. For both the participants and myself the site was familiar and convenient. Thus, observation consistently proceeded inside and outside the classroom. Most of the student participants in the study were students whom I taught at the time of data collection. According to Hitchcock and Hughes (1989, p.172), the students and the researcher were able to interact comfortably with each other in familiar "arenas of interaction".

Some Japanese students were willing to talk to me in my classroom after lessons. This situation had the advantage of ensuring confidentiality when the students wanted talk in my classroom. Also I often tried to meet JIs during yard duty at recess times and lunchtimes in the particular area where they usually congregated. As soon as they left the classroom or I returned to my office, I recorded conversations and occurrences, and took field-notes. The observations were carried out in class and in the schoolyard during recess and lunch times. The schoolyard was a familiar and comfortable place for casual talks.

I took extensive field-notes during the time available. These were refined and became progressively more focused as the project progressed. As Burns (1997) has observed, in the early stages of a qualitative research project the investigator generally took down everything. However, over time, observations and field-notes become more selective. This was not to suggest that I became more distant from the daily lives of the participants, but it was an indication, as Patton (1990, p.46) emphasised, of "getting close to the people and situations being studied in order to personally understand the realities and minutiae of daily life".

Interviews were conducted informally and formally, and individually and in groups. In this study, informal interviews occurred spontaneously while talking with students casually inside and outside the classroom. In such interviews, students talked openly and frankly. Yard duty time in

the area where JIs gathered at lunch and recess times was a good opportunity for me to talk freely. They explained their concerns and problems during casual talks in the schoolyard and occasionally before and after lessons. Shy students who could not speak confidently in front of others tended to express their opinions more openly in informal interviews.

On the other hand, for interviews of a formal type the venue and the time were pre-arranged. Formal interviews took place in a vacant classroom at lunchtime and I asked participants prepared questions. I interviewed four JIs. I also interviewed two Asian students who were born in Australia to find their viewpoints about multiculturalism and four Anglo-Celtic students who were born in Australia to check consistency of data.

In individual interviews, participants talked about their lives personally without considering other listeners. In group interviews, participants were encouraged to express their opinions. Often one individual's opinion triggered the thought of another individual. Thus, I found that hesitant participants became more involved in the discussion.

The questions were structured and unstructured. In structured formal interviews, I asked closed questions to obtain specific information on particular topics. However, in more unstructured formal interviews, open-ended questions, which did not demand particular answers, were asked. Here participants could express their opinions, expand on information and explore issues. Employing both unstructured and structured interviews enabled the triangulation of methods and assisted in strengthening the trustworthiness of data. In a structured interview some students were reluctant to respond to open-ended questions, but a structured interview helped them to give specific answers to prepared questions. In informal interviews, additional questions were asked that related to issues previously raised by participants. The types of interviews can be seen in Figure 1.

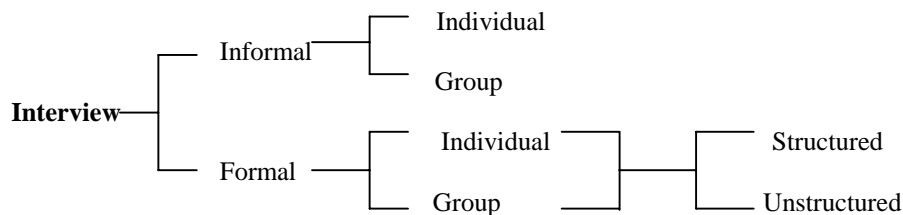


Figure 1. Types of interviews used in this study

I interviewed JIs and also conversed with them in their mother tongue. Speaking in Japanese allowed them to express their opinions without a language barrier. These conversations and interviews were then translated and recorded as field-notes and as interview transcripts in English. The danger here, of course, was a loss of meaning and emotion in the translation. As Patton put it:

There are words and ideas that simply can't be translated. People who regularly use the language come to know the unique cultural meaning of special terms, but they do not translate well. (Patton, 1990, p.338)

However, the advantage for me in this study was that I had an understanding of both Japanese and English. This meant that I was not simply a translator but an observer-participant with the same cultural understanding and an intimate knowledge of the contexts in which the data were collected.

DATA ANALYSIS

In this research, data analysis started while the fieldwork was still in progress. Indeed it was integral to the fieldwork. Frequent (or significant) events, ideas and observations were recorded as part of the fieldwork process. The ongoing analysis of data was very important in shaping the direction of the research. The act of systematically combing through field-notes resulted in the

emergence of new themes and the development of an understanding of the relations between themes. Data were analysed to find meaning by systematically arranging and presenting the information (Burns 1997, p.338).

I continued to keep field-notes for 19 months to minimise distorted information and to maximise building trust between the respondents and myself. As the site was the place where I taught for nine years, the knowledge of the site was sufficient. Thus, a natural atmosphere was kept and distortion of information from unfamiliarity was minimised. For 19 months persistent observation of issues on schooling, multiculturalism and cultural identity were pursued through three groups: Japanese, Australians, and Asians born in Australia. Notes from observation including field-notes and the interviews, from three different sources (Japanese, Australians, and Asians born in Australia), strengthened my findings.

The field-notes kept were a continuous journal of events and issues written as soon as possible relating to the research. The comprehensive field-notes were kept to capture deep and dense description of what actually happened at school on particular occasions. There was always an opportunity to address concerns again by meeting respondents at school. It was advantageous for me as a teacher and researcher in the place where I taught to be able to maintain on-going observation.

The information from interviews with Australians and Asians born in Australia assisted in avoiding a one-sided story told by Japanese students. Their responses provided a check for the data collected from Japanese students. For example, Japanese students commented on Australian life negatively in the early stages of their stay. However, Australian students and Asian students born in Australia gave opposite viewpoints for the same issues. The main factors such as issues and problems that emerged in formal and informal interviews were pursued by asking further questions as soon as possible, without re-arranging a visit with the respondents. Such a situation provided rich sources for depth of information.

At the research site the colleagues who were involved in the ISP helped to provide necessary information. These exercises helped me to be honest about what I was researching and to clarify vague areas of information necessary to the research. At the same time outside the research site the issues have been regularly reviewed, discussed with my supervisor, who examined them as a disinterested person. As the research became more focused on the theme from analysis of field-notes, the information from the interviews the notes concentrated more on issues based on the theme. In this way analysed data became reliable to a considerable extent.

BARRIERS TO MULTICULTURAL UNDERSTANDING

The study presents multiculturalism, not as an unproblematic singular entity but one associated with power relations between different groups in society. On this account meanings and their associated practices are the objects of struggle.

From analysis of data gathered during the fieldwork, three barriers emerged. They were language, cultural understanding and racism. They were problematic and affected power relations between different groups. JIs negotiated new cultural identities in the process of facing difficulties of language, cultural understanding and racism. The outcome shaped by this inductive analysis can be seen in Figure 2.

Language

Language was considered to be important for communication in a new country. In one of the interviews, a Japanese student showed how language difficulties were not only barriers to good communication but they also limited the possibility of establishing friendships with Australian born students.

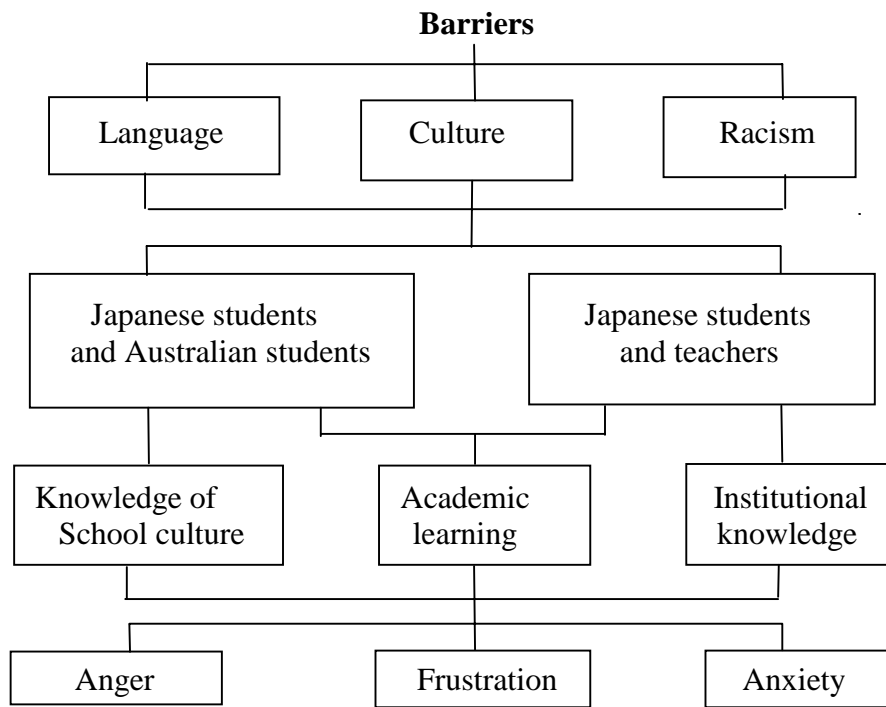


Figure 2. Emergent Themes - Barriers to Multicultural Understanding

Cultural understanding

Not only English skills but also cultural understanding was required to understand jokes. Difficulty in telling a joke related to a lack of cultural understanding: an ability to read or appreciate the collective history of what McLaren (1999, p.6) sees as the struggle over verbal and non-verbal symbols, “the interpretations of metaphors, icons, and structures of meanings”. Without such understanding came a feeling of cultural awkwardness and difference. It must be stressed that cultural difference was not the issue when considering barriers to multicultural understanding. Intolerance of difference was crucial. Where issues of intolerance surfaced most starkly was in relation to racism.

Racism

It was not unusual for Japanese students to be the objects of racism during their stay in Adelaide. Racism took different forms: direct or indirect and verbal or non-verbal. The distinction between direct and indirect rested on whether direct reference was made to race or ethnic origin through some form of verbal or non-verbal communication. As such, direct verbal racism would be the act of making racist comments directly towards a person or persons of a particular ethnic group. On the other hand, direct non-verbal racism was expressed through the written form or through bodily signs and symbols. Indirect verbal racism might surface in a person copying or correcting a foreign accent. An example of indirect non-verbal racism would be the act of avoiding mixing with people from particular ethnic groups or setting them up to get into trouble (see Figure 3).

The experiences of the Japanese students presented in the study reflected that multiculturalism was an active and continuous process involving the shaping and formation of new cultural identities.

MULTICULTURAL IDENTITIES

Early during their stay in Australia, it was common for Japanese students to emphasise their own culture and comment negatively on Australian culture. They thought a great deal about their home

in Japan and criticised Australian ways of doing things. They often described Australians as lazy, disrespectful or impolite. However, after their first few months in Australia, the Japanese students began to see Australian life in a more positive light. They also began to offer critical reflections of Japanese ways of doing things.

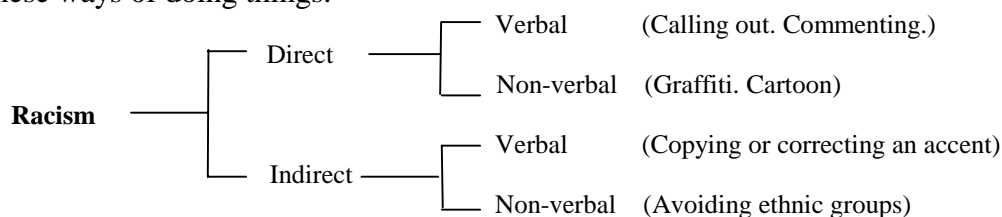


Figure 3. Forms of Racism

One of the Japanese students showed an ability to see Japanese culture from a distance – to step back and reflect critically. She saw herself and Japanese people in general, as introverted and shy. People from other countries and cultures were different. As Japanese students improved their English and came to a greater understanding of Australian culture, they saw aspects of an Australian way of life being quite attractive. This was particularly the case for what they saw as the friendliness and easygoing nature of Australians.

This positive attitude towards Australian culture was also reflected in viewpoints of Asian students born in Australia. An Asian student, the daughter of a Chinese mother and part Asian father, recognised the friendliness and openness of the people in Australia. Asian students who were born in Australia were generally very positive about their parents' culture. They also expressed positive attitudes towards Australian culture. Being bi-cultural and often bi-lingual, children of immigrants had some understanding of their parents' culture as well as Australian culture. One such student, an Asian student, who was born in Australia to Vietnamese parents was proud of his Vietnamese culture. He spoke Vietnamese, attended cultural festivals and visited his parents' country. He considered himself to be Asian when he mixed with Asian people. However, it also felt natural for him to mix with Anglo-Celtic students. He considered himself to be multicultural. However, for him, being multicultural did not mean discarding his Vietnamese culture. This surfaced strongly in a discussion on culture and competition. He considered that the people in the same ethnic group had a competitive attitude and performed better. He showed that multiculturalism did not mean 'sameness'. Competition for him was a marker between Vietnamese and Australian cultures that he wanted to retain.

In this light, multiculturalism is an active and continuous process involving the shaping and formation of new cultural identities. The experiences of the Japanese students presented in this case study reflect this.

OUTCOMES AND RECOMMENDATION

The JIs experienced barriers of language, cultural understanding and racism. Those problems caused difficulties for new arrivals, Australian born students and teachers. The JIs often experienced great anger, frustration and anxiety from these difficulties. However, through those difficulties, Japanese students began to see their own culture in a new light and take on elements of the new culture. In this way, those barriers were more like hurdles to be negotiated as part of the ongoing contest over Australian multiculturalism.

Language

The language barrier was the principal and immediate difficulty for newcomers identified in this study. Their English skills were limited and this left them unable to express themselves fully. This

often hindered them from adequately communicating with teachers, school counsellors, officers of International Education Services, their host family and Australian students.

Cultural understanding

Japanese students felt that they were not always accepted by Anglo-Celtic and European students. European students could make friends quickly, but it was difficult for Japanese students to make friends. Often Australian born students distanced themselves from Asian students. This situation made it hard for the more reserved Japanese students to mix with Australian students. However, the benefit for Japanese students living in a new country is that their original identity with Japanese culture is shaped in a new country and they adapt themselves. In order to change their identity they face constant conflict between social groups and struggles as they search for ways to be accepted in a new society.

Racism

The case study indicated racism occurred in the school. The students with a different cultural background who were in the minority tended to be targeted for annoyance by those in a majority group. This occurred directly or indirectly and verbally and non-verbally with remarks relating to race or ethnic origin. Examples were found such as name calling or annoyance among students. As a result of these influences JIs felt unwelcome while they were living in an unknown society without their family to talk to about their difficulties. There is a real danger of ethnic groups being reduced to so-called 'add-ons' to the dominant culture. Such conservative multiculturalism was observed in this study with JIs expected to adapt to dominant cultural expectations like accepting the new culture almost immediately on their arrival in the new country.

Recommendations

In the light of these difficulties three recommendations were made to educational policy makers. First, it is essential that JIs have access to counsellors who speak the same language, have the same cultural background and understand students' school life. Second, it is necessary to provide training courses for such counsellors appropriate to these students. Third, public recognition is important for the minority group. It is also beneficial for Australian students to have opportunities to know Japanese International students.

I hope that this research will offer schools and educational policy makers ways to better meet the educational and cultural needs of students in the ISP. I also hope that this research will contribute to a greater understanding of the contested relation between schooling, multiculturalism and cultural identity in contemporary Australian society.

REFERENCES

- Burns, R. (1997) *Introduction to Research Methods*, (3rd ed). Melbourne: Longman.
- Cohen, L., Manion, L. and Morrison, K. (2000) *Research Methods in Education*, (5th ed). New York: Routledge.
- Hitchcock, G. and Hughes, D. (1989) *Research and the Teacher*. London: Routledge.
- McLaren, P. (1999) *Schooling as a Ritual Performance—Towards a Political Economy of Educational Symbols and Gestures*, (3rd edn). Lanham: Rowman and Littlefield.
- Patton, M.Q. (1990) *Qualitative Evaluation and Research Methods*, (2nd ed). Newbury Park: Sage Publications.

Accomplishing new literate practices: Students with disabilities rewrite the story

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This paper relates a teacher's story about a classroom-based research project undertaken with a Year 3 to 7 Special Area Resource class, located in a Mainstream Primary School in the south west of Adelaide. The class consisted of 11 students verified as students with disabilities under the DECS disability criteria. The students' age range (from 8 to 13 years), variations in physical growth and development, different experiences, intellectual abilities and disabilities make co-teaching this group a challenging undertaking. Another difficulty faced involved establishing a sense of cohesion amongst this group who are taxied daily to and from the class from a number of suburbs. Despite these differences, the students shared an interest in popular culture. This opened an opportunity to engage them in the literacy work of the classroom through the use of media along with information and communication technologies (ICTs).

ICT, e-book, students with disability, literacy

WHAT HAPPENS WHEN STUDENTS WITH DISABILITIES DEVELOP AN E-BOOK BASED ON A FAMILIAR POPULAR CULTURE TEXT?

Imagine a group of 11 young people between 8 and 13 years of age in a single classroom. Imagine again those 11 young people with a range of disabilities (physical and intellectual) being taxied between home and school daily. Living out of the local area means that these students have little or no opportunity to interact or socialise with each other or with their same-age peers from within the school. Welcome to our Special Area Resource classroom, where group cohesion was minimal. Put plainly, our students simply could not get along – a state of affairs that was directly affecting our ability to teach and their ability to learn.

At the time of this research, our teaching team consisted of two teachers working part-time, with additional support provided by two School Services Officers (SSOs). As a team we took great comfort in being able to share the load, talk through issues and plan together. What had become blindingly evident to us during the first term was the need to try something different. We agreed that there was a need for a structured social skills program and subsequently all attended training and development in the *Stop, Think, Do: Social Skills Program*, during the Term 1 holiday break. We also decided that we needed to motivate the students somehow and agreed that:

- our students appeared to remain on task when accessing the computer; and
- students we had had in previous years had cooperated more when working together, using the computer to achieve a group goal.

We decided to base our Term 2 unit around the concept of 'getting along'. How to do so in a way that would engage our students but not rely on their ability to read and comprehend large amounts of written text was our next question. After much discussion, we decided to:

- use the popular culture movie “SHREK!” (which proved familiar to all the students) as the focal point of the unit;
- adopt a cross-curricular approach; and
- embed a structured social skills program.

Together, my co-teacher and I worked to plan the teaching and learning activities that we believed would best achieve our desired outcomes. What were we aiming for? The main aim of the unit was for our students to understand the term ‘getting along’ and develop behaviours such as managing their impulsivity, listening to others with understanding and empathy, and thinking interdependently. The story of Shrek provided us with an example of how friendships can develop and grow, in addition to what ‘getting along’ looks like, sounds like and feels like, in a format that our students could respond to.

Academically, our unit of work titled “SHREK: Getting Along” was designed with links to the SACSA Framework including Essential Learnings, Key Competencies, Habits of the Mind as well as subject area specific learning outcomes for English, The Arts, Technology, Studies of Society and the Environment, and Health and Physical Education.

BEGINNING THE UNIT

We read and compared the original text by William Steig (1990) and the modern version (based on the movie) by Weiss (2001), discussing similarities and differences in the characters, the story and the outcomes.

Concurrently, we viewed the movie “SHREK!” which involved repeated and interrupted viewings of particular sections (scenes) of the video with specific learning outcomes in the area of English attached to each scene viewed. Literacy tasks included: character profiles; words; definitions and pictures matching; identifying and matching words and actions; verbs (past tense to present or future); reading and understanding signs; sentence structure; and reading comprehension. Our students participated willingly and enthusiastically in these tasks, experiencing a high degree of success in the grammar-based tasks – an area in which they had generally struggled.

As a group, we re-wrote an alternative ending, which was a task much easier designed than done with this group of students. By their very nature, these students are comfortable with certainty, familiarity and repetition; typically they dislike and resist change. They can be literal rather than imaginative and find writing stories of any kind just too difficult. However, with persistence and lots of encouragement, we wrote an alternative ending (with a twist) to this story that they all knew so well.

HOW DID THIS BECOME AN ICT TASK?

My co-teacher and I had created e-Books with previous students (for example, *The Solar System*, *Australian Animals*, *Hickory Dickory Dock*) and agreed that this was a way of motivating our students to engage in literacy and ICTs simultaneously. Hence, we decided to create a class e-Book to share our alternative ending for SHREK with a wider audience that could include other classes at school, students’ families and friends.

Each student created a page of our alternative ending using Microsoft PowerPoint. Having written our alternative ending in a linear fashion and as a group, no specific individual had ownership of any one particular sentence or idea. Therefore, we needed an equitable way of ensuring that all 11 students had a page of our ending to illustrate and type. Why? Basically we were trying to strengthen group cohesion. Put simply, after I had divided our new ending into 11 logical sections, we had a structured but random draw, to establish who would illustrate and type the text for each page of our new story.

Probably, the most beneficial aspect of this whole process was how easily and happily the students accepted what part of the story they would illustrate and type. Students accepted this process as being equitable, with no individual feeling that any other had received extra favour or that any other would receive more kudos, which was a wonderful achievement and a positive move along the continuum of 'getting along'.

PRODUCTION BEGINS

Initially, the students illustrated their individual pages on paper. Once completed, students were assisted to scan their illustrations and save them into their personal folders on the school network.

The next step involved the students inserting their personal illustrations as the backgrounds for their pages (that is, slides). They then created text boxes and entered their text on their pages. We had established a list of assessment criteria whilst planning the unit of work and our students were informed of these before beginning any work on their own pages. Specifically, students were informed that each individual page would be assessed by a teacher and also by a small group of their peers who would both be assessing a number of the components of each page (for example, font size, type, colour, location; appropriateness of background pictures). The students made their own decisions about these aspects of their pages. They were also responsible for editing what they typed, checking that they had copied the text correctly. Editing is a task these students find most difficult on paper ... and equally so on the computer.

SUPPORTING THE STUDENTS WITH ICT

For a number of the group, this had not been their first encounter with either the hardware or the software. However, their difficulty in retrieving skills and prior achievement from long-term memory dictated a need for me to revisit the basics required. I used a range of strategies, depending on each particular student's needs to ensure that what was required was understood. Some students were very capable at following step-by-step verbal instructions to achieve a task (for example, locating a file or folder on the network, inserting an illustration as background). Others found verbal instructions difficult or confusing, requiring me to model how to do a specific step for them followed by talking them through tasks.

While the students were creating their individual pages, my task was to create the summary pages for the story up to the point at which our alternative ending began. As each student indicated satisfaction with his or her page, assistance was provided via oral prompts to enable each student to import his or her page into the main PowerPoint file at the appropriate point. Initially, I provided the oral prompts. However, as the more capable students became more confident, they became the peer tutors who provided suitable oral prompts. This was most gratifying to observe, and demonstrated how far we had come along the continuum of 'getting along'. It became clear that, as the students achieved success, they were more inclined to want to share their skills, their understandings and their knowledge with their peers, which had the desired result of improving group cohesion. I note though, that it is often disconcerting to hear yourself talking when in fact it is not you, but one of the students instructing another.

We assisted the students to record themselves, reading their own text and to insert this recording into their pages. During this stage of the project, the students were highly critical of themselves, persisting with rehearsing and re-recording their script until totally satisfied with the finished product. Students also volunteered to read and record the text in the summary section of the e-Book. This was a clear demonstration of how they valued their own work and achievements as well as the product as a whole. Further, it required them to be persistent to achieve the desired outcome, which was another benefit of the unit.

During the course of the unit the students accessed a range of resources including web links to sites related to the movie SHREK, sites related to both printed versions of the text and links to a range of SHREK based activities on the web.

We listened to and enjoyed the soundtrack from the movie during the term and two tracks from this source were included in our finished product, at the start and finish of our e-Book. Pages (slides) acknowledging all of these resources were created along with a front cover, last page and table of contents.

CREATING AN INTERACTIVE TEXT

Collectively, students and staff envisioned the finished product as an interactive e-Book with the reader able to enter and exit at his or her chosen point of the text, as might be done with a real book. We wanted our readers to be able to move forwards or backwards a page at a time, or if preferred, to access specific points of the story by selecting from a table of contents. We also wanted our readers to be able to enjoy the web resources and activities that were accessed during the unit. The problem solving of how to achieve these outcomes was my responsibility. However, once a group of buttons was created and tested thoroughly, I worked with each student to assist them to insert the group of buttons into their own pages.

Decisions about the interactive options that were included required our students to think beyond themselves, to consider what others might want to see, to do, and to read. This was possible due to the students personal experiences using ICT for pleasure, with eight of the 11 having regular access to ICTs at home. Each had a view on what was required, based on their own experiences with a favourite software program and my co-teacher and I marvelled at their contrasting views. Considerable discussion and negotiation was required to reach a consensus as to what the majority considered most important inclusions in our interactive text. The following points were agreed upon:

- We did not want our e-Book just to go in one direction.
- Copyright laws dictated that we needed to acknowledge all sources used.
- Our desire to have a finished product that reflected the fun aspects of the unit:
 - Reading the books
 - Viewing the movie
 - Listening to the soundtrack
 - Accessing various web sites
 - Participating in concrete technology activities
 - Creating puppets

Our students created a complete and polished product that had value for them. The added bonus is that it is of value to others as an interactive product that can be used over and over again for pleasure. Their level of success is evident to all who interact with the finished product. More importantly, it is evident to the students themselves, resulting in:

- improved self-esteem;
- greater confidence in their own abilities to read, write and re-write a story that is entertaining for a broad audience;
- increased enthusiasm in their learning; and
- a desire to do it again.

While creating an e-Book did involve paper-based activities including drawing the backgrounds and drafting the alternative ending, it did prove to be far more involved than creating a paper book. It also relied heavily on the availability of resources:

- human (adults to support, prompt, assist, instruct and with necessary expertise with aspects of the technology); and
- technological (computers available and functioning reliably, availability of appropriate software, scanner, Internet access for researching and activities, microphone and CD burning capabilities).

REWRITING THE STORY: WHAT DID THE STUDENTS ACHIEVE USING MEDIA AND ICT?

I was asked by a colleague to consider the aspects of why this unit worked for these students. To summarise the benefits of this task:

- it was visually appealing,
- it had a purpose,
- it was stimulating,
- it was entertaining and fun,
- it provided variety, choice of activities,
- the students could relate to the characters, to the story and to the music,
- it afforded the students an opportunity to observe, verbalise and discuss feelings with their peers in a non-personal way, and
- it enthused them in a way that we had not seen before. They wanted to work on the e-Book and continuously asked to do so.

What, for us, was most rewarding? Hearing our students offering to help each other accomplish components of the project; complimenting each other on their achievements; encouraging each other to persist when things weren't going well; seeing our students working together; seeing the degree of group cohesion increase; and knowing that, for all of us, being together in the classroom could be, and now was, an enjoyable experience where teaching and learning could, and did, occur. In summary, what was most rewarding for us was seeing the students getting along.

Although this project was incredibly time consuming and labour intensive in terms of supporting the students to access the hardware and software effectively, the rewards for all involved made it worthwhile. These students had each contributed to creating something very special, as a group and cohesively. This was a phenomenon we thought impossible at the end of the first term of the school year. Each student was provided a burned copy of our finished product on CDROM so that they could share their achievements with family and friends. The feedback from these sources has been most pleasing. Furthermore, our finished product, "SHREK: An Alternative Ending" is accessible on our school Intranet, along with the unit plan and assessment criteria.

REFERENCES

- Steig, W. (1990). *SHREK!* Harper Collins Production.
- Weiss, E. (2001). *SHREK: The Novel*. Puffin Books Publication.

“In the eye of the beholder ...”: Girls’, boys’ and teachers’ perceptions of boys’ aggression to girls

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Because children and young teenagers usually associate in same-sex groups, psychological research concerned with adolescent aggression has often concentrated on within-sex relationships. However, during adolescence, boys and girls increasingly interact socially. This paper reports a study of boy-to-girl aggression as perceived by girls, boys and their teachers. Focus group discussions were conducted with groups of Grade 9 adolescents (aged between 14 and 15 years) across four middle class schools in metropolitan Adelaide, South Australia, and individual interviews were conducted with their teachers. Thematic analyses revealed different understandings by girls, boys and teachers of the same behaviour. Girls and teachers reported that boys frequently use verbally offensive language including sexual harassment toward girls but boys argued that they were often not being malicious but rather just joking and that girls over-reacted. Girls, boys and teachers agreed that boys often harassed girls in order to impress other boys and for their own entertainment or fun. Teachers also emphasised home and cultural background factors in influencing boys’ behaviour toward girls. All three groups agreed that boys’ behaviour toward girls could have devastating effects on the girl victims. Girls’ appearance was reported as a major contributing factor associated with boys’ victimisation such that, while physical attractiveness could protect a girl from boys’ meanness, over-weight girls or those seen as being unattractive or ‘uncool’ were vulnerable. However, girls were not seen universally as passive victims. Girls, boys and teachers reported that many girls responded assertively and even matched boys’ aggression. Girls and boys agreed that teacher intervention was often not helpful. In contrast, teachers reported the effectiveness of school anti-harassment policies and a range of successful interventions. This study highlights the importance of understanding behaviour from different perspectives and confirms research that emphasises the crucial role of the peer group in influencing aggressive interactions among students in schools.

Aggression, cross-sex aggression, adolescence, multiple perspectives, peers

INTRODUCTION

In previous research, there has been a focus on same-sex aggression (namely, behaviour which is intended to hurt or harm others) among school-aged students. For instance, Bjorkqvist, Osterman and Kaukiainen (1992) argued that because boys and girls mixed predominantly in same-sex groups, it made more sense to study within-sex aggression. However, during adolescence, boys

and girls increasingly mix and there have been some studies of cross-sex aggression. For example, although Russell and Owens (1999) reported evidence that boys and girls occupied “separate spheres”, these authors noted that cross-gender interactions might provide a parallel social context in which children learnt somewhat different behaviour patterns. In their study, Russell and Owens (1999) found that in the cross-sex context, boys and girls tended to use a little more of the style of aggression typical of the other sex (that is, when compared with within-sex forms of aggression, girls tended to use a little more overt aggression to boys and boys tended to use a little more indirect or social forms of aggression toward girls).

Although the literature specifically on bullying (a form of aggression in which there is an imbalance of power between perpetrator and victim) indicated that boys were generally more victimised than girls, figures presented by Rigby (1998) showed that girls in co-educational high schools were more victimised than those in single-sex schools, and at a similar level to boys. Tulloch (1995) found that girls were as victimised as boys in Grade 8, and that girl victims reported being physically bullied, picked on and teased more by boys than by girls. Victimisation of girls by boys was thus an important aspect of the co-educational high school environment.

It is only relatively recently that research in the broadly-defined field of peer aggression has begun to address the issue of cross-sex aggression. For example, Crick, Bigbee and Howes (1996) found that 9 to 12 year-old students agreed that the commonest form of cross-gender aggression was the verbal insult. Paquette and Underwood (1999) asked young adolescents to provide examples of various types of aggression they had experienced: over 20 per cent of boys and over 30 per cent of girls gave cross-gender examples. Although physical aggression towards boys was usually from other boys, in nearly half the incidents of physical aggression towards girls, boys were the perpetrators.

The sexual harassment literature describes the serious negative effects of boy to girl harassment. For example, Collins (1997) found that in South Australia, 44 per cent of high schools students reported that verbal sexual harassment happened often to girls in their school. Bayliss (1995) found that girls chose academic subjects on the basis of avoiding harassment and many of the girls felt so victimised that they wished to leave school.

Any examination of between-sex aggression would need to take account of the perspective of the reporter. Hudley, Wakefield et al. (2001) reported that a particular behavioural episode might be judged differently by perceivers differing in gender. Murnen and Smolak (2000) found that ten-year-old boys and girls had different perspectives on sexually-toned behaviour from opposite-sex peers – girls were more likely to see the behaviours as frightening and boys as flattering. Owens (1998) reported that boys estimated less boy-to-girl aggression than did girls and teachers. Tulloch (1995) also found that girls reported more boy-to-girl bullying than did boys. In quantitative studies, the problem of shared method variance highlighted the importance of getting different perspectives when measuring amounts of social behaviours including aggression.

Investigations of aggressive behaviour among school students have revealed gender distinctive motives for within-sex aggressive behaviour. Girls’ tendency to harm each other in indirect ways was consistent with relational goals associated with manipulation of friendships (Crick and Grotpeter, 1995; Lagerspetz, Bjorkqvist, and Peltonen, 1988; Owens, Shute, and Slee, 2000a; Owens, 1996). Furthermore, our own research (Owens, Shute, and Slee, 2000b) has indicated that the alleviation of boredom and creation of excitement were also important factors in girls’ aggressive behaviour toward peers. Boys’ greater tendency than girls to use more overt forms of aggression is consistent with their gender typical goals of instrumentality and dominance (Crick and Grotpeter, 1995; Lagerspetz et al., 1988; Maccoby, 1990; Owens et al., 2000b). These understandings are helpful in relation to interventions to redress teenage peer aggression. One aim

of the current study was to investigate explanations for peer aggression, but in the cross-gender rather than same-gender context.

Studies of within-sex aggression have considered the characteristics of typical victims (Olweus, 1999; Rigby and Slee, 1999). Olweus (1999) summarised a number of studies in arriving at the following list of characteristics of typical passive or submissive victims: they were, insecure and lacking in self esteem; they felt stupid, ashamed and unattractive; they were unable to retaliate; and they felt lonely and abandoned at school. Olweus described another group of children as provocative victims who tended to irritate and antagonise their peers and who might react aggressively to victimisation. In the current study we asked the question about vulnerability in the across-sex context, namely, what are the characteristics of girls which make them vulnerable or typical targets of boy peers?

There is a comprehensive literature on interventions particularly for boy-to-boy aggression (Coie, Underwood, and Lochman, 1991; Olweus, 1991; Rigby, 1996, , 2002). Our own research on interventions in relation to girl-to-girl aggression (Owens, Shute, and Slee, 2001) suggested that there was a mismatch between what girls and teachers thought about the success of interventions to redress indirect forms of aggression. In this current study, we considered the views of girls, boys and teachers on interventions to redress boy-to-girl aggressive behaviour.

In summary, the present study aimed to investigate the perspectives of girls, boys, and teachers on the nature of boy-to-girl aggression among teenagers, drawing data from four schools in the Adelaide metropolitan area. With a population of just over one million people, Adelaide is the capital city of the state of South Australia. In this paper, we provide a brief overview of the study through reporting the following elements:

- types of boy-to-girl aggression,
- effects on girls,
- explanations for this aggression,
- characteristics of victims,
- girls' responses to boys' aggression, and
- views on interventions.

METHOD

Participants

The participants were 40 girls and 32 boys randomly selected from Grade 9 classes (14-15 year-olds) and seven of their so-called 'key' teachers (namely, teachers to whom students are likely to come to discuss peer relationship issues, such as, student counsellors or grade level coordinators) from four lower-middle to middle-class co-educational secondary schools in metropolitan Adelaide, South Australia. We have named the schools in this study Balton, Hyland, Hills and Valley.

Procedure

The students were interviewed in small groups (5 to 7 students per group) by a female graduate Psychology student who was experienced in working with youth groups. In order to encourage discussion, a scenario was presented in which a new girl had just arrived at the school and at recess time she joined one of the boy groups instead of any of the girl groups. The participants were asked to comment on this behaviour, and then discuss relationships between boys and girls at their own school. The interviewer used a semi-structured interview guide to address the research aims. This procedure was modelled on that adopted by Owens, Shute, and Slee (2000a).

Analysis of the Data

The interviews were taped and transcribed and a thematic analysis was conducted by the first author with the assistance of the NUD.IST qualitative software program.

Agreement Checking

In order to check reliability of the material classified under categories and codes determined by the first author, an agreement checking exercise was conducted. Approximately one fifth of the transcripts were coded by the second and third authors and a graduate Education student external to the project. The level of agreement with the first author was approximately 85 per cent. The coding was discussed and any differences were resolved between the different coders.

RESULTS

Types of Aggression by Boys to Girls

Use of Physical Aggression: "Guys never hit girls"

Boys, girls and teachers were in agreement that there was very little physical aggression by boys to girls. The boys and girls relied upon the concept of a social rule or the stigma involved in boys hitting girls. For example, a girl from Balton reported: "There's a social rule that guys can't beat up the girls." A Balton boy said: "It's an actual rule. Unwritten rule." As a boy from Hyland put it: "You'd be called a girl basher and stuff." The teachers, too, agreed that boys were very seldom physically aggressive to girls. A female Hills teacher explained the lack of physical aggression by boys as resulting from a sense of "old fashioned" chivalry.

Use of Verbal Aggression: "It's usually sexually oriented"

In contrast to the rare use of physical aggression, the girls in all four schools reported the use of verbal aggression by boys to girls to be very frequent. The girls agreed that nasty comments by boys were often about girls' physical appearance (for example, breast size) or about perceived sexual reputation. As a Hills girl said: "I get called a whale a lot." Later the same girl reported: "They pay you out if you're not the picture perfect long blonde hair, big boobs, long legs."

Unlike the girls, boys generally reported that there was "not much" verbal aggression by them to girls. They argued that when it did occur, they were "only joking" and that girls took it too seriously. Some boys, however, did admit to sexual harassment. For example, a Balton boy reported: "A boy might go up to a girl and ask her is she's a virgin and stuff like that." The following interchange between the Interviewer (I) and a group of boys (B) from Hills is illustrative:

I: What sorts of things would you pay a girl out about to do with sex?

B1: She never gets any.

B2: She gets too much

B3: Or she sleeps around, you know!"

Like the girls, the teachers were convinced that boys do verbally harass girls, often about appearance and reputed sexual behaviour. The female counsellor from Hyland reported that the harassment was "usually sexually oriented, so it might be slut or it might be something to do with their body shape – fat or big tits or no tits or something like that." Unlike the boys, the teachers believed that the boys were not joking but that their behaviour was deliberate and nasty and intended to hurt.

Indirect Aggression: "She slept with him"

The girls reported that boys often spread rumours, exaggerating about girls' sexual behaviours at social events such as parties. In contrast, many boys denied this, although some admitted it: "Then everyone throughout the school just earmarked her as a slut. And then they keep changing it around, and it gets worse and worse. Yeah, and it's funny." (Hills Boy). The teachers were uncertain of the extent to which boys were involved in spreading rumours about girls. Teachers' awareness seemed to be related to their role within the school – for example, student counsellors appeared more aware of this type of behaviour than did subject teachers.

Effects on Girls***"They'll probably cry themselves to sleep"***

Boys, girls and teachers were in agreement that boys' harassing behaviour toward girls could have devastating effects on girls. A girl from Hills reported her fear: "I try to get someone to walk across the quadrangle with me because I don't feel comfortable walking across there because they might say something and you're by yourself." While boys acknowledged the pain for girls, they maintained that girls often took things too seriously. A boy from Hyland explained it like this: "All the girls take it to heart. And then they'll go have a cry: "I'm all ugly and that." The teachers were particularly concerned about girls being absent from school and actually transferring to another school because of their treatment by boys.

Explanations for Boys' Aggression to Girls***Impressing Other Boys, Gaining Acceptance from the Group: "What the mates think is really important"***

Girls, boys and teachers agreed that boys often were verbally aggressive to girls as a way of impressing other boys and being "macho and tough." A girl from Balton reported: "I found that, like, boys are horrible to you, they tease you and they're horrible when they are in a group, like, they put on a show, but then you get them by themselves, they are really nice to you." A Balton boy argued that boys "paid out" girls "to impress their friends or from peer pressure." A female teacher from Hyland described boys' behaviour as arising from a "pack mentality." She continued: "They'll probably do things or say things that if they were by themselves they probably wouldn't."

Fun or Entertainment: "They do it to get a laugh"

Girls, boys and teachers agreed that boys often said nasty things to girls as a form of fun or entertainment for themselves. A girl from Hills reported: "They'll do it to give themselves a laugh. For their own entertainment." A girl from Valley said: "I think they're just bored." A boy from Hills reported: "Maybe some people just want to have a joke once in a while. And it's a good laugh." A female Hills teacher said: "It's to make themselves look tough and strong and funny ... and to enhance that boys' reputation as someone who's very funny and popular."

Impressing Girls or Flirting: "It's a kind of flirtation"

Some boys and teachers (but no girls) reported that boys sometimes verbally "put down" girls as a way of trying to flirt with them. A Hyland boy said: "to impress girls, flirt with them." A male Balton teacher reported: "It's competition and trying to impress." Later that same teacher said: "It's all that strutting about. It's all sex and natural."

Power: "They abuse their power"

Some girls and teachers but no boys used power as an explanation for boys' aggressive behaviour to girls. A girl from Hills reported: "I think it just makes them look powerful." The Hyland female

student counsellor reported: "It's a power and a put down thing." A female Hills teacher reported: "My general philosophy about bullying is it's very much into power."

Revenge: "They've been mean to you"

Several of the boys mentioned the idea of retaliation for something that girls did. A boy from Hills suggested: "Mainly because they are mean to you." Consistent with the boys, some teachers were aware of the revenge motive. The Hyland female student counsellor reported: "For some boys it's because they've been hassled by the girls. And they say things back." None of the girls mentioned the revenge motive.

Teacher-Only Explanations: "They come from a sexist home background"

The teachers provided several further explanations that were not evident in the boys' and girls' transcripts. The first of these is sexism. The Hyland female student counsellor described the type of boys who harass girls as those "who often come from a male dominated family. Boys who have a particular view of women, as not equal to men." The second additional explanation is one related to the boys' home backgrounds. This is one that a number of teachers emphasised and is illustrated well by a Balton male teacher: "It's culturally at home, whatever the background, all they're seeing is role modelling. It's what happens at home: This is what I'm expected to do." Related to home background is a cultural background explanation. The teachers who subscribed to this idea argued that poor treatment of females arise in part from immigrants who came to Australia with a background of male domination within the family. A male Balton teacher explained: "Certainly it's cultural. It is culturally brought to school and we had boys treating female teachers with almost disdain."

Types of Girl Victims

"You need to be cool and good looking"

Boys and girls agreed that whether or not a girl became a victim of boys' nasty verbal aggression depended largely on a girl's physical appearance. Attractiveness served to protect a girl from boys' meanness. The following exchange from two Hyland girls (G) is illustrative:

G1: "It depends if she's like really really pretty, and she wears, like, mini skirts and stuff to school."

G2: "Ah, the guys would love that!"

Other factors that might contribute to victimisation included girls who lacked self confidence, and how "cool" a girl was perceived to be. A female teacher from Hills reported: "Some girls who are obviously different, in their mannerisms or they say things that are not within the narrow confines of what's cool or appropriate to say." Girls also reported that it was dangerous to react to provocation by the boys. As one girl said: "Guys love getting a rise out of girls." The female Hyland counsellor reported: "The girls who laugh it off and it doesn't affect at all ... they don't get harassed again." The girls, boys and teachers also emphasised the importance of having friends. A girl from Balton reported: "If you're part of a big group of friends they don't do it as much." Boys and teachers mentioned that girls with a sexual reputation could become targets. A Hills boy remarked about a girl victim: "She sleeps around." Finally, consistent with the revenge explanation mentioned above, some boys mentioned that they "paid out" girls who were annoying or irritating or who thought they were too "high and mighty."

Girls' Responses to Boys' Aggression

Girls Hitting Back: "They can drive your friends away"

While it has been reported above that boys might be encouraged by a girl who reacted to harassment, girls could respond assertively, even matching boys' aggression. A girl from Balton reported: "I got so sick of it that I started spreading a rumour about him and I just yell all the way down the corridor." A girl from Valley reported: "They get really offended if you say they've got a small penis." The boys indicated that girls were not just passive recipients of boys' aggression and they could hit back, often using their friends to make life unpleasant for the offending boy(s). The following extract from a Balton boys' group is illustrative:

- B1: If you call, you go up to a girl in a group, call her a bitch to her face, or something, some of the girls just slap you right there.
- B2: Some other girls will hurt you, otherwise, like, going around and making sure you're a loner or whatever.
- B3: Yes, making influence on their friends.
- B4: Some, like, . . . if they're, like, . . . a really popular chick does this to you she can, like, probably drive your friends away from you.

(All agree)

- B1: The more popular they come, the more influence they've got.
- B3: They're good at luring people away, yes they can do that.

The teachers, too were aware that girls hit back as this female teacher from Hyland revealed: "Girls at this school are pretty good at answering back though; they're pretty good at standing up for themselves mostly, um, although there are, you know, always the more sensitive shy ones."

Interventions

"The only people I'd go to would be friends"

The general view from boys and girls was that teachers should stay out of it and that teachers could in fact make the situation worse. Some students, however, reported examples where teachers had been helpful. Some others said that teachers ignored boys' aggression towards girls or even laughed about it. Teachers, however, had a quite different view, citing examples where their interventions had worked. Students were pessimistic about the value of turning to parents, with one girl from Hills suggesting "that's the worst thing they can do." The girls, in particular, emphasised the important role of friends in offering consolation and support when a peer was being harassed by one or more boys.

DISCUSSION

This study revealed that girls, boys and teachers had different perspectives on boys' aggression to girls. While all agreed that boys seldom used physical aggression to girls, boys disagreed with girls and teachers about the amount and deliberateness of boys' verbally harassing behaviours towards girls. This finding is consistent with the earlier work by Owens (1998) who found that boys estimated less boy-to-girl aggression than did girls and teachers. This study also revealed the use by boys of indirect aggressive behaviours toward girls, specifically the spreading of rumours. Boys were less inclined to mention this than were girls. Overall, the study highlights the importance of using multiple sources for the collection of data on human behaviours.

Our finding that boys believed that they were only having fun is consistent with Tulloch's (1995) finding that what girls saw as bullying was seen as harmless fun by boys. Our results are also consistent with Murnen and Smolak's (2000) finding that what ten-year-old girls saw as frightening, boys saw as flattering.

Our results revealed that much of the boy-to-girl aggression takes the form of verbal sexual harassment, very often focusing on girls' physical appearances and sexual reputations. This is reminiscent of Duncan's (1999) sociological work in which he wrote in vivid detail about sexualised bullying in British schools including boys' harassment of girls, a clear indicator of the value of a qualitative study. Quantitative studies in the aggression literature have usually utilised questionnaires that have asked only general questions where the context has been lost so that sexual harassment has not been detected. Indeed there has been little overlap between the sexual harassment literature and the aggression literature with the former considering broad social influences and the latter taking individualistic perspectives, something the teachers in this study acknowledged. It would appear that future research should include combinations of research approaches, possibly including qualitative and quantitative methods to an equal degree, to victimising behaviours by boys to girls that were and were not sexually toned.

Even though boys tended to believe that girls took their harassing behaviours too seriously, they did agree with girls and teachers that the effects of their behaviour on girls could be very damaging. This acknowledgement by boys provides optimism for intervention efforts to redress this negative behaviour toward their opposite-sex peers. Pikas (1989), for instance, argued that empathy for a victim's pain was an important first step toward behaviour change by the perpetrators of aggression.

Our study reveals that the key explanations for boys' aggression to girls include the desire to have fun and the desire to impress other male friends. These findings are strikingly similar to previous research by our research team (Owens et al., 2000a; 2000b) where we questioned 15 year-old girls about their explanations for their within-sex aggression. In that earlier work, we found that girls tended to victimise same-sex peers in order to have fun and reduce boredom and for a host of reasons concerned with friendship and group processes, including gaining attention and impressing same-sex peers so as to be included in the peer group. Some girls and teachers also specifically referred to boys' abuse of power in their interactions with girls. Teachers in the current study had some additional explanations mainly concerned with the home and cultural backgrounds of students. Once again the importance of gaining multiple perspectives is evident in order to gain a comprehensive understanding of social behaviours such as peer aggression.

Our study reveals that girls with certain characteristics are more vulnerable to being the targets of boys' aggression. These pre-disposing factors include being over-weight, not having friends, lacking confidence, being perceived to be 'uncool', over-reacting and having a sexual reputation. In particular, physical attractiveness could protect a girl from boys' harassment. In addition, it would seem that boys often targeted girls in revenge or retaliation for what boys perceived as nasty behaviour by girls towards boys. It should be noted that this last point was mentioned frequently by boys but never by girls, highlighting again the understanding of behaviour according to the so-called "eye of the beholder." Some of these findings on victim characteristics are consistent with our earlier research (Owens et al., 2000a) where we found that girls tended to blame their own peers for bringing aggression upon themselves through their own annoying or aggravating behaviour and the importance of having good friends as protection from being singled out.

Our findings reveal that not all girls respond in a submissive way to boys' victimisation. Indeed some girls reported their own effective aggressive reactions to boys. Girls were astute enough to realise that they could hurt a boy's masculine pride through abusing his sexual anatomy (for

example, reference to small penis size). Some boys reported the use by girls of sophisticated forms of indirect aggression aimed at isolating boys from friendships.

In relation to interventions, the results of the present study reveal that students and teachers see the success of intervention differently. Teachers were optimistic that their interventions worked but students often (but not always) saw teacher intervention as flawed. Girls in particular highlighted the importance of turning to friends for assistance for peer relationship difficulties. Again, this finding is consistent with our earlier work (Owens et al., 2001) where girls reported on the success of using friends to assist in resolving peer conflicts. The finding is also consistent with research which indicated that girls used constructive forms of conflict resolution including compromise and seeking peer support (Osterman et al., 1997; Owens, Daly, and Slee, 2005). This study provides a timely reminder, therefore, of the importance of considering student perspectives in relation to the potential of peer mediation processes in school intervention policies and practices.

Our intention in this paper is to provide a brief overview of our study on boy-to-girl aggression, highlighting in particular the different perspectives of boys, girls and teachers. In future papers we plan to explore in more detail elements of this study including explanations of boy-to-girl aggression, sexual harassment, and issues related to intervention.

REFERENCES

- Bayliss, M. (1995, 7-9 September, 1995). It just shouldn't happen: the sexual harassment of schoolgirls by their male school peers. Paper presented at the Practical Diversity Conference, Townsville, Queensland.
- Bjorkqvist, K., Osterman, K., and Kaukiainen, A. (1992). The development of direct and indirect aggressive strategies in males and females. In K. Bjorkqvist and P. Niemela (Eds.), *Of Mice and Women. Aspects of Female Aggression* (pp. 51-64). San Diego, CA: Academic Press.
- Coie, J. D., Underwood, M., and Lochman, J. E. (1991). Programmatic intervention with aggressive children in the school setting. In D. J. Pepler and K. H. Rubin (Eds.), *The Development and Treatment of Childhood Aggression* (pp. 389-410). Hillsdale, New Jersey: Lawrence Erlbaum Associates.
- Collins, C. (1997, July, 1997). The gender and school education national sample study: Implications for girls. Paper presented at the DECS Section 47 Officers Conference, Adelaide.
- Crick, N. R., Bigbee, M. A., and Howes, C. (1996). Gender differences in children's normative beliefs about aggression: How do I hurt thee? Let me count the ways. *Child Development*, 67, 1003-1014.
- Crick, N. R., and Grotpeter, J. K. (1995). Relational aggression, gender, and social-psychological adjustment. *Child Development*, 66, 710-722.
- Duncan, N. (1999). *Sexual Bullying: Gender Conflict and Pupil Culture in Secondary Schools*. London: Routledge.
- Hudley, C., Wakefield, W. D., Britsch, B., Cho, S.-J., Smith, T., and DeMorat, M. (2001). Multiple perceptions of children's aggression. Differences across neighborhood, age, gender, and perceiver. *Psychology in the Schools*, 38(1), 43-56.
- Lagerspetz, M. J., Bjorkqvist, K., and Peltonen, T. (1988). Is indirect aggression typical of females? Gender differences in aggressiveness in 11 to 12 year-old children. *Aggressive Behavior*, 14, 403-414.
- Maccoby, E. E. (1990). Gender and relationships. A developmental account. *American Psychologist*, 45, 513-520.
- Murnen, S. K., and Smolak, L. (2000). The experience of sexual harassment among grade-school students: Early socialisation of female subordination? *Sex Roles*, 43(1/2), 1-17.

- Olweus, D. (1991). Bully/victim problems among schoolchildren: Basic facts and effects of a school based intervention program. In D. J. Pepler and K. H. Rubin (Eds.), *The Development and Treatment of Childhood Aggression* (pp. 411-454). Hillsdale, New Jersey: Lawrence Erlbaum Associates.
- Olweus, D. (1999). Norway. In P. K. Smith, J. Morita, J. Junger-Tas, D. Olweus, R. Catalano and P. Slee (Eds.), *The Nature of School Bullying. A Cross-National Perspective* (pp. 28-48). London: Routledge.
- Osterman, K., Bjorkqvist, K., Lagerspetz, K. M. J., Landau, S. F., Fraczek, A., and Pastorelli, C. (1997). Sex differences in styles of conflict resolution: A developmental and cross-cultural study with data from Finland, Israel, Italy, and Poland. In D. P. Fry and K. Bjorkqvist (Eds.), *Cultural Variation in Conflict Resolution: Alternatives to Violence* (pp. 185-197). Mahwah, NJ: Lawrence Erlbaum.
- Owens, L., Daly, A., and Slee, P. (2005). Sex and age differences in victimisation and conflict resolution among adolescents in a South Australian school. *Aggressive Behavior*, 31(1), 1-12.
- Owens, L., Shute, R., and Slee, P. (2000a). "Guess what I just heard!" Indirect aggression among teenage girls in Australia. *Aggressive Behavior*, 26, 67-83.
- Owens, L., Shute, R., and Slee, P. (2000b). "I'm in and you're out ..." Explanations for teenage girls' indirect aggression. *Psychology, Evolution and Gender*, 2(1), 19-46.
- Owens, L., Shute, R., and Slee, P. (2001). Victimisation among teenage girls. What can be done about indirect harassment? In J. Juvonen and S. Graham (Eds.), *School-based peer harassment: The Plight of the Vulnerable and Victimised*: Guilford.
- Owens, L. D. (1996). Sticks and stones and sugar and spice: Girls' and boys' aggression in schools. *Australian Journal of Guidance and Counselling*, 6, 45-55.
- Owens, L. D. (1998). Physical, verbal and indirect aggression amongst South Australian school students. Unpublished Ph.D thesis, Flinders University of South Australia, Adelaide.
- Paquette, J. A., and Underwood, M. K. (1999). Gender differences in young adolescents' experiences of peer victimisation: Social and physical aggression. *Merrill-Palmer Quarterly*, 45(2), 242-266.
- Pikas, A. (1989). The common concern method for the treatment of mobbing. In E. Munthe and E. Roland (Eds.), *Bullying: An International Perspective* (pp. 91-104). London: David Fulton.
- Rigby, K. (1996). *Bullying in Schools and What to Do About It*. Melbourne: Australian Council for Educational Research.
- Rigby, K. (1998). Gender and bullying in schools. In P. Slee and K. Rigby (Eds.), *Children's Peer Relationships: Current Issues and Future Directions*. London: Routledge.
- Rigby, K. (2002). *A Meta-Evaluation of Methods and Approaches to Reducing Bullying in Pre-School and Early Primary Schools in Australia*. Canberra: Attorney-General's Department.
- Rigby, K., and Slee, P. T. (1999). The nature of school bullying: Australia. In P. K. Smith, Y. Morita, J. Junger-Tas, D. Olweus and P. Slee (Eds.), *The Nature of School Bullying: A Cross-National Perspective*. London: Routledge.
- Russell, A., and Owens, L. (1999). Peer estimates of school-aged boys' and girls' aggression to same- and cross-sex targets. *Social Development*, 8(3), 364-379.
- Tulloch, M. (1995). Gender differences in bullying experiences and attitudes to social relationships in high school students. *Australian Journal of Education*, 39, 279-293.

Addressing the problem of service teaching introductory economics subjects

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Enrolments in undergraduate economics programs have been falling constantly since the early 1990s. This trend coincides with the increasing popularity of business and management degrees. Consequently, the major activity of many, if not most economics departments and schools in Australia is service teaching of introductory economics to first year business and management students. Such service teaching activities usually involve offering a conventional principles of macroeconomics subject and a conventional principles of microeconomics subject to business and management students. It is argued here that the conventional first year offerings do not meet the needs of the majority of the students taking these subjects. A review of the economics education literature has identified a number of strategies that have been proposed to increase the level of engagement of first year economics students. However, this article argues that these strategies are not considered to be appropriate for the challenge facing most Australian economics departments that are primarily teaching non-economics majors. The aim of this article is to propose an alternative framework that would allow economics departments to perform more effective and relevant service teaching activities. It is argued that current principles of economics subjects largely ignore two important institutions, in addition to markets, that societies use to answer the economic question, the government sector and the household sector. It is further argued that a principles of economics subject that places appropriate emphasis on a broader set of institutions should not just teach first year students about key economic theories, but it should also provide them with an understanding of how real economies work. This is a goal that is relevant for students undertaking either an economics degree or a business degree. The final section of the article provides a brief overview of how a principles of economics offering based on a broader institutional approach might differ from a traditional principles course.

Service teaching, undergraduate, introductory economics subjects

INTRODUCTION

The curtain rises on a scene: an introductory economics classroom, where students are sitting in neat rows. The professor begins the class by reminding students that economics is the study of how scarce resources are allocated among unlimited wants and proceeds to draw on the board a graph examining how the price and quantity of good X are affected by an increase in demand. In order to explain how the market achieves its new equilibrium, the professor then goes through, in a linear, logical fashion, exactly how inventory shortages lead the sellers of good X to raise its price, which causes buyers to purchase fewer units while simultaneously causing the sellers to increase the number of units they offer on the market. Sellers continue to raise prices until they eliminate their shortages, at which point supply equals demand, and the market achieves equilibrium. Enthusiastically, the professor concludes that due to

the workings of the market, our scarce resources can be shown to be allocated efficiently and all is right with the world – a point missed by most students who are at best disengaged or at worst asleep – because the professor’s explanation neither reflects the complex world in which those students live nor does his or her analysis seem terribly relevant to the contemporary economic issues facing these students. (Lewis 1995, p.555)

Undergraduate economics education is at something of a crossroads at present in Australia. Enrolments in undergraduate economics courses have been falling constantly since the early 1990s. This trend coincides with the rise of business and management degrees. Consequently, the major activity of many, if not most, economics departments and schools in Australia is service teaching to commerce, business and management students, hereafter simply referred to as business students. Service teaching usually involves offering a standard principles of macroeconomics subject and a principles of microeconomics subject to business students. This combination of subjects provides business students with the opportunity to undertake an economics major if they wish, an opportunity that most do not take up. Moreover, some economics schools offer a conflated one semester combined principles of macroeconomics and microeconomics subject as this is all that is required for the accreditation of accounting degrees in Australia.

These two models of service teaching lead to the emergence of a certain degree of tension between the two main groups of students who are taking these subjects. Conventional introductory economics subjects are designed to appeal to a select group of students who intend to complete an honours degree in economics and proceed onto postgraduate studies. Lucas, Kreuger and Blank (2000) argued that these students tended to be “mathematically oriented”, more interested in derivations and discussing underlying relationships and grasp the fundamental concepts more quickly. Furthermore, these students contrasted starkly with those students who comprised the majority of first year economics enrolments. Moreover, these authors argued that graphs were difficult for these students, as they tended to think verbally, rather than mathematically and visually. For these students, introductory economics was a series of “mind games” posed by their lecturer, games that they needed to play in order to pass the subject. Consequently, the majority of students who undertook introductory economics subject experienced difficulty relating economic theory to real world problems. But they studied economics in the hope of being able to solve real world problems. In short, principles of economics (PE) subjects do not meet the needs of most students.

The aim of this article is to propose an alternative framework that allows economics departments to perform more effective and relevant service teaching activities. Recent Annual Papers and Proceedings of the American Economics Association contain a collection of papers that address the problem of declining student enrolments in economics. A number of these papers are reviewed in the second section of this article. However, it is argued that these solutions are unlikely to be successful in the present Australian context, as they do not really acknowledge, let alone address, the real cause of the declining popularity of economics in general, and the needs of the majority of first year students in particular. There are two strands to this argument. First, Section Three argues that the content of service teaching is largely inappropriate. This needs to be addressed by helping external stakeholders to articulate more clearly their needs. The second strand to this argument is that the approach to teaching first year economics needs to be reconceptualised. Hence, Section Four provides a brief critique of the traditional framework and argues that the teaching of PE to business students can be improved by drawing on alternatives to neo-classical inspired economic theory. Of the range of competing perspectives on economics, some suggestions from institutional economics that may provide an opportunity to address better the needs of business students are reviewed.

THE CONVENTIONAL WISDOM

The Annual Papers and Proceeding of the American Economics Association contain a collection of papers that address issues relating to the declining enrolments in PE courses and the need to develop more appropriate curricula and teaching methods. This concern amongst economists about the teaching of first year economics is not new and dates back to at least 1950 (Taylor, 1950). Taylor was the Chair of the American Economics Association Sub-Committee on Elementary Courses. His study of PE courses in the United States found that:

1. many seek to serve too many objectives;
2. most courses lay principle stress on theory; and
3. many, if not most of them present a large volume of theory, and a greater variety of viewpoints and methods than are appropriate for young students inexperienced in abstract and sustained thinking. (Taylor, 1950, p.5)

Consequently, decisions needed to be made that involve two different, but related kinds of action:

1. take a fresh look at the introductory course with a view to determining anew what its objective ideally should be, with due regard to the possibility that it may now be confused with too many ideas; and
2. examine the curriculum and the rules of precedence and sequence of course, both in the department and in the college as a whole, in order to determine whether there is a consistent progression worthy of being called higher education, and not an uncoordinated hodge-podge of uneven courses. (Taylor, 1950, p.5)

A review of recent editions of *American Economic Review* shows that many of these concerns are still valid.

I have chosen to review article from 2000 and 2002 edition of the Proceedings of the American Economics Association, published in the *American Economic Review* in order to provide an indication of the state of the current debate about the efficacy of PE courses and the ways to improve them. These two editions are chosen as the eight papers that they contain are fairly representative of all of the papers that have been presented in this section at recent conferences. The solutions provided in these papers fall roughly into three categories: teaching tricks or hints, developing economic literacy and revising the content of PE courses. As these papers are generally presented by leading figures in economics education, they represent the so-called 'conventional wisdom' of the economics profession with regards to education in the PE. Hence, they serve as models of best practice for university teachers who are looking to improve their PE offerings, not just in the United States, but also in Australia.

The 2000 and 2002 editions of the *American Economic Review* included papers that addressed issues in undergraduate economics teaching. Both editions included four original papers plus discussants' comments or a panel discussion. The 2000 edition featured papers by Colander (2000), Parkin (2000), Kennedy (2000), and Taylor (2000). Parkin and Taylor are both authors of PE textbooks. Parkin's textbook has been adapted for the Australian market by McTaggart and Findlay and its first and second editions held market leadership until 1999 (Maxwell, 1999). Taylor is the Raymond Professor of Economics at Stanford University and Director of the Introductory Economics Studies Centre at Stanford. His PE textbook has been adapted for the Australian market by Moosa from La Trobe University (Taylor and Moosa, 2000). However, this book has not been adopted widely in Australia. Colander is the Christian A. Johnson Distinguished Professor of Economics at Middlebury College, Middlebury, Vermont. He has authored or co-authored economics textbooks including *Principles of Economics*, *History of Economic Thought* (with Landreth), *Macroeconomics* (with Gamber). Kennedy has been associate

editor of the *Journal of Economics Education* with responsibility for editing its research section since 1989 and has authored two economics textbooks. According to these papers, the key issues confronting teachers of first year economics are student boredom (Colander), failure to introduce the key concepts in a framework that is useful to students (Kennedy), content is not presented in an understandable or memorable way (Taylor). Parkin describes the contents of the introductory and intermediate macroeconomics textbooks.

The 2002 edition of *American Economic Review* included papers by Brown and Liedholm, Case, Hamermesh and Hansen with Salemi and Siegfried. Brown and Liedholm are from the Department of Economics at Michigan State University. Case is a co-author, with Fair, of *Principles of Economics*, a basic text in its sixth edition that has been adopted by more than 450 colleges and universities. Hamermesh is a labour economist from the University of Texas at Austin and has published a labour economics textbook and *Economics Is Everywhere*, a series of 400 vignettes designed to illustrate the ubiquity of economics in everyday life and how the simple tools in a microeconomics PE class can be used. Hansen, Salemi and Siegfried are from University of Wisconsin, University of North Carolina and Vanderbilt University, respectively. Hansen has published widely in the field of economics education. Salemi has been Professor of Economics at the University of North Carolina at Chapel Hill since 1987 and was Assistant Director of the Center for Economics Education at the University of Minnesota between 1973 and 1976. Siegfried is Professor of Economics at Vanderbilt University and Adjunct Professor of Economics at the University of South Australia. Brown and Liedholm compared the results of students taking a PE course in the traditional mode with those taking a completely online course and those taking a hybrid of the two. Case (2002) suggests a “list of important goals and some new topics and some approaches to teaching them” (2002, p.454) in a micro PE course. The paper by Hamermesh (2002) is entirely about technique and presentation, “how to avoid having the course burden students and instructor” (2002, p.449). Hansen et al. (2002) argued that the PE course fails students who take it and frightens away others because it has competing goals: trying to expose students to a short list of the core ideas of the discipline, while at the same time achieving a viable foundation of economic understanding for subsequent economics coursework. Finally, Frank (2002) argued that the effort spent by students to learn the technical details of courses would be much better spent learning a short-list of the most important principles by repetition and practice, especially applying the principles to explain some pattern of events or behaviour that they personally have observed.

The set of four papers in the 2002 volume of *American Economic Review* is followed by a panel discussion in which three members present a perspective on the Hansen et al. paper. None of the discussants disagree with the diagnosis arrived at in this paper of the problem with PE teaching. Not all agree with their solution, but they do not offer any other. However, in her review of the Hansen et al. (2002) paper, Lucas, Kreuger and Blank (2002) succinctly redefines the main problem faced by people who teach PE courses. They argued that the fundamental problem of teaching first year economics is that it is targeted at the needs of those students who intend to take an economics major.

However, as discussed in the introduction to this paper, the majority of students who take PE courses have quite different needs and learning styles compared to the majority of students taking PE courses. Who then should PE courses be targeted at, the minority who intend to take an economics major, or the majority who are unlikely ever to study economics again? If the answer to this question is the latter group, then tinkering at the edge of the PE curriculum, which is essentially the remedy proposed by the papers in *American Economic Review*, is not going to solve the problem. If service teaching is to meet the needs of the majority of students then the PE curriculum needs to be totally re-conceptualised. The question is how?

This raises a number of questions about what is taught in the first year PE subject. First, is the content appropriate for non-economics majors, who have different objectives in taking the PE subjects than economics majors? Second, what opportunities exist to ensure that the objectives of the programs offered to business students are compatible with the objectives of their professional bodies? There are two broad approaches to answering these two questions. One of these I call 'conservative', and the other, 'radical'. The conservative approach is exemplified by the debate about which of the existing principles could be excluded to make the PE course more accessible, or by suggestions to change the emphasis or presentation of the existing PE format (for example the paper by Kennedy on the importance of the real interest rate). A more radical approach argues that the PE course as taught provides insights into economics, but not necessarily into how economies actually work. For example, Stiglitz (2002) argued that economics teaches students about economic theory, but they learn very little about how real economies actually operate. The feedback received from those involved in accreditation accounting programs in Australia have argued that it is the latter that is important for their graduates. The issue of content can be addressed in consultation with external stakeholders, as discussed in the following section. An alternative paradigm within which to teach first year economics is then discussed.

GIVE STAKEHOLDERS A VOICE

Now we turn to the question of what it is that our students want or need from an introductory economics course. As a result of the continued growth of business programs, most of the students who enrol in PE courses are not economics majors. Furthermore, many of them are studying economics because it is a compulsory subject in their degree of choice. For example, majors in accounting and marketing and management are all required to take economics subjects. In some cases, the requirement to do so is set down by the relevant professional association. Economists have a good understanding of what first year economics students need to learn in order to be prepared for further study in economics. Yet, how well do academic economists understand what business majors need to learn in an economics course in order to be competent in their chosen fields?

Churchman and Woodhouse (1999) argued that a number of stakeholders seek to influence professional education. According to Watson (1992), the key external stakeholders in professional education are sponsors, providers and clients. From this perspective, we are the providers, our students are the clients, while the key sponsors are the professions, as represented by professional associations. They determine entry requirements and codes of practice. Hence, Churchman and Woodhouse (1999) argued that there is a role for professional associations in curriculum design and the stipulation of content as part of the accreditation process for graduates and consequently:

professional educators work within a contractual relationship with their tertiary education institution as well as the professional regulatory body and are accountable to both; to the institution for the quality of education, and to the body for the curriculum and the competence and sometimes the character of graduates. (Churchman and Woodhouse, 1999, p.212)

The contractual relationship can give rise to tension between the legitimate requirements of professional regulatory bodies and the autonomy of universities.

Harrison (1984, p.155) observed that professional associations may seek to ensure that the competence of entrants by controlling admission standards, the content of accredited courses, the amount and type of practical experience and the methods and standards of assessment. Further, Harrison (1984, p.154) observed that these controls may be administered through a combination of the following methods:

- a decision to accept a particular class of qualification;

- a set of rules for courses that can be applied by lay administrators;
- a core syllabus that must be followed by any course that is accredited;
- negotiation of the syllabus between the validating body and the teaching institution;
- periodic or continuous inspection of the teaching process and resources;
- control of the assessment of the student by setting and marking or moderating the examinations or by nominating examiners; and
- supervision of new entrants to the profession during a probationary period.

I therefore decided to ascertain the extent to which the key professional associations in Australia exerted influence on economics departments to ensure that their service teaching offerings meet their needs.

PE courses are compulsory in most business degrees taught in the three South Australian Universities. The accreditation requirements for joint membership of the Institute of Chartered Accountants (ICAA) and The Australian Society of Certified Practising Accountants (CPA) stipulate studies in economics as a pre-requisite for membership. The Australian Institute of Management and the Australian Marketing Institute make no such stipulation. However, the publicly available accreditation documentation ICAA/CPA do not specify what they want students to achieve by studying economics. Hence, they do not prescribe the content to be taught or the approach to be used in teaching. I therefore decided to use my relationship with accounting academics to try and shed some light on these two questions.

The first step in this process was to discuss these questions with staff from the School of Accounting at the University of South Australia. When I contacted a University of South Australia School of Accounting staff member who has been involved in accreditation for the University of South Australia Accounting program, her response, in an email, was that “any business graduate should have some understanding of the way in which the economy operates in order to be a successful participant in it at any level and in any business profession” (Marks, personal communication). A view was also sought from an equivalent person at the University of Adelaide who sits on the CPA Australia National Professional Education Board that oversees the philosophy and policy of the CPA Program of Studies, which graduates do as part of their postgraduate professional entry studies for CPA Australia. He is also a board member of AIM in South Australia. His response was that:

one or two semesters of economics as essential education requirements for aspiring members in that this provides important understandings of the way the whole economy and business work and interrelate - ie they provide the wider background environment and context within which business, government and professional organisations operate. This ensures that CPAs have an appreciation of the context surrounding their primary foci which are accounting, finance and business advisory services. (Parker, personal communication)

Finally, the response from the CPA Australia accreditation consultant:

I have not been able to find any official documentation regarding CPA Australia's views on this matter. I agree with Professor Lee Parker's view on this matter. Accountants operate in the ‘real’ world and therefore require a good understanding of how that world operates. Macroeconomics provides a significant part of that understanding while Microeconomics provides a model of how organisations operate within the wider environment. (Woolley, personal communication)

So, there is a pretty unanimous view among this non-random sample, that study in economics should provide business graduates with the background and context that they require to

understand how the real world operates, including the economy and organisations within it. Is this what the economists who run first year economics subject believe they are teaching, and do all economists agree with them?

If we return to the collection of papers that were reviewed at the beginning of this paper, we find that a number of objectives for PE courses were identified. These included improving economic literacy (Hansen et al., 2002), instruction in personal financial literacy, providing students with sufficient information on what the field of economics entails so they could make an informed judgement as to whether they want to study economics further (Lucas, 2002) (not really a realistic goal for most service-taught PE students in this context), absorbing the economic way of thinking (Frank, 2002), providing the student with an introductory glimpse at macroeconomics as it exists today (Parkin, 2000) and teaching the modern view of macroeconomics (Taylor, 2000). Clearly, these solutions do not address the main problems being faced by Australian academic economists.

However, the view from the accountants is pretty vague and leaves it up to the economists to decide what to teach. Hence, economists have decided to teach what they have always taught to first year economics students. However, the first year PE curriculum fits most closely with the objective of preparing students for further courses of study in economics and not with the poorly articulated views of the relevant external stakeholder professional accreditation bodies. Clearly then, there is a need to get these external stakeholders to articulate more clearly their needs for those of us who teach PE courses to business students to listen to these views. The economics profession could act proactively in this regard and provide these external stakeholders with assistance to help them articulate more clearly their needs. Furthermore, these discussions could then provide the basis of the re-design of our service teaching offerings.

A SPECULATIVE TURN

The lack of a clearly articulated rationale for the teaching of economics in undergraduate programs for business professionals creates both a problem and an opportunity for the economics teaching profession. First, it provides an opportunity for economists to teach business students the economics they think business students should know. However, the available evidence suggests that what economists teach to these students is pretty much the same economics that they were taught in first year economics, and the same economics that they would teach to first year economics majors. This is evidenced by the fact that most economics departments teach the same PE subjects to business majors as they do to economics majors. Second, it raises a problem for business students and external stakeholders. That is, is the content of a traditional economics major meeting their needs as outlined in the Introduction to this article? The previous section discussed how content could be made more appropriate, within the present paradigm. The aim of this section is to develop an argument for an alternative paradigm within which to provide service teaching offerings.

The mainstream critique of first year teaching has been outlined in Section Two of this article. A more radical critique of first year economics teaching is evident from a survey of articles of teaching from a major heterodox journal, *The Journal of Economic Issues*. For a number of reasons below outlined, I argue that an institutional paradigm is more likely to meet the needs of business students studying economics, than the traditional paradigm.

Traditional introductory microeconomics courses introduce students to core concepts in microeconomics that have been developed to explain how markets work. The introductory course in microeconomics concentrates on the theory of the firm, or the supply-side of the supply-demand diagram. The focus is on cost-curves, with some time given to market failure and the effects of government intervention in markets. Consumer theory is mostly covered in intermediate microeconomics courses. Introductory macroeconomics generally introduces the Aggregate

Supply/Aggregate Demand model that is used to analyse the effects of various external shocks to the economy, the effect of fiscal and monetary policy and the effects of changes in the labour market on the economy. Knoedler and Underwood (2003) provides a list of the “Ten Things Every Principles Student Should Learn”, according to the traditional model. These ten points, presented in Table 1, essentially summarise the traditional PE course.

Table 1. Ten things every principles student should learn

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1. Economics is the study of choice under conditions of scarcity.
 2. Economic actors are motivated by rational self-interest to maximize their satisfaction from consumption (based on a given set of preferences).
 3. Economic efficiency (technical and allocative) is the primary goal of an economy.
 4. The market values (prices) established in a "free market" economy are the critical guides to economic efficiency. Anything that "distorts" free market values reduces efficiency, thus imposing costs on society.
 5. Government "interference" in the free market distorts market values, thus reducing efficiency. A policy of laissez faire is optimal.
 6. The history of economic thought began and ended with Adam Smith. This historical context of development of economic theory is not important'.
 7. Inequality and poverty are completely unrelated to race, gender and class. Thus, evaluation of policy reforms does not require any knowledge of the history or structure of the programs involved or the characteristics of those who participate in these programs.
 8. In an advanced market economy money is used to make exchange, a store of value, and a unit of account. However, money is a neutral variable in analysis of the economy. Given this, the first objective of monetary and fiscal policy s combating inflation and stabilization of employment is a by-product.
 9. Economics, practiced correctly, is a "positive science" based in value-free, objective knowledge. The role of the economist is to engage in the science of "positive" analysis of the economic processes described above. While there may be some disagreement among economists, they do agree on many core "truths," such as: "All economists agree that as government redistributes more income to the poor, it has to raise taxes on those with a highly valued marginal product (i.e., rich and middle-income individuals) which weakens their incentives to work and decreases national income."
 10. The natural world, the source of all energy and materials and the repository of for all waste, is not a necessary (complementary) element in production.
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Source: Knoedler and Underwood (2003, p.708)

In addition, there is also conflict among economists as to what constitutes a good education in economics. For example, the key criteria for critical thinking are: realistic assumptions, predictive theories, logical consistency of theories, explanatory power of theories, and empirical evidence (Borg and Borg, 2001, cited in Knoedler and Underwood, 2003). Economics sacrifices two of these criteria, realistic assumptions and empirical evidence, in favour of predictive power and logical consistency through the use of models, which are crucial for training students to think critically. Thus, what they generally teach is analytical, rather than critical thinking (Knoedler and Underwood, 2003). In addition, the abstract reductionism of the neo-classical paradigm limits its usefulness in addressing contemporary social issues and there is a lack of connection between the simplistic economics of the classroom and the complex economic activity of the world in which students function (Lewis, 1995).

This article has made a number of arguments about PE teaching. First, most students who undertake PE are business students who will not major in economics. Second, those PE courses continue to be taught as if the students were economics majors. Third, that in addition to pedagogy, the approach and content of PE courses needs to be reviewed. Fourth, external stakeholders could be more closely involved in the development of PE courses. I would like now to take a more speculative turn.

The information that we do have from those with a stake in economics teaching to accounting students indicates that they believe that students should learn something about how the economy operates. This will give them a better understanding of the context in which they operate. Currently, suggestions to improve PE courses aim to improve economic literacy, help students to

understand the implications of policy decisions and to prepare them for future studies in economics.

The model of both markets and the macroeconomy that are presented in PE courses are simplified representations of rather more complex phenomena. Simplification, it may be argued, is a necessary part of the process of distilling out key features that we want to understand. However, we risk serving students poorly if they leave the PE course with an impression that what they have learned is a sufficient explanation of the economy and of economic behaviour. However, more seriously, we risk disengagement and disinterest if we insist that they suspend their own experiences and understanding of the world and ask them to replace it with the traditional economic models without accounting to them for the differences between our models and their experiences.

A survey of papers on economics teaching from the *Journal of Economic Issues*, a major heterodox journal produced by the Association for Institutional and Evolutionary Economics, highlighted three papers that are relevant to this topic. Between them, these papers highlight a range of issues for economic education. They range from a complete change in paradigm, to changes in pedagogy, content, the definition of economics, method, performance criteria, the role of values, and the role of government. I do not discuss pedagogy, since this topic is already widely discussed. The other seven issues are discussed below.

Paradigm

The first of the papers by Knoedler and Underwood (2003) calls for a paradigm shift in what is taught in PE courses. They claim that critical thinking begins when students learn that there are alternative thought structures, each consistent with the real material world. This is consistent with the approach to critical thinking in other disciplines. Students in other social science disciplines are taught to recognise that different thought structures, paradigms and theories can be applied to a particular problem, all with some validity. The critical exercise is to assess each theory and decide which is most useful for each situation. Economics principles teaching does this only to the extent that it might compare Monetarist or Classical theories with Keynes, in the macroeconomics section and possibly (but only in passing) with Marx. This broader definition of critical thinking also asks students to examine the theories that they are working with and to reflect on their validity, given their own experiences, and the other theories that they have been asked to examine. That is, they are asked whether they have any evidence that tends to falsify (in the Popperian sense) the theory or at least to think about what kinds of evidence might be needed to do so. In the teaching of PE, the models that are taught are taken as proven and students are asked to memorise and reproduce them, rather than critically examine them, asking ‘when, in my experience, would this not be so?’

Other disciplines in the social sciences are also interested in teaching their students to place the theories that they are learning into some context. They recognise that knowledge is not an entity that exists in isolation from a context, waiting to be discovered by the trial and error processes of pure science. Knowledge is made and constructed in a social context and reflects the concerns and cultural influences of those who make it.

In the same way, students filter the material from university studies according to their own experiences. This often causes conflict within the student when the material that they are presented with is at odds with their own experiences, or with material that they see in other subjects taught in the same degree program. Imagine the surprise a student who is taking a marketing major gets when they are told that consumer tastes and preferences can be taken as given! Part of an education that produces critical thinkers is helping students to come to terms with a world where more than one truth is possible.

I am not advocating that the traditional paradigm be completely replaced. Rather that it be studied as one of the theories of how the economy works and examined for its strengths and its weaknesses and compared to other theories that are available. Thus Knoedler and Underwood (2003) offer an alternative list of ten things every PE student should learn. This is outlined in Table 2.

Table 2. Ten Things Every Principles Student *Should* Learn

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1. Economics is the study of social provisioning, not merely choices and scarcity.
 2. Both scarcity and wants are socially defined and created.
 3. Economics systems are human creations: no particular economic system is “natural.”
 4. Ecological literacy (economy ecology interface, unity between biophysical first principles and economic sustainability) is essential to understanding the economic process.
 5. Valuation is a social process.
 6. The government defines the economy; laissez-faire capitalism is an oxymoron.
 7. The history of economic thought is critical to the study of “basic principles” of economics.
 8. Economic theory (“logical economics”) and real world economics are often very different things.
 9. Race, gender, and class shape economic processes, outcomes and policies in the real world economy.
 10. There are many different types of economists who do not agree on many things. This reflects the fact that economics is not “value free” and ideology shapes our analyses and conclusions as economists.
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Source: Knoedler and Underwood (2003, p.714)

Knoedler and Underwood (2003) argue that this list reflects the needs of people to apply successfully technical knowledge in an “historically conditioned social context ... to provision themselves and to reproduce culture”. These ten things not only emphasise that people are rational participants in the economy, but also their role in shaping the economy in order to address problems and address avenues of redress.

Content

In relation to content, Lewis (1995), who, at the time, was an Assistant Professor of Economics at the College of St Benedict, argued that that instead of beginning with abstracted models that primarily serve to:

teach students to manipulate graphs or equations that signify an idealised reduction of complex economic life ... we need to begin with current economic issues representing paradigmatically significant problems that give rise to economic investigation and explanation. (Lewis, 1995, p.555)

This approach appeals to the desire for ‘real world’ relevance that is required by sponsors as it reinforces the basic understanding by students of the economy and requires discussion of economic policies. Business students do not have the need to be able to manipulate graphs and equations, this is not one of the reasons they should study economics as stated by interested members of the accounting professions. Indeed, experience suggests that struggling with graphs and equations distracts many students from learning the economic principles that they require to make sense of the economy.

Definition of Economics

The traditional definition of economics is based on rational individual choice under conditions of scarcity so that constrained maximisation, fundamental trade-offs and opportunity cost become the focus of most introductions to the subject. The traditional PE course focuses on how resources are allocated through the maximising behaviour of individual decision makers in the context of a market economy. The institutional view recognises that both human wants and resources are largely socially defined and created. Consequently, from the Institutional view economics becomes a study of how societies organise themselves to secure the material goods and services necessary to maintain and reproduce themselves. Resource allocation and distribution are viewed

as interrelated parts of this ongoing process. Social norms, customs, and institutions play an important role in defining and guiding the economic process and determining how the three economic questions are answered (Peterson, 1995). For business students, understanding that resource allocation is not simply the result of self-interested decisions of individuals allows them to develop a fuller understanding of how decisions they make in their professional lives interact with a range of influences on their customers, not just the price.

Methodology

Lewis (1995) also argued that a better understanding of the economy also requires a different method for examining economic issues. Rather than using mathematically elegant, but substantively sterile arguments, a holistic method is needed that combines empirical evidence and appropriate analytical frameworks that emphasise the interaction of the institutions and values underlying the issues (Peterson, 1995). Some would say that this means we are no longer teaching 'economics', but 'political economy'. I would argue that this is not a problem if it meets the educational needs of the majority of our students to understand better the economy. In addition, it is an important part of critical thinking that students are able to test the validity of theories, or at least to view the data that convinced the economics profession that the theory was valid.

Performance Criteria

Traditional economics emphasises efficiency over all other criteria and is defined in ways that set it in opposition to other goals such as equity. Efficiency (defined in terms of non-wasteful resource use) and equity both contribute to the success of society in sustaining and reproducing itself. Allocative efficiency is only meaningful in terms of a particular distribution of income. How goods and services are produced is determined as much by social norms and institutional structure as it is by the market for factors and individual technology. The treatment of costs reflects the distribution of power in the economy. Hence, technical efficiency is also socially determined in many ways and reflects distributional concerns. In the context of a microeconomics course, there are many possible efficient market equilibria associated with many different income distributions. Consequently judgments about the acceptable distribution of income are not peripheral or in opposition to the analysis of market outcomes, but provide that basis for determining what is efficient (Peterson, 1995).

Role of Values

Traditional economics invokes the positive-normative dichotomy. It is argued that economic analysis must be said to be 'positive' because conclusions based on opinion or value judgements do not advance the understanding of events. This limits the acceptable topics for economic analysis, with issues for example, income distribution being viewed as 'values issues' and unacceptably normative. Institutional Economics rejects the belief that 'value-free' economic inquiry is even possible. Knowledge is socially constructed and reflects the values and bias of the individual researchers, social system and the culture that produced it. Ignoring this obscures the particular values and priorities embedded in the theory.

With Institutional Economics, the goal of value-free inquiry is replaced with the goal of applying warranted knowledge to the solution of economics problems. This calls for a comparative approach where explicit attention is given to the roles of values and ideology in shaping the way economists view the world, encourages students to examine their own belief systems and develop informed opinions about economic problems (Peterson, 1995). As currently taught, PE courses tend to deliver a dogma to students that remains unquestioned throughout the course. This not only risks accusations of being unscholarly, but ignores the place of values in economic theory.

When this is combined with a claim that economics is 'value-free', the accusation might be upgraded to dishonesty.

Role of Government

Traditionally, the economy and the government are defined as separate entities. The three main economic questions, **what, how** and **for whom**, are most legitimately answered in the private sector, while governments exist outside this process, intervening or interfering in the market in response to efficiency and equity goals. The primary role of government is to provide and enforce the economic rules of the game that facilitate the operation of the market economy. Governments may also enforce competition, correct market failure and promote an equitable distribution of income.

On the other hand, traditional economics is wary of other roles for government and they are often discussed in terms of efficiency goals and are associated with non-economic goals that economists claim to have no specific role in evaluating. However, Institutional Economics argues that the conceptual separation of the economy from government severely limits the scope and relevance of the economic analysis. The traditional emphasis on the private market provides an incomplete and distorted picture of both the operation of the market economy and the broader process of providing goods and services. It also obscures that nature of the economic role of the government in shaping the economy by giving support to the interests of some participants and not to others. By not interfering in the economy, the government tacitly supports the status quo distribution of income and power. In the view of Institutional Economics the policeman view of government is replaced with a more holistic and realistic view of the political economy. Government intervention becomes a meaningless concept. Government policies are not ranked according to the degree of their intrusiveness into a mythical free-market, but are evaluated in terms of their contribution of the social provisioning process. (Peterson, 1995) If business students need to have an understanding of the 'real-world' then sidelining government in the study of economics provides them with a distorted picture of how developed capitalist economies operate.

I do not necessarily suggest that everything the Institutional Economists have to say about the teaching of PE should immediately be adopted. However, if the goal of having business students studying economics is to give them an understanding of the 'real-world', then these ideas provide useful material for thinking about how a PE course might better serve their needs.

CONCLUSION

This article started from the observation that although enrolments in economics in Australia might be increasing this is largely due to increased service teaching and not an increase in the number of students undertaking an economics degree. Consequently, an increasing amount of the teaching that is being undertaken by schools and departments of economics in Australia is service teaching. However, it was demonstrated that the standard PE courses do not meet the needs of the majority of first year students. Consequently, the article addressed the issue of how best to meet the needs of business students, given that they were an increasingly important client group.

The article started with a review of eight papers in two recent editions of *American Economic Review* that were intended to serve as guides to improving the teaching of PE courses. However, it was argued that the solutions offered in these papers were inappropriate to the present context as they focused on the perceived needs of the minority of first year students, those undertaking economics degrees and not business programs.

The question of how to make service teaching more relevant to business students was answered at two distinct levels, a conservative approach and a more radical approach. The conservative approach argued that academic economists needed to consider the needs of key sponsors. In

particular, the professional associations that business graduates joined. These professional associations were important external stakeholders as many of them stipulate economics study as a pre-requisite for membership. However, it was demonstrated that at least one of the most important professional associations in Australia had poorly articulated its reasons why they required graduates to have studied economics. Hence, it was argued that academic economists should help these professional associations to articulate more clearly their needs. This in turn would make it easier for providers, that is, economics departments, to develop curricula to meet better the needs of business students.

The more radical approach argued that the traditional paradigm within which PE courses were currently taught was the main reason why service teaching did not meet the needs of business students. A number of concerns about the traditional paradigm were expressed in Section Four. In particular, the abstract reductionism of the neo-classical paradigm limited the usefulness in addressing contemporary social issues, and there was a lack of connection between the simplistic economics of the classroom and the complex activity of the real world in which our students functioned. In brief, the professional associations want students to learn about how real economies operated and not just to learn about economic theory. Hence, if we are to meet better the needs of our students we need to place our teaching into a broader theoretical framework. Institutional Economics was briefly explored as a framework in which this might be achieved.

REFERENCES

- Australian Society of Chartered Accountants and Institute of Chartered Accountants in Australia (1996). Guidelines for the joint accreditation of tertiary courses by the professional accounting bodies. Sydney: Australian Society of Chartered Accountants and Institute of Chartered Accountants in Australia.
- Borg, J.R. and Borg, M.O. (2001). Teaching critical thinking in interdisciplinary economics courses. *College Teaching*, 49(1), 20-29.
- Brown, B.W. and Liedholm, C.E. (2002). Can web courses replace the classroom in principles of microeconomics. *American Economic Review*, 92(2), 444-448.
- Case, K.E. (2002). Reconsidering crucial concepts in micro principles. *American Economic Review* 92(2), 454-458.
- Churchman, R. and Woodhouse, D. (1999). The influence of professional and statutory bodies on professional schools within New Zealand tertiary institutions. *Quality in Higher Education*, 5(3), 211-226.
- Colander, D. (2000). Telling better stories in introductory macro. *American Economic Review*, 90(2), 76-80.
- Frank, R.H. (2002). The economic naturalist: Teaching introductory students how to speak economics. *American Economic Review*, 92(2), 459-462.
- Hamermesh, D.S. (2002). Macroeconomic principles teaching tricks. *American Economic Review*, 92(2), 339-458.
- Hansen, W., Salemi, M. and Siegfried, J.J. (2002). Promoting economic literacy in the introductory economics course. *American Economic Review*, 92(2), 463-473.
- Harrison, R. (1984). Overview of accreditation, validation, evaluation and assessment in professional education. In ed. S. Goolad, *Education for the Professions: Quis Custodiet?* Birmingham: Quality in Higher Education, University of Central England in Birmingham.
- Kennedy, P.E. (2000). Eight reasons why real versus nominal interest rates is the most important concept in macroeconomics principles courses. *American Economic Review*, 90(2), 81-84.
- Knoedler, J.T. and Underwood D.A. (2003). Teaching the principles of economics: A proposal for a multi-paradigmatic approach. *Journal of Economic Issues*, 37(3), 697-725.

- Lewis, M. (1995). Breaking down the walls, opening up the field: Situating the economics classroom in the site of social action. *Journal of Economic Issues*, 24(2), 555-565.
- Lucas, R.E. Jr, Kreuger, A.B., and Blank, R.M. (2002). Promoting economic literacy: Panel discussion. *American Economic Review*, 92(2), 473-477.
- Maxwell, P. (1999). The economics principles text: Its evolution and influence in Australia. *Journal of Economics and Social Policy*, 33(2), 117-132.
- Melman, S. (1972). The peaceful world of economics 1. *Journal of Economic Issues*, 6(1), 35-41.
- Parkin, M. (2000). The principles of macroeconomics at the millennium. *American Economic Review*, 90(2), 85-89.
- Peterson, J. (1995). For whom? Institutional economics and distributional issues in the economics classroom. *Journal of Economic Issues*, 24(2), 567-574.
- Siegfried, J., Bartlett, R.L, Hansen, W., Kelley, A.C., McCloskey, D.N. and Teitenberg, T.S. (1991). The status and prospects of the economics major. *Journal of Economics Education*, (Summer 1991), 197-223.
- Stiglitz, J. (2002). *Globalisation and its discontents*. New York: WW Norton & Company.
- Taylor, H., O'Leary, P.M., Phalan, J.L., Spengler, J.J., Stewart, W.B. and Wolfe, A.B. (1950). On teaching undergraduate economics. *The American Economic Review*, 1-17.
- Taylor, J.B. (2000). Teaching modern macroeconomics at the principles level. *American Economic Review*, 90(2), 90-94.
- Taylor, J.B. and Moosa, I. (2000). *Economics*. Brisbane: John Wiley.
- Watson, D. (1992). The changing shape of professional education. In H. Bines. and D. Watson (eds), *Developing Professional Education*. Buckingham: Society for Research into Higher Education and Open University Press.

The inquiry nature of primary schools and students' self-directed learning knowledge

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Self-directed learning (SDL) is viewed as a desirable outcome of schooling, yet scant information is available to educational leaders and teachers on how to implement an inquiry-based curriculum or to support effectively students' development as self-directed learners.

To understand better the relationship between the inquiry nature of primary schools and students' SDL knowledge, The Primary School Characteristics Inventory was used to categorise six South Australian primary schools as providing a low, moderate, or high, level of support for inquiry. From within these schools, 150 students were explicitly taught about SDL. Students' SDL knowledge was assessed before engaging in four lessons on SDL, at the completion of the lessons, after three months and again after six months.

Also, students' class work was assessed and examination made of the relationship between levels of thinking and the schools' emphasis on inquiry-based learning. This study identifies significant relationships between school context, SDL knowledge and classroom performance.

Self-directed learning, inquiry-based curriculum, explicit teaching

INTRODUCTION

South Australia's education system is increasingly emphasising the need for all students to become self-directed lifelong learners, yet there is scant information available to educational leaders and teachers on how to implement an inquiry-based curriculum or to support effectively students' development as self-directed learners. To date, most information on self-directed learning (SDL) draws on adult learning literature with little research to guide practice at the school level. Recently there has been a call for research with K-12 students to describe self-directed learning as it relates to students in schools (Hmelo-Silver, 2004).

This paper reports a study of the relationship between the inquiry nature of primary schools and students' knowledge of SDL, and the relationship between the inquiry nature of these schools and the thinking skills of primary students in classroom work. It describes a model of self-directed learning in primary students that was used to guide the development of two instruments: one to assess the inquiry nature of primary schools, the other to assess students' knowledge of SDL. Key concepts in the model were incorporated into class lessons designed to teach explicitly students about self-directed learning.

Current descriptions of SDL (Hmelo-Silver, 2004) in adults emphasise the processes of planning learning, developing and applying strategies to learn and use appropriately learning resources. The

skills that are needed to engage in SDL involve students being aware of what they do and do not understand, being able to set learning goals, identify what they need to learn more about, plan and select strategies, and being able to monitor whether or not goals have been met (Hmelo-Silver, 2004).

SELF-DIRECTED LEARNING IN PRIMARY STUDENTS

Generally, SDL focuses on students' ability to self-assess their own learning needs in order to carry out activities to inquire and find out about the things they want to know (Blumberg, 2000). Self-management has been emphasised and it has been suggested that there may be characteristics of learners that relate to their movement toward self-management (Treffinger, 1975). More recently self-directed learning in elementary (primary) students has been defined as "self-directed work on problems for which the individual or small group has ownership" (Treffinger, 1993, p.431). SDL has been emphasised for gifted students, although it has been suggested that all students could engage in it (Treffinger, 1993). If this is to happen, it is important to clarify what SDL means for all primary students.

The model of self-directed learning in primary students presented in Figure 1, depicts SDL as composed of internal and external influences. Internal influences comprise personal characteristics of the learner such as attitudes and dispositions, which influence the way students approach tasks, as well as their initiative, effort, and persistence. Other internal influences are personal learning strategies of self-regulation and metacognitive strategies of planning, checking and reflecting. The external influences involve the context that directs and structures an overall inquiry activity in order to reach goals, the curriculum, the teacher, the classroom, as well as the availability of resources such as books and ICT equipment.

A positive motivation for SDL is important as it enables a student to initiate effort to carry out SDL strategies, to find resources and to persist when running into difficulties (Wigfield, Eccles, and Rodriguez, 1998). Also pertinent to motivation are the processes of self-efficacy related to being able to carry out an inquiry task, and causal attributions that explain who or what is held responsible for the students' success or failure on the task. Although motivation is recognised as a characteristic of a student, it is increasingly being recognised as being dependent on external social influences such as the way classrooms are organised (Pintrich and De Groot, 1990). Within schools and classrooms students interact with their peers and teachers, and these interactions have a major influence on students' motivation (Wigfield, Eccles, Rodriguez, 1998). The model presented indicates this view of motivation as exerting both an internal and external influence.

The arrows in the model depict a direct interaction of the student variables of attitudes, dispositions and motivation with self-regulated learning strategies and motivation and external self-directed learning strategies. The arrows also indicate that there is an interaction of context variables with self-regulated learning strategies.

Inquiry and Higher Order thinking skills (HOTS)

The model also depicts an inquiry task as having an important effect on SDL as well as being recognised as providing the incentive to be self-directed. Inquiry requires creative and critical thinking and these are important aspects of higher order thinking. Creative thinking involves analysis and creating, while critical thinking also involves evaluation. These higher order thinking skills are described in Bloom's taxonomy of cognitive objectives (Anderson and Krathwohl, 2001). Higher order thinking involves reflective thought and is often done under conditions of uncertainty that require self-regulation and knowledge construction (Hmelo and Ferrari, 1997). Inquiry tasks aim to develop students' higher order thinking as inquiry involves the need to

analyse the possibilities involved, bring together ideas and judge the relevance of each idea to the problem as well as reflecting on and judging the adequacy of a final solution.

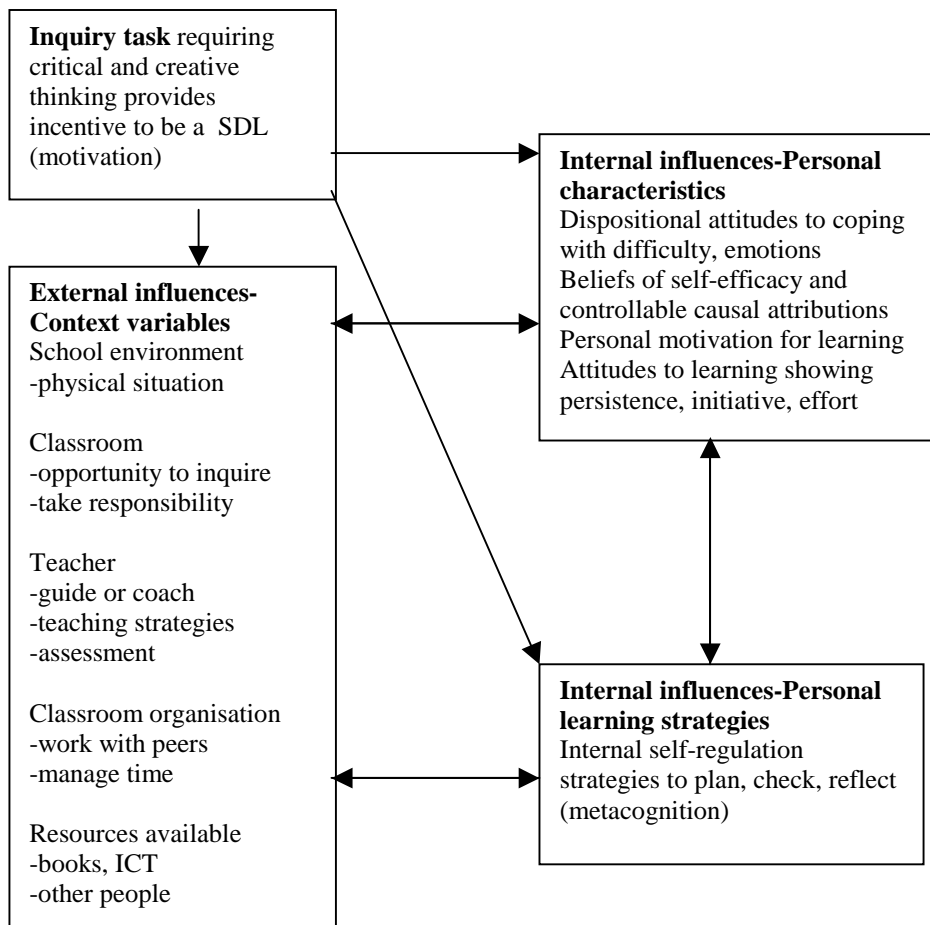


Figure 1. Model of self-directed learning in primary students

School influences on self-directed learning

Increasingly, there has been a focus on the influence of school level factors on students' learning and this is particularly important in considerations of SDL.

Perry and Weinstein (1998) indicated a need for empirical studies that explored classroom-school relations and school-level factors at the elementary school level. Most studies have focused on the effects of the amount of schooling, rather than the effects attributable to the quality of the schooling received by children (Rutter and Maughan, 2002). Rutter and Maughan described the qualities as contextual factors such as school organisation and management, group management in the classroom, and the pedagogic qualities of the teacher. Further, they argued that variations in school qualities have effects on pupil behaviour. These qualities have provided a useful basis for explaining the extent to which school characteristics could support student self-directed learning.

The influence of school level factors on student learning were also the focus of Sternberg's (2000) School Characteristics Inventory (SCI), which was constructed to develop a profile of a school that would reveal patterns about its structure and functioning that might impede or progress the school moving towards desired goals. Sternberg's inventory was designed to be used by any educational staff to assess the modifiability of a school context prior to carrying out interventions to improve student or teacher performance. Teacher level effects on student learning were studied by Rhine (1998) who found that when classrooms were designed by teachers so that student

understanding was the primary goal they emphasised the nature of classroom tasks, the teacher's role, and the social culture of the classroom.

The dimensions described by Rhine (1998), the features of schools described by Rutter and Maughan (2002) and the School Characteristics Inventory (SCI) designed by Sternberg (2000) guided the development of the 'Primary School Characteristics Inventory' (PSCI) for this study to assess the inquiry nature of primary schools.

Explicit teaching of self-directed learning in primary schools

From studies designed to promote learning and understanding with Chinese learners, Chan (2001) concluded that students' approaches to learning developed in response to learning environments, and implied that it would be important to change an existing learning environment in order to help students develop different ways of thinking and approaching learning. Chan highlighted the importance of bridging learning with direct instruction.

Westwood (1997) argued that teaching students explicitly about SDL reduced the likelihood that learning vital self-directed learning skills was left to chance. As suggested by Westwood, explicitly teaching students about SDL involved analysing tasks into easy steps, teaching task approach strategies, using clear teacher modelling, frequently revising previously taught skills and maximising time on task (Westwood, 1997).

This study is part of a larger investigation of primary school students' knowledge of self-directed learning. The aims of this study are (a) to clarify whether there is a relationship between primary students' knowledge of SDL and the inquiry nature of the school environment and (b) to assess the relationship between the inquiry nature of schools and students' thinking.

METHOD

This section outlines the procedures for selecting schools, the instruments used to assess the inquiry nature of the schools, the SDL knowledge of students and their reasoning levels (Ravens' Standard Progressive Matrices) and describes the intervention program of four lessons designed to teach students about SDL explicitly.

Participants

Cluster sampling was used to select 20 South Australian primary schools of more than 250 students to which the PSCI was sent. Thirteen schools returned one or more completed inventories; thus the sample was also a convenience sample as the return of the inventories meant that the schools were willing to participate in the study. Six schools were chosen on the basis of the PSCI classification of the inquiry nature of each school. One High, three Moderate, and two Low inquiry schools were selected from the inventories returned by the 13 primary schools. In total, 150 students from six intact Year 5 classes were taught about self-directed learning in four lessons carried out over one week. Whole classes participated in the class lessons (mean of 25 students per class).

Instruments

The Primary School Characteristics Inventory (PSCI)

The Primary School Characteristics Inventory (PSCI) was developed to assess the inquiry nature of the school. The inventory was pre-tested with 12 teachers in one school before being piloted by being sent to 100 schools across South Australia. Statements were written to elicit ratings of the beliefs of the school staff about the characteristics of the school that supported inquiry. The statements represented five broad characteristics of the school regarded as indicative of the

school's inquiry orientation. These characteristics included the general ethos of the school, the nature of classroom tasks, the role of the teacher, the role of students, and the organisation of the school. An example of the PSCI is the statement "A climate of mutual respect exists between staff and students" to which each school staff member was asked to respond by considering each statement and rating it on a Likert-type scale of 1 Never, 2 Rarely, 3 Sometimes, 4 Often, and 5 Always, whether they experienced this in their school. For example, if the statement "The school is involved in community activities" was rated at 1, it would indicate that the respondent believed that he or she had never experienced this characteristic at the school, while a rating of 5 would mean that he or she always experienced this at the school.

Responses from 59 schools were factor analysed using principal components analysis. From the analysis, three meaningful factors were achieved which were derived from characteristics indicating the school's inquiry orientation. The reliabilities for the each of the three components of the PSCI were then calculated. The three components were named 'Motivation for student inquiry' (Cronbach alpha = 0.94), 'Organisational structures to support inquiry' (Cronbach alpha = 0.90), and 'Structures to support inquiry strategies in school (Cronbach alpha = 0.85). The scores for the items were also Rasch scaled with the RUMM program (Sheridan, Andrich and Luo, 1997), which confirmed their fit to the three scales.

A PSCI total score was calculated for each of the 59 schools and they were ranked in descending order as to the percentage of agreement for the inquiry nature of each one. Schools were assigned to categories of high (89%+), moderate (71-88%) and low inquiry (70% agreement or less). These categories were used to identify the six schools discussed in this study.

Learning At School Questionnaire (LASQ)

The *Learning At School Questionnaire* (LASQ) was developed from the model of self-directed learning. It has three sub-scales:

- (1) The Motivation sub-scale, which includes statements about attitudes to self-directed learning that contribute to dispositional orientation, as well as statements about self-efficacy and causal attributions.
- (2) The Strategies sub-scale, which includes statements about self-regulated and self-directed learning strategies that can be employed in self-directed learning.
- (3) The inquiry nature of the School Context or environment sub-scale, which includes statements about the support available in the school environment for self-directed learning to be employed in inquiry tasks.

Students were asked to respond to each statement in the questionnaire by circling the words 'Agree', 'Disagree', or 'Unsure'. An example of this is the statement in the Motivation sub-scale: "*I know how to learn about topics that I am interested in*", to which a student could respond by circling Agree (scored 2), Disagree (scored 0), or Unsure (scored 1).

Two versions were pre-tested and piloted with 55 students in one primary school. The reliabilities were calculated for each of the three scales: motivation (Cronbach alpha = 0.77), learning strategies (Cronbach alpha = 0.77) and inquiry nature of the school context (Cronbach alpha = 0.73). The final version of the LASQ used in this study has 46 items in the scales of Motivation, Learning Strategies, and Inquiry context of the school.

Raven's Standard Progressive Matrices

Raven's Standard Progressive Matrices (Raven, 1956) is a test of non-verbal general reasoning ability. It was used to determine the reasoning level of the students in each school. The Raven's SPM had 60 items which required students to select a piece in order to complete each pattern

accurately. Correct responses were tallied and the raw scores were interpreted with the re-standardised Australian norms (Australian Manual, 1986).

Class lessons on self-directed learning

Four lessons on self-directed learning were developed from the constructs of the model of self-directed learning in primary students and were taught by the researcher to intact classes in each of the six participating schools.

The class lessons undertaken in each school had a problem-based approach. Scenarios about a dolphin sanctuary were developed and presented at the beginning of each lesson and discussed as the basis for classroom activities. The scenarios were real-life issues developed from the information brochure *Adelaide Dolphin Sanctuary* (Government of South Australia, 2003). An active approach was taken where the students were encouraged to discuss issues and role-play in pairs and groups.

The lessons covered motivation and strategies for self-directed learning. Motivation included strategies for promoting a positive attitude to self-directed learning, coping with difficulties in self-directed learning, strategies to be used to persist with difficulty, ways to approach an inquiry task, and strategies for attributing lack of success to external forces such as the resources chosen. The work on self-regulated and self-directed strategies included discussion of learning strategies that could be used to work on inquiry tasks, develop questions to guide information finding, evaluate the usefulness of resources, search for information, evaluate information, and check completed work. Discussions of planning strategies included those useful to work with others to plan activities, strategies to be used to work on a topic, as well as strategies to plan and use time effectively. Negotiation strategies that could be used to work with peers to plan activities were discussed as well as those to negotiate with teachers to work on particular topics.

Lesson Worksheets

Work sheet activities were designed to accompany the lessons about motivation and strategies for self-directed learning. These activities were classified in Bloom's taxonomy of cognitive objectives (Anderson and Krathwohl, 2001). The levels of Bloom's taxonomy are 'remember', 'understand', 'apply', 'analyse', 'evaluate' and 'create'. At the completion of each activity students wrote responses to describe what they could do at school to work in a self-directed way. The responses for each student were transcribed by the researcher and the frequency of responses for each activity was tabulated. The responses were regarded as an index of student engagement which has been described as an important academic outcome (Furrer and Skinner, 2003). The frequency of responses were calculated as engagement in each level of thinking according to Bloom's taxonomy.

PROCEDURES

The thinking skills of the students were assessed by inspecting the written responses to the activities undertaken in the lessons designed to teach explicitly about SDL. The mean frequencies were calculated in each level of thinking for the activities classified in the cognitive domain of Bloom's taxonomy of educational objectives.

Using LASQ, an assessment was made of the SDL knowledge of the students in the sub-scales of Motivation, Strategy, and School Context. Following the lessons, a second assessment was made with LASQ. Three months and six months later assessments were made again of students' SDL knowledge.

The research described in this study was carried out in three phases in order to assess the effect of the inquiry nature of the school on primary students' knowledge of SDL and thinking skills. First, the inquiry nature of schools was assessed using the PSCI, and an initial assessment using the LASQ was made of students' existing knowledge about self-directed learning, and the reasoning level of all students was assessed using the Raven's Standard Progressive Matrices (Raven, 1956). Next, students were explicitly taught about SDL and then assessed on their SDL knowledge. Then students' knowledge of SDL was assessed later after three and six month intervals.

RESULTS

Each sub-scale of the LASQ was Rasch scaled (Sheridan, Andrich and Luo, 1997) in order to convert the raw scores to an interval scale. Rasch interval scale logits were then able to be used to study changes in the students' knowledge of SDL. The means and standard deviations were calculated for the Rasch logit scores on these sub-scales and are shown in Table 2. Effect sizes were calculated (Coe, 2000) to indicate the size of the effect in each sub-scale between each assessment within the schools grouped by inquiry. Cohen (1992) described effect sizes between 0.20 and 0.50 as 'small', between 0.50 and 0.80 as 'medium', and above 0.80 as 'large'.

The relationship between primary students' knowledge of SDL and the inquiry nature of the school environment

The results of the analysis are presented in the three separate components of self-directed learning identified in the study, namely Motivation, Strategy and School Context support for inquiry, and are shown in Table 2.

Table 2. Rasch logit score means and standard deviations (SD) on LASQ 1, 2, 3, 4 for Motivation, Strategy, School Context shown with effect sizes (ES) for Low, Moderate and High inquiry schools

LASQ sub-scales	Low inquiry schools	Moderate inquiry schools	High inquiry school
	Mean (SD) ES	Mean (SD) ES	Mean (SD) ES
Motivation			
LASQ 1	1.57 (0.99)	1.72 (1.20)	1.60 (0.93)
LASQ 2	1.36 (1.27) -0.18	2.08 (1.36) 0.28	1.86 (0.99) 0.39
LASQ 3	1.42 (1.42) 0.04	1.76 (1.26) -0.24	1.60 (0.84) -0.28
LASQ 4	1.42 (1.29) 0.00	1.74 (1.05) -0.02	1.66 (1.34) 0.05
Strategy			
LASQ 1	1.13 (0.97)	1.34 (1.16)	1.48 (0.93)
LASQ 2	1.41 (1.51) 0.08	1.75 (1.39) 0.32	1.86 (0.99) 0.39
LASQ 3	1.20 (1.41) -0.22	1.60 (1.25) -0.11	1.60 (0.84) -0.28
LASQ 4	1.28 (1.24) 0.06	1.52 (1.23) -0.06	1.66 (1.34) 0.05
Context			
LASQ 1	1.07 (0.97)	1.22 (1.10)	1.20 (0.79)
LASQ 2	0.85 (1.54) -0.17	1.26 (1.21) 0.03	1.61 (1.20) 0.40
LASQ 3	0.74 (1.25) -0.08	1.14 (1.11) -0.10	1.42 (0.74) -0.19
LASQ 4	0.68 (1.41) -0.04	1.12 (1.25) -0.02	1.20 (1.15) -0.22

Motivation in SDL

Figure 2 shows the mean scores for motivation in Low, Moderate and High inquiry schools at the four LASQ assessment times

In the Moderate and High inquiry schools, the effect size was small and significant ($p < 0.05$) indicating that scores increased for knowledge of Motivation immediately following explicit teaching about self-directed learning. In Figure 2 the scores show a decrease at the three and six month testing. In the Low inquiry schools the effect size was not significant and the scores decreased for Motivation following teaching. The scores also show a small increase at the three and six month testing This decrease in scores for motivation knowledge in the Low inquiry school

could indicate that students held a positive view of their abilities prior to explicit SDL instruction and might have modified their assessment to be less positive following instruction.

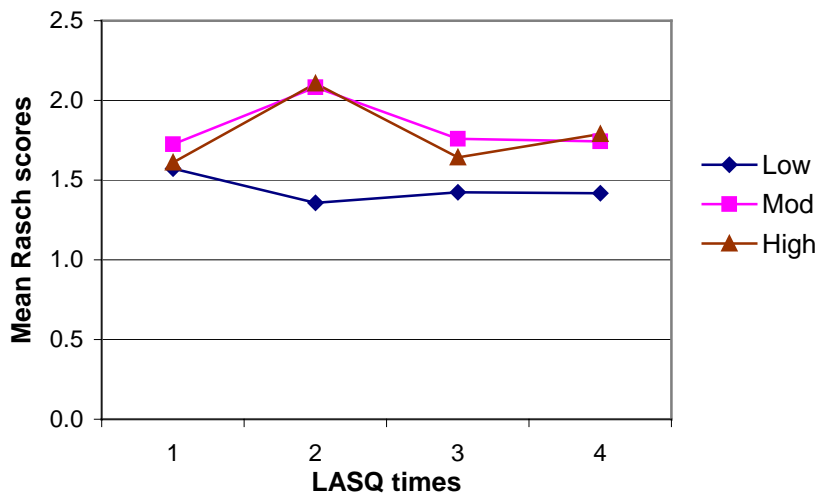


Figure 2. Mean Rasch scaled scores for Motivation in Low, Moderate and High inquiry schools on 4 LASQ assessment times

Strategies in SDL

With regard to learning strategies in the LASQ, the profile of mean score responses for students within each school grouped by inquiry nature is depicted in Figure 3.

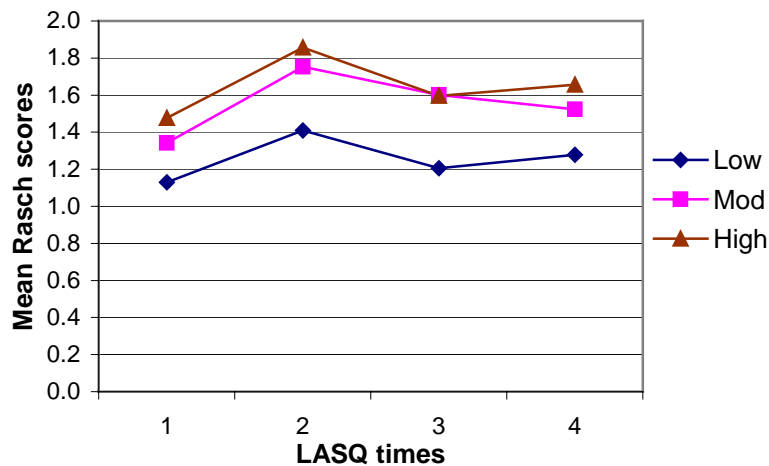


Figure 3. Mean Rasch scaled scores for Strategy in Low, Moderate and High inquiry schools

In all inquiry groupings of schools, the scores for the Strategy sub-scale increased directly following explicit teaching. The gain was significant ($p < 0.05$) in Moderate and High inquiry schools with a small effect size and not significant in Low inquiry schools. The mean scores for Strategy decreased from time two to time three in all inquiry schools.

Unlike the scores for Motivation, the Strategy scores in the low inquiry schools increased after instruction. Students in all schools irrespective of inquiry nature, responded positively to the strategy aspects of the lessons on self-directed learning. This suggests that for students in low inquiry schools, knowledge of strategies is more likely to be influenced in a positive way by instruction than knowledge about motivational influences.

School context in SDL

The students responded to the statements about school context by circling 'Agree', 'Disagree' or 'Uncertain'. Explicit teaching about school context was not a strong feature of the lessons. However, students were involved in discussion about availability and access to school resources. Although the students were not taught explicitly about the school context in class lessons, this variable was of interest because it was expected that the level of school support that students perceived as available to them could influence their motivation towards SDL. The graphed mean scores for school context are shown in Figure 4.

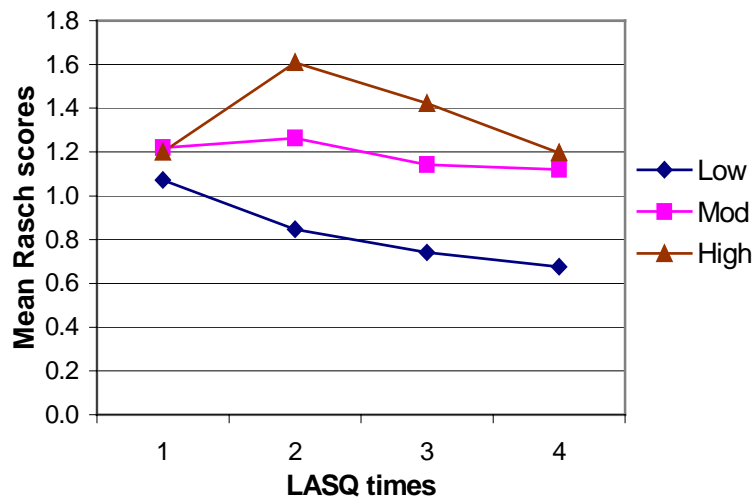


Figure 4. Mean Rasch scaled scores for School Context in Low, Moderate, and High Inquiry schools

The profile of responses, presented in Figure 4, shows a different pattern for the scores related to the inquiry nature of the school context. The scores in the low inquiry school decreased from Time 1 to Time 2 with a small negative effect size. In the Moderate inquiry schools the scores increased on each assessment but the effect size was not significant. In the High inquiry school the mean scores increased at Time 2 with a small effect size and decreased at Times 3 and 4.

Although the inquiry nature of the school context was not a strong focus of instruction, the scores in the Moderate and High inquiry schools indicated that students increased their views of the inquiry nature of the school context following the class lessons. In contrast, there was a decrease over time in the scores for Low inquiry schools.

In summary, The pattern of results on the LASQ indicated that the inquiry nature of a school had an influence on students' knowledge and development of self-directed learning following explicit teaching. The effect sizes indicated that there was a significant gain in scores in High inquiry schools over four occasions ($p < 0.05$) for Motivation and Strategy. Following the intervention, there was a gain in Moderate inquiry schools for scores on Motivation and Strategy. In the Low inquiry schools, there was a small (not significant) gain in scores for Strategy, and a decrease in scores for Motivation.

The relationship between students' levels of thinking and the inquiry emphasis of schools

Students' raw scores on the Ravens' Standard Progressive Matrices (mean for students in Low inquiry schools 105.3, Moderate 107.9, and High inquiry schools 107.4) indicated that across all schools irrespective of inquiry, the students were of similar reasoning ability.

Table 3 summarises the reasoning levels of the students classified by the inquiry nature of the schools, and the mean frequency of responses by the students to the class lesson work-sheets for the activities classified according to Bloom's taxonomy. The frequency of responses to the activities on the lesson work sheets were regarded as an indication of the engagement of the students at each level of thinking in Bloom's taxonomy.

Table 3. Engagement of students in schools categorised by support for inquiry (N=150 primary students)

Level of school inquiry	Low Inquiry Schools N=2	Moderate Inquiry Schools N=3	High Inquiry School N=1
Bloom's levels	Mean (SD)	Mean (SD)	Mean (SD)
1-Remember	7.94 (2.98)	10.74 (4.44)	13.46 (4.38)
2-Understand	11.38 (3.63)	12.36 (2.95)	11.82 (2.65)
3-Apply	8.94 (3.02)	10.91 (3.02)	12.79 (3.00)
4-Analyse	10.33 (3.22)	11.16 (3.12)	11.96 (3.52)
5-Evaluate	12.17 (2.93)	12.83 (3.31)	14.11 (1.23)
6-Create	5.73 (2.49)	6.26 (2.07)	6.54 (1.91)

Low inquiry =PSCI<70%, Moderate inquiry = PSCI 71-89%, High inquiry = PSCI >90%

The findings in Table 3 indicate that students were more engaged in the High inquiry school than in the low and Moderate inquiry schools in five of the six levels of thinking. The students in the Low inquiry schools were least engaged across all of the six Bloom's levels.

An examination was made of the three most complex levels of thinking in Bloom's taxonomy, classified as Higher Order Thinking Skills (HOTS). These are shown in bold type in Table 3. The HOTS are the processes needed to analyse, evaluate, and create. The classification of HOTS showed that students in the High inquiry school had a higher mean frequency of responses in activities classified as higher order thinking, while students in the Low inquiry schools had the lowest means for each of the three HOTS. This finding suggests that there was some emphasis on higher order thinking in the high inquiry school and that there was less emphasis on these skills in schools with less emphasis on inquiry-based learning.

The frequency of lesson worksheet responses indicates that students were most engaged in the High inquiry school and least engaged in the Low inquiry schools. Thus, the difference in mean frequency of responses of the students indicates that the inquiry level of the school was associated with the engagement of students when participating in classroom activities.

DISCUSSION

Self-directed learning in primary schools has been recommended for gifted students (Treffinger, 1993) although Treffinger also suggested that all students could be self-directed learners. This study indicates that for primary students in general there is value in assessing and teaching about self-directed learning.

The findings of the study show that in High and Moderate inquiry schools students improved their knowledge of motivation and strategies for self-directed learning after being explicitly taught about SDL in class lessons. The students in the Low inquiry schools had decreased scores on motivation following the teaching intervention and increased scores on strategies. The increase in knowledge of strategies following instruction for all students in each category of inquiry-based school showed that students responded positively to instruction about strategies for learning and increased their knowledge on this sub-scale.

Due to the small sample, it is only possible to identify trends in the results for further investigation. Motivation for self-directed learning and the influence on students of a low emphasis on inquiry-based learning at the school level could be investigated further.

This result suggests that students in schools where there is a higher level of support for inquiry-based learning, benefited more from instruction about motivation than students of comparable ability who were in schools that gave less support to inquiry-based learning. This finding is reinforced by the lesson work-sheet responses that indicated that students were more highly engaged in the High inquiry school and least engaged in the Low inquiry schools. Moreover, this finding supports the view advanced by Wigfield et al. (1998) that school level factors did have a major influence on students' motivation. This indicates that further research could investigate the development of self-directed learning and levels of thinking in large numbers of primary students as well as the relationship of both to the inquiry nature of schools.

Sternberg's (2000) inventory classified schools in terms of modifiability in order to consider whether schools need to be made more modifiable before interventions were undertaken to improve teaching or learning. The results of this study suggest that schools accommodate and support inquiry and self-directed learning more readily than some other schools. In the school context, schools with a strong focus on inquiry-based learning seem to help students develop self-directed learning knowledge. It is important to know this in the context of advocating that schools should develop student knowledge of SDL.

CONCLUSIONS

This paper makes an important contribution to understanding the influence of the school context on knowledge of self-directed learning in primary school children. The study identified significant relationships between school context, SDL knowledge and classroom performance. It showed that primary school students knew about SDL and that there was a link between the inquiry nature of the school and students' knowledge of, as well as their response to, explicit instruction about SDL.

The model of self-directed learning in primary students was the basis for developing class lessons to teach SDL and provided a valuable framework to guide explicit teaching of SDL in primary schools.

It is clear from this study that some schools placed a stronger emphasis on inquiry than others. In light of the relationship that existed between this emphasis on inquiry and students' SDL, effective implementation of SDL in primary schools would be more likely to occur where the school context supported inquiry. As an innovation in primary schools, SDL is less likely to be effective if the level of support for inquiry in the school context is not considered.

REFERENCES

- Anderson, L.W. and Krathwohl, D.R. (2001). *A Taxonomy for Learning, Teaching, and Assessing*. (A revision of Bloom's Taxonomy of Educational Objectives). New York: Longman.
- Blumberg, P. (2000). Evaluating the evidence that problem-based learners are self-directed learners: A review of the literature. In D.H. Evensen and C. Hmelo (Eds.) *Problem-Based Learning: A research Perspective on Learning Interactions*. Mahwah, NJ: Erlbaum.
- Chan, C. (2001). Chapter 9. Promoting learning and understanding through constructivist approaches for Chinese Learners. In D.A. Watkins and J.B. Biggs (Eds.) *Teaching the Chinese Learner: Psychological and Pedagogical Perspectives*. Hong Kong: Comparative Education Research Centre, and Melbourne, Victoria: The Australian Council for Educational Research.
- Coe, R. (2000). What is an 'effect size'. [Online] <http://www.cemcentre.org/ebeuk/research/ effectsize/ESbrief.htm>
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112(1), 155-159.

- Furrer, C. and Skinner, E. (2003). Sense of relatedness as a factor in children's academic engagement and performance. *Journal of Educational Psychology*, 95(1), 148-162.
- Grady, N.B. and Fisher, D.L. (1993). Teachers' images of their schools, as revealed by metaphor, and students' perceptions of their classroom environment. Paper presented at the Annual Conference of the Australian Association for Research in Education. Perth, Western Australia. November, 1993.
- Government of South Australia, (2003). *Adelaide Dolphin Sanctuary*.
- Hmelo, C.E. and Ferrari, M. (1997). The problem-based learning tutorial: Cultivating higher order thinking skills. *Journal for the Education of the Gifted*, 20(4), 401-422.
- Hmelo-Silver, C.E. (2004). Problem-based Learning: What and how do students learn? *Educational Psychology Review*, 16(3), September.
- Montalvo, F.T. and Torres, M.C.G. (2004). Self-regulated learning: current and future directions. *Electronic Journal of Research in Educational Psychology*, 2(1), 1-34.
- Pintrich, P. and DeGroot, E. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, 82(1), 33-40.
- Perry, K.E. and Weinstein, R.S. (1998). The social context of early schooling and children's school adjustment. *Educational Psychologist*, 33(4), 177-194.
- Raven, J. (1956). *Standard Progressive Matrices*. New York: Psychological Corporation.
- Raven, J., Raven, J.C. and Court, J.H. (2000). *Section 3: Standard Progressive Matrices*. Oxford, England: Information Press
- Rhine, S. (1998). The role of research and teachers' knowledge base in professional development. *Educational Researcher*. June-July. 27-31.
- Rutter, M. and Maughan, B. (2002). School effectiveness findings 1979-2002. *Journal of School Psychology*, 40(6), 451-475.
- Sheridan, B., Andrich, D. and Luo, G. (1997). *RUMM, Rasch Unidimensional Measurement Models*. Perth: Murdoch University.
- Sternberg, R.J. (2000). *Making School Reform Work: A Mineralogical Theory of School Modifiability*. Bloomington, Indiana: Phi Delta Kappa Educational Foundation.
- Treffinger, D.J. (1975). Teaching for self-directed learning: A priority for the gifted and talented. *The Gifted Child Quarterly*, XIX(1), 46-59.
- Treffinger, D.J. (1993). Fostering effective independent learning through individualized programming. In J.S. Renzulli (Ed.), *Systems and Models for Developing Programs for the Gifted and Talented*. Australia: Hawker Brownlow.
- Westwood, P. (1997). *Commonsense Methods for Children with Special Needs*. (3rd ed.) London: Prentice Hall.
- Wigfield, A., Eccles, J.S. and Rodriguez, D. (1998). The development of children's motivation in school contexts. In D.P. Pearson and A. Iran-Nejad. *Review of Research in Education*. Washington, D.C.: American Educational Research Association.

Teachers' learning in an innovative school

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The successful establishment of a purpose-built innovative school designed to support new ways of teaching and learning in the senior secondary years, particularly in the area of science and mathematics, required a comprehensive and research-based professional development policy and program. Planning professional learning opportunities for the teachers located within the Australian Science and Mathematics School (ASMS) emerged from reviewing the literature on effective professional development and collaboration between the ASMS leadership team and staff from Flinders University. In keeping with honouring the individual teachers and their specific learning needs a professional learning program that provided a range of options was developed. This article reports on the reasoning behind the design of the professional development policy and two specific strategies used to support teachers' learning and practice in this innovative environment.

Professional development, teachers' learning, professional partnerships

INTRODUCTION

Who dares to teach must never cease learning.
John Cotton Dana (cited in Guskey, 2000, p.146)

Teachers' learning is a critical aspect in schools attempting to work in innovative ways. Researchers, including Darling-Hammond (1999), Fullan (2001), Loughran (2002), and Sparks (2002), note the importance of teachers' learning in promoting change at the school level. But as Elmore and Burney (1999, p.267) also note "teachers do not respond to simple exhortations to change their practice", they must have access to professional learning opportunities that link with their perceived and current developmental needs. Such opportunities should have a strong focus on the acts of teaching and learning, as Darling-Hammond (1999, p.8) suggests, "...teachers who know a lot about teaching and learning and who work in environments that allow them to know students well are the critical elements of successful learning." King and Newman (2002) also provide advice when considering how to plan for effective teachers' learning.

Since student outcomes and how teachers teach are profoundly influenced by the school in which the students and teachers work, the design of professional development itself should be grounded not only in a conception of how individual teachers learn, but also in a conception of how schools as organisations affect teachers' learning, teachers' practice, and student achievement. (King and Newman, 2002, p.577)

The school at the centre of this paper, the *Australian Science and Mathematics School* (ASMS) is innovative in many ways including: a) being architecturally designed to promote new ways of

teaching and learning; b) being situated on a university campus (Flinders University) to promote collaboration between staff in both organisations; c) catering specifically for senior secondary students who have a strong interest in mathematics and science; d) designing and implementing an interdisciplinary curriculum; and e) providing a major role in the professional development of teachers in and beyond the school. The infrastructure for innovation is in place for promoting educational reform. However, whether true educational reform occurs or whether the status quo of education in the senior years is maintained in this school, may be significantly influenced by the quality of the opportunities for teachers' learning and the subsequent outcomes of this learning.

The school's vision, as stated below, suggest that the way teachers and students work and learn in this school may look very different from more traditional senior secondary schools.

The Australian Science and Mathematics School will be recognised as a quality school that provides leadership of innovation and reform of the teaching and learning of science and mathematics. (ASMS Vision Statement, 2004)

Achieving such a vision requires significant consideration about how to support teachers to work in new ways. The school links one of its mission statements to this very notion in stating that:

The ASMS will be one of the most advanced learning centres of its kind, it will provide Australian educators, and South Australians in particular, with state of the art professional development. (ASMS Mission Statement, 2003)

This mission clearly indicates that the opportunities for teacher learning are not confined to those working in the school but to the wider professional field. However, this paper focuses specifically on two of the initial strategies that have used to support teachers' learning within the school.

Research on professional development presents a dichotomous view on optimal approaches to professional development, noting that many traditional models of professional development are considered fragmented and poorly coordinated (Guskey, 2000, Cohen and Spillane, 1992 cited in Sykes, 1999). Often little thought has been given to the strategic application of knowledge and skills presented in professional development programs. Many professional development programs are presented as so-called 'one hit wonders' with a focus on the latest 'trend' (Hawley and Valli, 1999). Increasingly, it is recognised that there is no one perfect approach to successful professional development because the content, process and contextual variables differ across programs, styles of delivery and learning, and situation. However, Hawley and Valli (1999, p.137) have described eight characteristics of effective professional development. Some of these characteristics included:

- teachers clearly identifying their learning needs,
- processes that involve collaborative problems solving,
- organisation based on the continuous and ongoing involvement of a cohesive group,
- opportunities to develop theoretical understanding of new knowledge and skills
- integration of professional development within a comprehensive change process including the facilitation of student learning, and
- incorporating evaluation of multiple sources of outcomes for teachers, students and organisations.

All of these characteristics are featured in the professional development policy at the ASMS. The policy is aimed at promoting effective teacher learning that ultimately supports rich learning

outcomes for students at the school. As Guskey (1994, p.43) points out, "the teaching and learning process is a complex endeavour that is embedded in contexts that are highly diverse". Given this premise it is important to consider that even within this school there are diverse contexts for teaching and learning and therefore a diverse approach to supporting professional development is required. The fundamental aspect that is addressed consistently in the school's professional development policy is the situating of learning opportunities on real problems and practices. Loughran cites Dewey (2002, p.10) who recognised that:

educational practices themselves must be the source of the ultimate problems to be investigated if we are to build a science of education, so a focus on teacher research is paramount as it is teachers who work in the crucible of educational practice from which the 'problems' are derived.

Some of the real problems faced by teachers at the ASMS are the development and implementation of an interdisciplinary curriculum, the use of new pedagogies, reframing the role of the teacher, designing authentic and transparent assessment, the de-privatisation of practice and the provision of learning opportunities that stretched teachers and students alike but meet the criteria for the South Australian Secondary Schools Assessment Board. While teachers at the school all faced these issues they did so to varying degrees depending on their specific leadership role. This diversity of teachers' learning needs required much flexibility within the professional learning opportunities that the school provided. Shulman's (1999) comment guided the shaping of learning opportunities that varied from traditional so-called 'sit, listen and discuss' seminars.

Acquiring sophisticated knowledge and developing a practice that is different to what teachers themselves experienced as students, requires learning opportunities for teachers that are more powerful than simply reading and talking about new pedagogical ideas (Ball and Cohen, 1996). Teachers learn best by studying, doing and reflecting, by collaborating with other teachers, by looking closely at students and their work, and by sharing what they see. (Shulman, 1999, p.11)

The following section of this paper provides details about two professional learning opportunities that are in action at the ASMS. The first centres on a partnership between the school and Flinders University to engage teachers in sustained professional learning around an issue of significance to them; and the second, a learning-in-action opportunity where teachers and additional expert personnel, either from the university or industry, work together to support students in individually designed inquiry based projects.

PROFESSIONAL LEARNING PARTNERSHIPS

The situating of the ASMS on a university campus provides many opportunities for interaction between staff in both settings. Staff from the Faculty of Science engage with staff from the ASMS in developing new and innovative curriculum offerings (see the *ASMS Curriculum Handbook 2004* for specific details). Flinders University School of Education staff and staff from the ASMS work as a team in developing opportunities for teachers' learning that can be formally recognised. The stress placed on collaborative processes was generated from considering the key elements associated with building professional learning communities. Sparks, (2002, p.66) suggested that "successful learning communities have at their base high quality relationships, collegiality, reflection, risk taking and collaborative problem solving". Developing professional partnerships whereby staff from both organisations viewed themselves as colleagues of equal status was critical to building a sense of shared responsibility for learning outcomes at the ASMS.

From the collaboration between the School of Education staff and the ASMS leadership team a formal graduate level certificate program was developed. The Graduate Certificate in Education (Professional Learning) was designed to promote professional learning groups that involved staff

from both organisations. Teachers at the ASMS were invited to participate in this program with the understanding that they would be required to attend formal sessions and submit some form of evidence about their professional learning at the completion of the program (approximately 8 months in length). It was hoped that the outcomes from successful involvement in the program would include significant professional learning and subsequent contribution to the policies and practices within the school in addition to a formal tertiary qualification.

Although the program provided an opportunity for teachers to reflect in detail on issues of interest and concern that had emerged from their role in the school initial sessions had an explicit focus on 'the self as a learner'. It was viewed as paramount to consider effective learning from a personal perspective as teachers often found themselves responsible for enhancing the learning of others rather than engaging in learning themselves. Bransford et al. (1999, p.183), noted that, "...teachers are generally accustomed to feeling efficacious – to knowing that they can affect students' learning – and they are accustomed to being in control". Teachers often viewed themselves as being responsible for the learning of others but struggled with the notion of being learners themselves. By engaging the teachers at the ASMS in the learning process the notion of who was in control of what could be experienced first-hand. The teachers in the program were all strongly encouraged to document their learning processes and outcomes and to reflect on what made a difference for them. The aim of this activity was to assist teachers to generate a deeper understanding of the processes of learning and to examine whether this was transferred to their planning and support for student's learning. As Perry (2004, p.36) suggested,

Revitalising one's creativity and intelligence can come from being a true student again. Educators need time to be students in several different ways...Being a student again creates greater empathy for students in our own classrooms while deepening our understanding[s] of subject matter and [self].

Moon's (1999) Map of Learning was used as a model to track the teacher's learning in this program. Moon drew on constructivist views of learning, notions of cognitive structure, content, stages in learning, and deep and surface approaches to learning in building her model. Key stages in the map along with links to surface and deep learning as suggested by both Entwistle (1988, cited in Biggs, 1999) and Biggs (1999) are detailed below.

- | | | |
|--|---|------------------|
| <ul style="list-style-type: none"> • Noticing • Making sense | } | Surface Learning |
| <ul style="list-style-type: none"> • Making meaning • Working with meaning | } | Deep Learning |
| <ul style="list-style-type: none"> • Transformative learning | | |

In using Moon's model teachers at the ASMS were able to track their own learning commencing with what they noticed most about their current work in the school. How they made sense about what they noticed was supported through professional discussion within the group. As Schon (1983, p.243) suggested "Awareness of one's own intuitive thinking usually grows out of practice in articulating it to others". The role of others in supporting 'making sense and meaning' of teachers' issues was also recognised by York-Barr, Sommers, Ghore and Montie (2001, p.59) who noted that "Because we filter our experiences through our own view of the world, reflecting alone can result in self-validation and justification". The very nature of being involved in the professional learning group ensured that even when a sound idea was proposed close scrutiny of the belief or practice was generated between members.

The program provided much time for initial making sense and meaning of the teachers' issues as they revolved around real and complex notions including: student engagement, individual learning plans, transparency in assessment practices and pedagogies that supported student learning. Teachers commenced working with meaning when they felt prepared to, and this varied for the individuals within the group. The so-called 'working with meaning' stage of the program resulted in less formal meetings and more individual consultation between the university and ASMS staff. For example, when a small group of teachers felt the need to develop skills in analysing qualitative data a session on this was provided. Other ASMS staff sought meetings to discuss the data gathered from students that reflected Feather's (1982) theory of 'expectancy x value'. This reference was provided for these teachers who then changed their practice (transformative learning) to support student engagement.

The teachers in the program presented their work to others in the group and also to the wider community within and beyond the school. Different ways of providing evidence about their own learning journeys reflected the way in which the individuals preferred to work and this was noted as something that should be available to their own students as well. The evidence that has been generated from the group has provided impetus for continued focusing on several areas as well as a range of valuable documents that could be used in a number of ways, particularly as evidence of the history behind the practices and beliefs emerging in this school.

In seeking feedback from the teachers involved in the program all participants responded that the program was "highly integrated" with their work at the ASMS. Comments about the most significant outcomes from engaging in the program included the following:

The most significant outcome for me has been about planning for supporting change in the learning environment. My action research had focused on priorities for change and action to support those priorities. I have also reflected on myself as a learner and my capabilities and characteristics and how they have helped or hindered my progress. I did manage to keep journals as a practice to monitor and understanding my own learning and this is certainly an improvement for me which I am glad I persisted with. I need to further develop explicit learning in regard to learning theories.

In reflecting on the structure and organisation of the topic the following comments were made.

A good start and end but I fell down a little in the middle however, this wasn't exactly the fault of the topic it was probably due to me putting priority on other things, more regular contact may have reduced this.

Seemed to open and lacking in direction in the beginning but this has to do more with my lack of experience and on reflection that time allowed for exploration of the research question. I changed my focus many times as I tried to make sense of where I wanted to focus my energies.

I think I needed more scaffolding and support, like some of my students, we need help but don't bother to ask for it.

These comments provide valuable feedback to the designers of the program and they also provide evidence of the teachers reflecting on their own style of learning. Understanding self as a learner was a key aim of this program. Transferring this knowledge of self as learner to thinking about learning for students is evident in the last comment. The teachers as learners in this program all take some responsibility for their learning. They appear to recognise that to gain the most from learning situations learners have a significant responsibility too, and this concept is something that can be continually and explicitly shared with all learners at the ASMS.

LEARNING-IN-ACTION

This second aspect of professional learning opportunities provided by the ASMS has emerged from innovation around the topics that were available to Year 12 students at the school. In seeking to provide innovative practices and learning opportunities for both teachers and students in this school the concept of ‘extension studies’ – a model where students in their final year of secondary schooling could engage in a self directed study was developed. Extension Studies would replace one of the five more traditional subjects that on successful completion would result in the South Australian Certificate of Education, a pre-requisite for university entry, being awarded. Some of the more traditional topics available for students in their final year of schooling included Pure Mathematics, Physics, Chemistry, Biology, English Studies and Geography. As the ASMS was committed to transforming the way student learning and achievement were defined and measured it has been a key innovator in the development of Extension Studies.

In line with the teaching and learning principles of the ASMS, Extension Studies used an inquiry approach to learning. Students nominated an area of interest suitable for a research investigation that enabled them to be engaged in learning experiences that were complex and creative and more specifically linked to the real world. The projects should build their processes and skills in research in addition to developing key content knowledge. This was achieved by providing opportunities for students to conduct concentrated research in a specialised field. Students drew on many information sources and traditional subject disciplines and on the way they learnt to manage and allocate resources such as time and materials.

The Extension Studies investigation topics designed by current students at the ASMS, stated below, gives some indication of the interdisciplinary nature of the inquiries and the depth of knowledge and skills needed to address the student’s investigation.

- How can the laws of electricity, magnetism and mechanics be made consistent?
- How is artificial intelligence technology poised to enrich the life of an individual with a disability?
- Design and build a device that sends digital data over UHF radio.
- What skills does a scientist need to act in an entrepreneurial way?

Inevitably student’s Extension Studies investigations were across traditional subject disciplines. In fact many of the new sciences were derived from emerging technological developments and sat between disciplines. This creates new demands on teachers who were supporting the students through their Extension Study. Teachers were no longer in a position where they could turn to a pre-determined curriculum or traditional ways of teaching.

Support for students engaging in such inquiry-based projects required the teachers to contribute to curriculum development and reassess their notion of evidence of learning. Previous work at the Year 12 level was constrained by statewide assessment procedures, with any alternative approaches to the traditional exam orientated model, often considered as lacking in academic rigour particularly in the science and mathematics domains. Any initiative in the area of reforming learning and assessment at the senior years levels would be closely scrutinised by such organisations as the Senior Secondary Assessment Board of South Australia (SSABSA). Therefore working closely with professionals from these organisations was critical to developing a shared understanding about the broader outcomes of such an initiative.

Professional learning opportunities were provided for the staff in a number of ways but foremost through connecting a staff member with significant others, including the content expert, assistant principal of the school and also with personnel from the SSABSA. This provided the credibility

demanding by many at this level of schooling and facilitated working partnerships between educators and practising scientists and technologists. These working relationships provided opportunities for all to consider aspects beyond the individual student's progress in an Extension Study. Opportunities to review pedagogies that supported deep learning, considered alternative assessment practices for the senior years and introduced the new sciences to the curriculum offered at the ASMS could emerge through such collaboration. As a student's Extension Study was nine months in length it also provided for ongoing interaction between all the people involved but in particular for the teachers at the ASMS and the expert mentor. The teacher was provided with a sustained opportunity to learn new content knowledge from the mentor and to consider carefully the most effective way to develop students' understanding of this content. The staff member in working and learning along side of the student modelled for the student the responsibilities of the learner as discussed in the previous section. Such responsibilities might include careful planning to get maximum benefit from meeting with the mentor, the need to ask questions if unclear about specific aspects and the active theorising about possibilities.

Although this project has been in its infancy, other outcomes to date have included:

- teachers developing insights into the latest scientific research;
- development of teacher skills in supporting learning styles and inquiry based learning;
- recognition of constraints on students learning afforded by the current senior secondary school assessment structures; and
- support for teachers in developing deep knowledge and understanding of their subject.

CONCLUDING COMMENTS

This article describes only two aspects of the learning opportunities presented for teachers at the ASMS. There are many other aspects including teachers accompanying university colleagues to conferences on the new sciences; jointly planned and run statewide professional development workshops in areas such as nanotechnology; and ongoing workshops and professional discussion about working with the new technology in the school. In planning for teachers' learning at ASMS it is paramount to draw on our understanding of learning and how we learn in different ways. As Biggs (1998) noted there were times when we learnt at a surface level and times when learning was for strategic purposes but it was deep learning that was required before significant change could occur. While the teachers in this school are working in an environment of significant change they are still in control of how and what they teach. As Fullan (1991, p.117) noted, "Educational change depends on what teachers do and think. It's as simple and complex as that". Without appropriate support to learn and reflect on whether their beliefs and practices were creating rich learning experiences for the students desired outcomes would not be achieved. Providing for teachers' learning remains a significant priority at the ASMS.

REFERENCES

- Australian Science and Mathematics School (2004). *Curriculum Handbook*. Adelaide: Australian Science and Mathematics School.
- Biggs, J. (1999). *Teaching for Quality Learning at University*. Buckingham: Open University Press.
- Bransford, J.D., Brown, A.L. and Cocking, R.R. (Editors) (1999). *How People Learn: Brain, Mind, Experience, and School*. Washington D.C: National Academy Press.
- Darling-Hammond, L. (1998). Teacher learning that supports student learning. *Educational Leadership*. 55(5), 6-11.

- Elmore, R. and Burney, D. (1999). Investing in teacher learning: Staff development and instructional improvement. In L. Darling-Hammond and G. Sykes (Eds.) *Teaching as the Learning Profession: Handbook of Theory and Practice*, (pp.263-291). San Francisco CA: Jossey-Bass.
- Feather, N. (Ed). (1982) *Expectations and Actions*. Hillsdale, NJ: Erlbaum.
- Fullan, M.G. (1991). *The New Meaning of Educational Change*. New York: Teachers College Press.
- Fullan, M.G. (2001). *Leading in a Culture of Change*. San Francisco CA: Jossey-Bass.
- Guskey, T.R. (1994). Results-oriented professional development: In search of an optimal mix of effective practices. *Journal of Staff Development*, 15 (4), 42-50.
- Guskey, T.R. (2000). *Evaluating Professional Development*. Thousand Oaks CA: Corwin Press.
- Hawley W.D. and Valli, L. (1999). The essentials of professional development: A new consensus. In L. Darling-Hammond and G. Sykes (Eds.) *Teaching as the Learning Profession: Handbook of Theory and Practice*, (pp.127-150). San Francisco CA: Jossey-Bass.
- King M.B. and Newmann, F. (2000). Will teacher learning advance school goals? *Phi Delta Kappan*, 81(8), 576-580.
- Loughran, J. (2002). Teacher as researcher: The PAVOT project. In J. Loughran, I. Mitchell, and J. Mitchell, (Eds.) *Learning from Teacher Research*, (pp.3-18). Crows Nest: Allen and Unwin.
- Moon, J. (1999). *Reflection in Learning and Professional Development: Theory and Practice*. London: Kogan Page.
- Perry, A. (2004). *Deep Change: Professional Development From the Inside Out*. Langham, Maryland: Scarecrow Education.
- Schon, D.A. (1983). *The Reflective Practitioner: How Professionals Think in Action*. New York: Basic Books.
- Shulman, L.S. (1999). Taking learning seriously. *Change*. July/August, 31 (4), 10-17.
- Sparks, D. (2002). *Designing Powerful Professional Development for Teachers and Principals*. Oxford: National Staff Development Council.
- Sykes, G. (1999). Introduction: Teaching as the learning profession. In L. Darling-Hammond and G. Sykes (Eds.) *Teaching as the Learning Profession: Handbook of Theory and Practice*, (pp.xv-xxiii). San Francisco: Jossey-Bass.
- York-Barr, J., Sommers. W.A., Ghere, G.S. and Montie, J. (2001). *Reflective Practice to Improve Schools: An Action Guide for Educators*. Thousand Oaks: Corwin Press.