Technology in Teacher Education: Using Multimedia to Enhance the Design and Make Processes.

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Implications for future

The future of communicative teaching in China needs to acknowledge the investment required in the education (in the broadest sense) of Chinese teachers of English. It is not only their professional language-specific preparation that requires to be addressed but also the associated national educational policy directions that affect industrial matters such as their recruitment, promotion and working conditions. Importantly, although universal Western teaching methodologies that dismiss the local context are unlikely to flourish. Young (1987) may well be correct when he argues that educational change of any permanent consequence can be achieved only through culturally responsive reform and that externally imposed, bureaucratically-efficient methods often fail. There is obvious strength in his view that any successful application of a communicative approach to English teaching in China needs to be predicated on a careful (and inevitably slow) ethnographic analysis of the Chinese classroom context.

However, the external bureaucratic Chinese education system also forms part of the local context for Chinese middle school teachers of English and hence cannot be ignored. There are several aspects of the education system that impinge on the way teachers in China teach English and these need responses and action before English can be taught communicatively in China. These aspects are practical and industrial as well as academic. Progress has been made, especially in the national examination system, but much remains to be done.

REFERENCES


education in Australian primary schools. In 1989, the Discipline Review of Teacher Education in Mathematics and Science (DEET, 1989) revealed that science education had become a low priority in many teacher education courses, and this low priority was reflected in the lack of attention that science receives in primary schools. Current research associated with technology education suggests that there is a lack of opportunity for primary teachers to train in the processes involved in technology education (Layton, 1993). Therefore teachers are unlikely to develop the competence, confidence and enthusiasm needed to provide quality instruction in technology education, and there is a danger that there will be a minimal classroom response to the inclusion of technology in national curriculum statements.

This study discusses some important issues about the preparation of teachers to instruct primary school children technology-related education. In particular, it discusses the use of multimedia to complement and extend traditional methods of instructional delivery in this area.

The rationale for a preservice subject in designing and making

Technology education includes four distinct but interrelated strands: technological literacy, technological awareness, technological capability, and information technology (ASE, 1988).

- Technological literacy is defined as familiarity with the content and methodologies of a range of technologies.
- Technological awareness means awareness of the personal, material, economic, ethical, cultural, aesthetic considerations and environmental impact of technological developments.
- Technological capability means the ability to tackle a technological problem, both independently and in co-operation with others.
- Information technology means competence and confidence in the technological handling of information (Layton, 1993).

In primary schools it is expected that these strands would be developed through integrated, interdisciplinary investigations. The technology profile for Australian schools (Curriculum Corporation, 1994) states that:

"Technology in the school curriculum combines theory and practice. It includes much that is scientific, ethical, mathematical, graphical, cultural, aesthetic and historical. It explores the synthesis of ideas and practices, and the effects of technologies on societies and environments" (p.2.)

It follows that a technology subject that introduces preservice teachers to the strands of technology education should also use an integrated, interdisciplinary investigational approach so that preservice teachers have first-hand experience with the processes that their pupils would experience. The subject also has to empower trainee teachers in the design and make process (Bonollo, 1993) and develop trainee teacher competence, confidence and enthusiasm. Competence and confidence come from first hand experiences that challenges one to extend current skills and develop new skills, but a certain amount of judgment is required in order to match the challenge to the person. This requires a negotiation and mentoring process in which the lecturers and preservice teachers are fully aware of the outcomes of the subject (Lewis and Bonollo, 1994); Ramsden, 1990). If the process has been successful, then it is likely to have generated enthusiasm and confidence in the student. Hence, student competence, confidence and enthusiasm may be used as outcomes to measure the success of the subject offered.

Restructuring of the four year Bachelor of Education degree for primary teachers at the University of Wollongong provided an opportunity to offer a four year elective subject related to technology education in primary schools. The commencement of a new science and technology curriculum in 1992 in New South Wales primary schools (Department of School Education, 1991) and the development of national profiles in technology education added further support for the need to develop such a subject. Moreover, findings from previous research (Ferry, 1993) had shown that primary school teachers wanted help in designing and making. Therefore we decided to focus upon this aspect of technology education.

Two lecturers shared the responsibility for this subject. It was also important to us to develop a resource that could be used in the future by preservice and classroom teachers. Two parallel processes were put in place to meet these needs: one concentrated upon the delivery of the subject to the students and the other concentrated upon the task of developing a multimedia "class journal" that would become a resource for preservice and classroom teachers. While both lecturers involved in the subject had expertise in multimedia and technology education, it was convenient to divide the responsibilities and to collaborate on a "need to know" basis. Therefore the more experienced lecturer in pedagogy took overall responsibility for the delivery of the subject and the more experienced one in multimedia took overall responsibility for the development of the multimedia "class journal".

Subject Organisation

The subject was allocated three hours of face to face teaching for one semester. It consisted of a one hour lecture and two hours of tutorials. Three compulsory assessment tasks were set. Two tasks involved the development of a prototype of a technological solution to a problem identified by the student. The third was a responses paper to a series of process tasks related to electronics. The prototype development followed a typical technology/design process of: investigating contexts and human needs, devising possibilities and alternatives, communicating plans and actions, production of processes and products, reflection on progress and results (Curriculum Corporation, 1994).

Care was taken to present the technology/design process as recursive and non-linear, and Figure 1 shows the model that was presented in lectures.

Figure 1: A model of the processes involved in technology as it responds to a human purpose (from Fensham, 1990, p.17)

Lectures and tutorials were scheduled to support the stages in the technology/design processes that the trainee teachers could be expected to experience as they developed their prototypes. They were required to keep a reflective journal that contained their responses to the different stages of the technology/design process. These responses were used to generate discussion during tutorials. Tuman (1992) claims that reflective journals represent a new form of "engineering literacy" and they have a legitimate place in the design and make process. Journal writing helps the student to construct knowledge (Wisnor, 1950) and Johnson, Lee and McGregor (1994) argue that there is a need for engineers to write their own knowledge. The reflective journal entries also helped us to monitor the stages that most trainee teachers "were at" and to make final adjustments to our lecture/tutorial sequence so that we corresponded as closely as we could with current and anticipated future needs. Also a certain amount of negotiation took place in order to ensure that the prototype was challenging but "do-able". Thus the total process gives students the opportunity to integrate and make use of what they know and to confront new ideas and test them against their own or possible misconceptions (Boysen, 1994; Lawson, 1980).

When we were planning the subject we were concerned that anxiety associated with assessment and the perception that engineering was a "male" subject could adversely affect the outcomes. Initially most students were very
wished about how they would be assessed, and
discussion centred around product assessment
versus process assessment. It was agreed to give
equal weight to both product and process. That is
equal marks were allocated to what was produced
(the artefact) and their personal journal.
This turned out to be an approach that challenged
students to address the whole process of
designing and making rather than just one aspect.
Other researchers (Boyapati, 1994; Boyapati, Inglis
and Phillips, 1994) also support this approach.

Another factor reported in the literature was a
student perception that subjects associated with
processes such as construction, design and
engineering were more suited to males (Nandy,
1979; Georg, 1993; Wiley, 1992). As the majority of
students were female and were prepared to enroll
in what was perceived to be a "high risk subject
(Julie) it was important that both lecturers provided
support and acted as mentors.
Moreover we felt that we had to actively dispel
this perception.

The following transcript is part of an interview
with Julie shows how we attempted to relieve
anxiety and provide support. During this
interview Julie was talking about designing
indicators for her bicycle. She stated:

"I was really scared about my project. ...Early in
the session I came to Brian and talked about
giving up. He talked me into continuing and
then gave me a book to show me how the indicators
for my bike would work. ...Then my flat-mate helped
me to start and a week later I had made a small
working model. At this stage I was relieved
because I could see that it would work."

Her feelings of anxiety were typical of both male
and female students as they viewed the prototype
development tasks as threatening and, like Julie,
many expressed doubts about their ability to
complete the task.

In an attempt to address the dual issues of anxiety
and perceived gender bias we allowed students to
consult with the lecturer of their choice. Some
consulted with both lecturers, but overall a
student tended to find the lecturer that they were
most "comfortable with" and to work with that
person. Even though one lecturer was male and
the other female, there appeared to be no gender
difference in numbers of students consulting each
lecturer. Subsequent analysis of our personal diary
entries showed that this was the case.

The electronic journal

The electronic journal was in HyperCard form
and entries were gathered during the session.
Each entry contained a photograph (taken with a
Canon ion camera) of the preservice teacher plus
a title for their prototype. Buttons allowed the
browser access to selected sound files chosen
from interview tapes, photographs of various
stages in the development of the prototype, and
selected entries from the reflective journals.

Diagrams of the electronic projects completed in
tutorials were scanned and included in the
electronic journal.

The HyperCard stack takes 6Mb of memory and
is recorded on compact disc for regular use. We
intend to expand the electronic journal as new
ideas are developed. Later the compact disc will
be available to classroom teachers for professional
development purposes.

The navigation screen and one of the project
screens are shown in Figures 2 and 3.

The navigation screen

Nine buttons are available to the student and
these are labelled help, course selection,
background to this subject, other activities, project
results, evaluation, theories behind the practice,
and student briefing. The buttons that students
used the most were project results and the
evaluation. When students click on these buttons
the screen displays selected images of projects
plus relevant excerpts from written journals.
This display provides students with some
photographs of the stages involved in a specific
design and make project, plus a photograph of the
final product, and the designer's evaluation
comments about their project.

The journal entry

The screen was organised as shown. The slide
icons indicate that a photograph of the project can
be viewed. These photographs were viewed by
most students. The loud speaker icons indicate
that a sound file can be accessed. When the a
student clicks on a sound file, an interview
question appears on the screen and then the
response is played through the speakers of the
computer. Access to a student photograph
proved to be a popular option as current students
often contacted students from the previous year's
cohort to seek advice.

Figure 2: The main navigation screen of the
electronic journal

Figure 3: An example of a journal entry

Figure 4: A model of technology education (in Fensham, 1990, p. 16)
provided ideas for modifying the project to suit primary school children.

The students enrolled

The subject was introduced in 1993, and sixty eight preservice teachers and four class teachers have completed the subject. Sixteen were males and fifty two females. The youngest was twenty two years old and the oldest forty six (mean 29.5). As this was an elective subject most enrolled out of interest.

Data gathering

Data were gathered from three sources: a university evaluation survey of the subject, journal entries and interviews.

The university survey was constructed and administered by the centre for staff development (an independent university body). A copy of this instrument is included in Appendix 1. All subjects were interviewed during a three week period after their projects were completed. The female lecturer who conducted these interviews began with the following questions:

1. What did you learn about designing and making as you made your project?
2. What new skills did you learn from the experience?
3. Did you use the electronic journal? If they used the journal they were then asked What features did you find useful?

The interviews were open-ended and follow up questions were asked. Most interviews took 30 minutes to complete.

Results and discussion

The subject was evaluated by the university centre for staff development. The instrument uses a five point Likert scale to rate the various questionnaire items. The highest score is five and the lowest one, and a mean of 3.4 (S.D. 0.5) is regarded as standard for most subjects. The mean for this subject was 4.75 (S.D. 0.4), higher than most subjects. Therefore the subject appears to have been well regarded by the students. Table 1 summarise the student responses to relevant questions from the survey.

Table 1: Preservice teacher responses to relevant survey questions (N=68)

<table>
<thead>
<tr>
<th>Item</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have felt enthusiastic about attending lectures in this subject</td>
<td>4.81</td>
</tr>
<tr>
<td>I felt enthusiastic about attending lectures in other subjects</td>
<td>3.01</td>
</tr>
<tr>
<td>My enthusiasm for this subject has increased greatly</td>
<td>4.72</td>
</tr>
<tr>
<td>The subject material has been very interesting</td>
<td>4.67</td>
</tr>
<tr>
<td>Lectures have stimulated me to think about the subject</td>
<td>4.81</td>
</tr>
<tr>
<td>I am confident that I will be able to teach this subject*</td>
<td>4.81</td>
</tr>
<tr>
<td>*additional question added to the survey</td>
<td></td>
</tr>
</tbody>
</table>

It can be seen that the outcomes of enthusiasm for the subject and confidence in teaching designing and making appear to have been realised. However, data from the subject is not sufficient to substantiate claims about the outcomes of the subject, as the sample was small and the subjects chose to enrol in the subject. Therefore other sources of data need to be examined. The other sources used for this study were the reflective journal entries and the transcripts from the interviews. Whilst both sources of data support the view that the outcomes of competence, confidence and enthusiasm were achieved, it needs to be acknowledged that the factors that led to the success of the subject may not transfer to a different context.

The following quotes are selected from the reflective journals and represent some reactions of participants to these questions.

Quote 1: Jenny B, a female teacher, aged in her mid forties who enrolled as a full-time student in a fourth year subject. She describes the outcomes of her chosen task which was to design and construct a children’s game. The design features incorporated "the properties of magnets and the principles of simple circuits to provide opportunity to develop hand/eye coordination skills and to demonstrate the layout of an electric circuit..."

"I’m pleased with the finished model. It’s gone through a few modifications since my first concept of using a magnet, but I have learnt something about circuits and their assembly. I learnt to solder light wiring too.”

Quote 2: Ian M, a male trainee teacher aged in his early twenties. His chosen task was to produce a better surfboard cover.

"The final product has turned out satisfactorily. For all its good points there are still some bad ones.....(these are then described)

Some of the tasks that I did were: finding a purpose, exploring possibilities, researching, organising, making plans, following plans, collaborating, managing time, and choosing appropriate resources.

The most important skill I believe is reflection. If you don’t spend some time sitting back and looking what you have done and where you are heading then you are not fully participating in the design and making process. Therefore, for us as teachers it is important that we recognise this and allow time for this in the classroom.”

Quote 3: Fiona N, a female trainee teacher aged in her mid twenties. Her chosen task was to design a removable parcel shelf for hatchback cars.

"... It is important to make use of other people to listen to your ideas and discover whether or not what you have done and what you are doing is the same thing...

...the experience has been extremely rewarding, especially in the sense that I have solved my own problem.”

Two important themes emerged from the interviews transcripts and from the journals. One theme was the importance of collaboration with a wide range of people; many of whom were not "experts" but sympathetic listeners (mentioned by 74% of subjects). These people acted as a non-threatening audience with whom the learner could "speak out" ideas. Often the "sympathetic listeners" who acted as collaborators and confidants were close friends or relations. A study by Tibbitts, Collits and Lucas (1994) supports these findings. They report that it is important for students to share and discuss projects in a non-threatening situation.

The other theme was the satisfaction gained from their chosen task which was to produce a model that the learner could discuss their ideas with. For example some were contented to browse at the pictures of projects, while others wanted to read the related text or listen to relevant interviews.

Features of the journal that appealed to the preservice teachers were:

- access to the pictures, printed text and sound. They could browse and select the features that were relevant to their interests. For example some were contented to browse at the pictures of projects, while others wanted to read the related text or listen to relevant interviews.

- access to the ideas of others. They often used the pictures of students in the previous cohort to find students with whom they could discuss their ideas.

Those that chose to use the journal tended to produce better projects. It cannot be claimed this effect was due to the journal as the sample is small and no control group was organised. It may
We also feel that the multimedia journal was a popular and effective tool for reflection. Photographs of projects focused student attention and encouraged them to reflect on their role at the different stages in the design and make process. In particular, the photographs often provided an insight into the thinking and problem-solving strategies that helped to dispel any anxiety in enrolled students. Lecturers need to ensure that the journal is used as an effective and enthusiastic approach to teaching designing and developing technology. The journal can provide a platform for critical discussion and reflection, and can be used to help students develop personal competencies and technological literacy. It is also important that preservice teachers develop skills that are transferable to very important instructional strategies.

The way in which the subject was delivered often underestimated. The majority of trainee teachers enrolled in this subject now realise the importance of integrating, interdisciplinary and investigational work. The data supports the interpretation that the preservice teachers had developed their technological literacy and awareness. The traditional lecture/tutorial means of delivery are considered to be less effective and enthusiastic classroom practice. It is important that preservice teachers are enthusiastic about teaching designing and developing technology.

CONCLUSION

The Australian National Centre for Education Research (1993). 0.5. the traditional lecture/tutorial means of delivery are considered to be less effective and enthusiastic classroom practice. It is important that preservice teachers are enthusiastic about teaching designing and developing technology.


Appendix 1: The University of Wollongong Subject/Teaching Evaluation Questionnaire.

Responses are recorded in pencil on a form that can be scanned and processed by a computer.

7. I have felt enthusiastic about attending lectures in this subject:
   always (5) most of the time (4) sometimes (3) rarely (2) never (1)

8. I have felt enthusiastic in attending lectures in other subjects:
   always (5) most of the time (4) sometimes (3) rarely (2) never (1)

9. Because of the lecturer, in this subject my enthusiasm:
   increased greatly (5) increased (4) stayed the same (3) decreased (2) decreased greatly (1).

10. The subject matter has usually been:
    very interesting (5) interesting (4) neutral (3) uninteresting (2) very uninteresting (1).

11. Lecture material has been presented:
    very clearly (5) clearly (4) uncertain (3) unclearly (2) very unclearly (1).

12. The sequence of topics within each lecture has been organised:
    very logically (5) logically (4) uncertain (3) unclearly (2) all over the place (1).

13. The quantity of materials presented in lectures has been:
    far too much (1) too much (2) about right (5) too little (2) far too little (1).

14. The lecturer stimulates me to think about the subject:
    always (5) most of the time (4) sometimes (3) rarely (2) never (1)

15. The lecturer has demonstrated understanding of the subject:
    very well (5) well (4) sometimes (3) poorly (2) very poorly (1)

16. The lecturer's interest in assisting students to learn is:
    very high (5) high (4) uncertain (3) low (2) very low (1).

1. I have felt enthusiastic about attending lectures in this subject:
   always (5) most of the time (4) sometimes (3) rarely (2) never (1)

8. I have felt enthusiastic in attending lectures in other subjects:
   always (5) most of the time (4) sometimes (3) rarely (2) never (1)

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THE HAWTHORN INSTITUTE FOR TECHNICAL TEACHERS

ABSTRACT

The Hawthorn Institute for Technical Teachers (TAFE) has a long tradition of training future teachers at the initial preparatory level. This initial growth in technical teacher education occurred in the years following the end of World War II when schools were being established in a system related to the education of senior technical college students. In the early days, courses were given by the regular faculty members who were required to have sufficient training to become teachers. The TAFE course (with some aspects of the former Technical Colleges of Victoria) was provided at the Hawthorn Technical Teachers Centre in Toorak and then to Latrobe University in 1970. Over that period, a significant component of training was provided concurrently with the Hawthorn Institute's four years of training.

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