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ENHANCING TEACHING EXPERTISE : A CASE STUDY OF THE PROCESS OF CHANGE

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INTRODUCTION

This is an interim report of action research on the teaching and learning of science in a secondary school. It involves teachers at Eltham College, Melbourne, among whom are the first two authors, and academics from Monash University and the Melbourne College of Advanced Education. The article has three main sections: description of and comments on the method of research, an account of benefits that Bob Ross and John Hills perceive they have received from the project, and a report on the outcomes to date.

METHOD OF RESEARCH

Before the project began in early 1987 the members of the Science department at Eltham College were reasonably satisfied with their situation. Ross states:

> "We have a fairly well developed curriculum consisting of units of work which we have written; we have excellent laboratory facilities; all junior science classes take place in a lab; we do pretty well in the timetable battles, etc."

They did, however, recognise that there was room for improvement:

> (Ross) "Our curriculum had been in place for a number of years. Most of the units had been written three, four or five years ago and needed review. The students were not really jumping out of their skins with enthusiasm about Science. In fact, many were bored, especially at Year 10. However, we were unclear as to the nature of the problems. Moreover, we were not sure how to find out more about them or how we could overcome them. We were in a bit of a rut and not sure what to do next."

It is not clear whether the Eltham College teachers fulfilled the first requirement for conceptual change specified by Posner, Strike, Hewson and Gertzog (1982) of dissatisfaction with the present situation, but they were sufficiently open to new ideas to

welcome the offer from Monash people to assist in researching improvement in the quality of teaching and learning.

It was arranged that the research would be a collaboration between five members of the Eltham College Science department and four Monash staff, of whom one (Baird, who is on secondment from Melbourne CAE) would have greater day-to-day involvement. It would be action research, with the teachers reflecting on their current practice followed by collaborative development of ideas; then action, based on those ideas; then evaluation of the action followed by further reflection. All of this would take place in a cyclic, ongoing way. What was wanted from the research was an infrastructure, a mechanism which could be used in a long-term way to continually evaluate and improve the teaching practice, the learning processes of the students, and the curriculum.

The first target for reflection was the way energy was taught, which was chosen because of its importance as a concept in science and because something about it is taught at all year levels, which gave the five teachers the opportunity to work together on a theme.

They began by considering how the topic of energy should be treated, drew up idealised concept maps, and met to discuss approaches. Baird interviewed them about their conceptions of energy. The discussions and interviews led the teachers to judge that there were flaws in their notions of energy, and that they were making little progress in seeing how to improve their teaching and the quality of the students' learning. Therefore they were ready to adopt a new approach.

A more direct course of investigation into the teaching process was then begun. Baird visited each of the teachers' classrooms over three consecutive lessons with the aim of comparing their teaching intentions with the actual outcomes. After each lesson the teacher and Baird conferred about how they thought the lesson went while students filled in questionnaires on their perception of the lesson. The teachers compared their perceptions with those revealed by the questionnaires.

> (Ross) "We were impressed in various ways with this exercise. We were forced to think very carefully about our intentions and aspirations for these lessons. Students clearly revealed their view of lesson outcomes. This exercise led us to realise the potential for improvement in our teaching."

An outcome of this exercise became the focus of the project. Because Baird saw lessons at all year levels, he was better placed than the teachers to compare the behaviours of the students. He noted a pronounced decrease in interest and enthusiasm of students as they passed on up through the school. Whereas Year 7 students were alert, enthusiastic and responsive, the older students seemed lethargic and uninterested. This observation was not a surprise to the teachers, for like teachers at other schools they had commented on it before.

To tackle the problem of what was responsible for students' loss of interest, the Eltham and Monash people began by having informal discussions and then took a half-day for a brain-storming session on the possible factors that may contribute to the drop-off. At this session the group identified 44 factors. It was obvious that not all could be investigated in detail and so the group selected just three of the areas for attention. Three sub-groups were formed, each selecting one factor for investigation.

Ross and Hills followed up the suggestion that students became less interested in Science because it held less challenge for them as they progressed through the school. They discussed what they understood by the term challenge in this context. The statement that they eventually used when talking to students was "a subject or topic or idea that is challenging is one that you have to think about, ask questions about or investigate further in order to understand it properly."

Ross and Hills composed a questionnaire which they administered to students at all Year levels 7 - 11. The questionnaire asked students to:

(a) compare the amount of challenge in Science compared with other subjects;

(b) compare the amount of challenge in difference Science topics; and

(c) explain what they found challenging in the different topics and in Science generally.

Responses were, of course, varied, but the things that students found challenging could be divided into two broad groups - those that were challenging in a positive way, e.g., new ideas, different work, practical exercises - and those that were challenging in a negative way, e.g., work that was not well explained by the teacher, or excessive factual content.

The questionnaire was followed with student interviews in order to probe more deeply into their responses, and to elicit more detail on their feelings. Ross and Hills met with a randomly selected group of students from Years 8 to 10. The meeting was recorded on video.

> (Ross) "Students were very open in their responses to our questions, and the discussion ranged freely and fairly widely. Although the purpose of our investigation was the consideration of factors affecting challenge, at this stage the boundaries of our line of research started to become a bit blurred. We were drawn more and more (by student responses) into aspects of science they found interesting, as well as challenging. This led us into areas of investigation which overlapped significantly with those of other groups."

Factors that students suggested were responsible for fall in interest in science included lack of relevance of the knowledge to their lives, triviality and repetitious nature of practial exercises, the quality of the teaching, and the lack of time to understand a topic before moving on.

All of the findings were considered in an attempt to develop a more satisfactory teaching program for a unit on Force that had rated poorly with year 8 students. Ross and Hills interviewed Year 9 students who had done the unit the previous year, and collected the following comments:

- much of the work was irrelevant and academic. The section that dealt with whiplash ("inertia") was one of the few that was interesting to them;
- experiments were trivial and repetitive. They had to use the "force measurers" in too many simplistic activities;
- some said that they did not do well in the unit because they did not feel moved to try and this was because they were not challenged;
- they did not like the A.S.E.P. books - they found them boring.

The students suggested that to improve the unit, and the science course as a whole, the teachers should:

- cut down on the amount of time spent in reviewing the results of the activities;
- have options;
- give students the opportunity to design and carry out their own practical activities;
- have mid-unit tests which will give students the chance to assess their own progress.

The students' reactions were discussed by the whole research group. Although there was useful clarification of our own ideas of force, little progress was made on how to teach it in a way which students would see as relevant to their experience and daily lives.

PERSONAL BENEFITS

(Bob Ross) "The project has helped me in establishing a way of identifying problems, and methods of handling them. This is a benefit that will always be useful to me. I feel more in control of our situation now than I did previously. I certainly don't know the answers to all of our difficulties but I feel that I can analyse them more closely and carefully, and work with them. This is better than a vague notion that all is not well, but being not very sure what it is or where to start in trying to handle it.

Secondly, the expansion of a dialogue with staff has been most beneficial. As a Head of Department, I have always been reluctant to require staff to discuss issues other than the immediate administrative necessities, as they all work hard and value their spare time in school. So it has been gratifying to see the blossoming of a desire and willingness to discuss the teaching and learning process itself; to try new techniques; to encourage others; and to share in the obvious successes of the project.

I have also enjoyed enormously the opening of a dialogue with students in the school. The consultations and interviews have yielded lots of information but have also been fun. I now regularly consult my classes on their feelings about a unit of work; what should be changed; what has been successful. They are more forthcoming each time and seem to value the opportunity to make their contributions to the program.

And, last but not least, the opportunity to work with someone from outside our department has been of inestimable benefit to us all. The provision of expertise, detached views, and encouragement have been the driving force for the project."

(John Hills) "In general, I would classify myself as a teacher who works reasonably hard but does not go looking for extra work. In some ways, I am a perfectionist and have therefore often felt that there is not enough time in a day to do the job properly. If time was short, the first thing that suffered was preparation. This made teaching less satisfying.

I have also considered most educational research hard to relate to, too general and seemingly too large a task to tackle, given the time pressures mentioned above. Early in my teaching career, I taught students with the overall aim of them learning work so they could hopefully pass a test. During that time, I spent much effort trying to protect students from failure by spoon feeding them. As years passed, I noted that several students who left school to tackle university courses were failing and dropping out in their first year. My unsubstantiated conclusion was that the spoon feeding was responsible for this. I then assumed that self discipline was a necessary quality for students to develop and that by letting students experience failure they would have to develop self-discipline to survive. This change was essentially the extent of my educational research, if you can call it that, in nine years of teaching.

As you would expect when John Baird came to the school and invited me to join the project, I was quite negative. In fact, I joined the team because most other members of the department had agreed to and I felt like I would be letting the side down if I did not do so. Again my lack of enthusiasm was due to a further time commitment which I did not need and also the fear that the research would involve talking in generalities, never really achieving anything. Initially, John was seen as the man who aggravated your conscience if you had not completed the weekly task set. As time passed, I gradually became positive towards what we were doing, although I don't know what factor made me turn the corner. Time is still a pressure but in hindsight we have rarely spent more than two hours in any one week on this project and there have been several weeks where we have done nothing - though I guess we are now informally reflecting on our practice without consciously doing so. By aiming for small short term goals the research seems less of an inconvenience and more natural inquiry into what, why and how well I am teaching, which must overall lead to increased job satisfaction if improvements are made."

OUTCOMES TO DATE

Action research pervades the whole of one's involvement, and is not restricted in its effects to one or two outcomes. Further, it takes a long time for its effects to become clear. Hence this is an interim report that picks out changes in practice that the research has promoted. There are not yet any extensive data to report on changes in perceptions and behaviour of students.

The first instance of how the reflection and discussion promoted by the project led to a change in practice occurred late in 1987. During a school inservice day the science department considered the problem of making the Year 10 science course more appropriate, given that students of mixed ability and motivation levels were currently taught the same material. By pitching at the middle ability range, we did not challenge many of the more able members of the group. By so doing, we also created a problem where many students found the transition from Year 10 to Year 11 science-based subjects a large jump for which they were not prepared.

The discussion led to two possible strategies being discussed:

i. the introduction of streaming, whereby one group of units of higher conceptual difficulty and volume of work would be developed for the group of students intending to pursue science in Year 11.

ii. the writing of synopses of possible new units as well as current units and give students the choice of which units they would prefer to tackle. The units which were deemed as being of a higher conceptual difficulty were stated within the synopsis as suitable for gaining a good basis for the appropriate Year 11 subject (i.e. Biology, Chemistry, Physics).

The group unanimously preferred the second alternative, because it might lead students to stream themselves as well as allowing them to pursue individual interests. This preference probably indicates a change in view about practice.

To implement the second alternative, a program was devised in which the 112 students were allowed to choose between five groups which followed different patterns of choices of eight units from a total offering of 14. Although formal evaluation of this system has not yet been made, students have commented positively about it. Its merits have spread to lower forms, where students have asked that it be introduced for them, too.

Another change in practice has concerned assessment. Our surveys have indicated that students wish to become more involved in developing their assessment programs. In the past, assessment in Junior Science has been fully teacher determined and has relied essentially on test performances alone as a means of determining a student's grading, although assignment work and general written work have been given some consideration.

One change that followed analysis and discussion of the survey data was to give students the opportunity to determine the criteria for assessment. This has produced more varied methods.

Bev Walsh used the following methods to assess performance in Year 10:

- open book testing
- assignment work (one unit was assessed solely on this basis)
- notebook work
- class work.

These changes led to previously highly graded students now needing to work consistently in class in order to achieve the same grade.

John Hills meanwhile worked on increasing the level of self assessment by the Year 8 science students. Initially they were asked to assess their practical work based on:

i. their skill, involvement and efficiency in carrying out the exercise; and

ii. how well they understood the exercise prior to class discussion. As students began to accept this process, self-assessment spread to the grading of their unit booklets and eventually to the students determining what factors were to be assessed and the percentage breakdown allocated to these factors. For example, in the latest unit, the following categories and weightings were decided upon:

i Completedness 20%

ii Presentation 30%

iii Depth of understanding 15%

iv Practical work 15%

v Overall effort 20%

In general, students have been enthusiastic towards grading themselves, but a meaningful scale for measurement of their achievement has yet to be reached. However this will occur soon through further reflection and trials.

Possibly the greatest change in practice, and one which we are documenting for a subsequent report, is the dramatic increase in discussion between teachers and students. This involvement of students in overt reflection on the purposes of the science program and on how best they might be achieved is the mainspring of the project. In retrospect, what seems remarkable was the negligible level of that interchange that existed before the action research began.

REFERENCES

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