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THE USE OF ACTIVE LEARNING TO IMPROVE TEACHING OF BIOLOGY

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1. INTRODUCTION

Biology is the study of living things. One of the major goals in the teaching of biology is not only to enable the students to acquire part of this large knowledge base, but to enable them to understand the key concepts, and to synthesise the knowledge, and be able to apply them in new situations. However, students may find the learning of biology less stimulating or even boring if they are expected to acquire the knowledge through passive learning approach, that is through mere memorization of facts and reproducing them when assessed. Such forms of passive learning may be encouraged by conventional lectures consisting of mainly talk and illustrated with slides, transparencies or live examples. The important principles and facts are usually reinforced through students' activity in the class practicals. In some biological modules such as ecology, students are also expected to participate in field trips to observe at first hand what they have been taught in the classroom. This has helped them to acquire a good knowledge base in biology. But, it is inadequate to promote higher order thinking and more active learning. In biology teaching one of the ultimate objectives is to enable the students to integrate the knowledge acquired in lectures, tutorials, practicals and experiences in the fields. Students often have difficulty to link the difficult concepts with real life situations resulting in mere memorisation of fragmented facts and procedures.

This paper reports the use of deep and active active learning approach by first year Diploma in Education students in a biological module covering the unity and diversity of organisms.

2. DEEP AND ACTIVE LEARNING

Research has shown that course design and delivery mode have a great effect on the extent to which learning will be active or passive, deep or shallow, relevant and interesting or dry and boring. If a course is so designed and delivered for active learning, students will be given opportunities to read key texts in a focussed manner, relate information to previously known facts or experiences, synthesise them into new wholes, and apply the concepts learned to new situations.

A review of literature shows that educational researchers in the United Kingdom and Europe have identified deep processing learners as those who are able to interact deeply with content, integrate parts into a whole and tasks with earlier experiences (Biggs, 1978, 1979; Entwistle, 1979,1985, 1987; Morton, 1976, 1979; Ramsden, 1979, 1981; Saljo, 1979, 1981). They are also achieving types and performed at a high level in any given academic tasks. While most educationists decry using extrinsic motivation such as grades to promote active learning, Elton advocated using assessing strategies for intrinsic motivation that go beyond the assessment for knowledge and technical competence, but in addition included assessment for meaning, originality and creativity (Elton, 1988). This can best be seen in the students' portfolios and projects.

In a 1991 study of Hong Kong University students, Kember and Gow found that a large number of Asian students scored high on the deep and achieving scales similar to those previously obtained in Australia. They also suggested that tendency for reproductive approaches to learning may be a function of teaching practices than an innate tendency of Asian students.

A more recent Canadian study (Amundsen et al., 1993) showed that faculty discussion groups on teaching at MacGill University found that an examination of the knowledge structure of different disciplines and the expected learning of students helped the lecturers to look at teaching from the perspective of learning rather than as the organisation and presentation of information. They in turn changed their teaching methods to encourage deeper and more active

learning among the students.

3. RESTRUCTURING THE COURSE AND MODIFYING THE LECTURE METHOD

A biology module covering the unity and diversity of organisms was taught to the Year 1 students of the Diploma in Education programme in 1992 and 1993. The course objectives are as follows,

a) to enable the students to recognise the diverse range of organisms on planet earth and understand how organisms originate as explained by scientific hypotheses and how diversity of the organisms arose with the passage of time based on evolutionary principles.

b) to enable the students to understand how these organisms are united by certain processes that are common to all organisms.

c) to enable the students to understand the need to classify these organisms into respective kingdoms for systematic studies and the criteria used for such classifications under the 5 kingdom system.

d) to enable the students to synthesise the information so that they can classify unidentified or hypothetical organisms into the respective kingdoms based on sound rationale and criteria taught.

The first two objectives require the students to acquire the knowledge, possibly through passive and surface learning, while the last two objectives can be considered to be higher level objectives based on Bloom's classification of educational objectives. Higher levels of educational objectives will require students to synthesise and apply the knowledge acquired.

The profile of the students in the two classes, in terms of their background in biology as reflected by the levels of examinations taken in the schools, is summarised in Table 1. Clearly, Table 1 shows that each class is made up of students with different backgrounds in biology. For the class of 1992, more than half the class studied biology at both A and O levels while in the case of class of 1993, half the students studied biology at the O level only. There are also some

students in each of the two classes, who studied only Human and Social Biology at A level. Compared with the other students, these students can be considered to have a weaker foundation in biology. In terms of grades obtained by the students in their respective school examinations, those in class of 1992 did better comparatively. For those who did Biology at A level, students in the class of 1992 scored grades ranging from B to D, whereas those in class of 1993 scored mainly Es. For the Human and Social Biology, those in the class of 1993 did better with all scoring A1 except for one. For the class of 92, the scores of the 4 students who did Human and Social Biology range from A1 to C6.

Table 1 : Profile of students based on their background in biology

Level of biology taken in school examinations	Class 1992	1993
1. O and A levels	7	4
2. O level only	-	9
3. Human and Social Biology	5	5
Total	12	18

The module was taught to the class of 1992 through both lectures and practicals. The module outline as well as some notes were distributed to the students at the start of the course. The students were briefed on the module objectives, the module outline and the lecturer's expectations by the end of the module. For the lectures, each topic was covered with the use of transparencies as well as some slides. The lecture presentation was done with a short recap of the previous lecture, an introduction to the new topic to be covered, delivery of the contents and a summary at the end. Some questions were asked during the lectures to diagnose whether the students are keeping pace with the lectures and to allow them to clarify certain points where required. The practicals were conducted with the use of prepared microscope slides and normal

slides projected on to the screens. Representative examples of organisms classified under the five different kingdoms were used for examination by the students. The students were required to identify the key characteristics of each of the organisms shown and explain why, using the information presented during the lectures, each of the organisms was classified in their respective kingdoms. At the beginning of every practical, the objectives of the practical were explained to the students.

Unlike the class of 1992, an element of active learning was incorporated into the module when it was taught to the class of 1993, in addition to the lectures and practicals. At the end of every lecture, a short question related to the topic that was covered during the lecture was given to the students as a "homework" exercise for them to think over until the next lecture. Students were also expected to read up certain literatures for more information to help them with the answer. The questions were discussed at the beginning of the following lecture. Some examples of the questions include, "Explain what Stanley Miller and Sydney Fox tried to prove, with their classical experiments?, Why are slime molds classified under Protista when they also reproduce by spores?" These questions will not only require the students to acquire the knowledge, but also be able to synthesise and integrate the knowledge to arrive at the answers. Discussion on such questions would normally take about 5 to 8 minutes at the beginning of the lecture. Different students were asked at random to give their answers and this would be followed by some discussion. There is therefore more active participation on the part of the students in the learning process.

4 EVALUATION AND DISCUSSION

Students were responsive to the "homework" exercises. There was also active participation by the students during the discussion. A verbal survey of the students showed that everyone found the "homework" exercises extremely beneficial. They found that the questions that were asked, were stimulating and helped to generate other related questions in their mind.

This had helped motivate them to look for answers through additional reading. More than 90% of the students confirmed that they had done additional reading to help them answer the questions. The discussions were found to be very useful as they were able to clarify various points which they found to be unclear or less understood during their attempt to read up more information to help answer the questions.

The answers given by the students during the discussion sessions, is a good qualitative gauge on whether the students had acquired the required knowledge and were able to integrate them as a whole. The answers given by most students were accurate and they were able to present their explanation based on sound scientific principles. This suggested that they were able to integrate the knowledge acquired. For the other students whose explanations were not fully satifactory, the discussion sessions provided good opportunities for clarifications to be made effectively, hence enabling the students to learn better too.

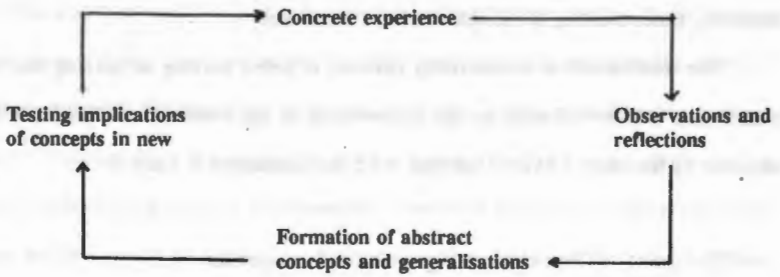
The effectiveness of incorporating elements of active learning in teaching this biology module, can also be indicated by the improvement in the results of the practical reports submitted by the class of 93 over the class of 92, as summarised in Table 2.

Table 2 : Results of practical reports

Class	Mean score out of 10		
	Practical 1	Practical 2	Practical 3
1. 1992	5.4 ± 1.2	6.6 ± 1.3	5.9 ± 1.4
2. 1993	7.2 ± 0.7	7.4 ± 1.1	7.4 ± 0.6

The practicals conducted for both classes were the same. The class of 93 was however able to answer the questions of "whys" and "ifs" more effectively. Another significant difference observed was that more than 80% of the students of 93 did additional reading to help them with

the answers and discussions presented in the reports. This was revealed during the survey of the students and the summary of bibliography contained in some of the reports. This tends to suggest that the incorporation of some elements of active learning which would stimulate thinking in students and requiring them to conduct additional reading, would encourage students to engage in Deep Learning as the reports showed that they were able to synthesise and apply the knowledge effectively. This was so, despite the fact that the students of class of 93 had a weaker background in biology comparatively as 50% of the students did biology at O level only, while for the class of 92, more than 60% did biology at both O and A levels. This effectiveness of learning by the students of 93 through incorporation of some elements of active learning can be explained by Kolb's Learning Cycle model (Kolb, 1983) which is summarised as follows;



The "homework" exercise which required students to gather the necessary information through the lectures and additional reading, gave the students a concrete experience of their own in dealing with the topic(s). Then, they made observations and reflections leading to formation of abstract concepts concerning the topic and applying them to the new situations as outlined in the questions posed to them a part of the "homework" exercise. Through such a process, the students were able to understand the topic(s) better as they were able to synthesise the knowledge for testing the implications of the concepts in new situations. The "homework" exercise has therefore enhanced the learning process by the students.

A cursory analysis of the students' practical reports further showed the effects of active learning on the quality of the projects. They were more substantial in content, better organised, better illustrated and presented. These are concrete evidence of the relationship between thinking and writing when the same time limitation was imposed on the two batches of students.

5. CONCLUSION

The incorporation of elements of active learning in the teaching of this biology module on the unity and diversity of organisms, did produce more effective learning by students based on the students' response during discussions and performance in their practical reports. Active learning by students tend to encourage them to engage in Deep Learning hence helping them to synthesise and integrate the information more effectively.

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