Problem based learning in practice: understanding human water needs

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Abstract

Undergraduate students are subject to increasing learning pressures relating to the amount, level and variety of reading and research they are required to undertake in relation to taught sessions and assignments. This paper outlines a problem-based learning exercise designed to facilitate a deeper and more managed understanding, while at the same time teaching students the importance of effective group working. To ensure validity of the teaching approach adopted, the core knowledge and professional values of the Higher Education Academy are discussed in relation to the developed learning exercise. It is concluded that the learning exercise developed is useful in promoting an in-depth and managed critical understanding, but that students still require guidance in relation to learning outcomes of the exercise and appropriate resource usage. The use of colleagues is cited as being an effective resource to utilise when reviewing the use of a PBL and attempting to increase its effectiveness as a learning approach.

Introduction

Undergraduate students are increasingly subject to learning pressures relating to the amount, level and variety of reading they are required to undertake in relation to their studies (Savin-Baden, 2001). Enabling students to 'manage' this 'learning situation' effectively has, in recent years, become of increasing importance due to the rapidly expanding media formats in which information is presented. Equipping students with the skills to manage knowledge effectively, rather than just assimilating it, is seen as key to successful study and future employment (Savin-Baden, 2001; Blumhof *et al.*, 2001; Biggs, 2003).

Problem-based learning asserts that the curriculum content for a particular course or module should be organised around problem scenarios rather than subjects or disciplines. Students are then expected to manage such situations and acquire a series of answers which are not defined beforehand (Savin-Baden, 2001; Biggs, 2003). The onus is on the student to manage the information obtained in a manner that allows them to develop an effective understanding. Just as much as PBL encourages the development of a wide variety of answers and study skills, so PBL can be implemented in a correspondingly diverse manner (see Belt, 2001; Blumhof *et al.*, 2001; Solem, 2001). As long as the central aim of the learning exercise is to encourage the student to explore a wide range of information which was not predetermined beforehand, and in turn become aware of the learning and skill development needs they need to explore a particular issue or issues (Savin-Baden, 2001; Lee, 2001; Biggs, 2003). In the second year of undergraduate study, students are generally expected to consult an increasing variety of information to help them develop a deeper more critical level of understanding than they may have done in previous years of study (UH, 2003). Therefore, PBL can be used to encourage students to explore a variety of information sources and develop the necessary study skills needed to effectively manage their learning.

A deeper understanding of information can occur when learning involves relating parts of the subject matter to the real world, and when information is subsequently interpreted and understood in a differing way (Säljö, 1979; Biggs, 2003). By adopting a PBL approach, based upon group not individual learning, a degree of student 'learning autonomy' can be promoted that encourages a deeper understanding of the material provided, for if the students are to engage in meaningful conversation they will 'actively' aim to understand identified material, which can subsequently be verified and discussed in a group situation (Laverty, 1998; Biggs, 2003). PBL in a group situation can also be claimed to promote, as other group learning approaches do, greater flexibility in the toleration of different learning styles. Such an educational goal is key to encouraging effective learning amongst a diverse student body, for students with differing levels of study skills can then work together to achieve a common goal, that of understanding a particular issue (Beswick, 1977; Cox and Gibbs, 1994; Laverty, 1998). The resource based learning approach is also useful in promoting a deeper level of understanding, as it more realistically copies how people learn in reality, that is via collection and interpretation of a variety of information to solved problems (Laverty, 1998; Lee, 2001, Savin-Baden, 2001). The existence, and promotion of such learning techniques, could also be claimed to play a key role in widening and encouraging more individuals to enter into higher education. PBL can help to demonstrate to potential learners that a wide variety of teaching and learning approaches are actively being employed to embrace the needs of the learner, not the institution.

In order to provide a group of second year undergraduate students, undertaking the module 'Global Change', with an understanding of how human water needs can be met a problem-based learning (PBL) exercise was developed. As part of the aforementioned module, the students are expected to develop an understanding of water resource issues in a changing world. In particular, they are encouraged to think about the distribution of water resources and associated needs from an anthropocentric perspective. Therefore, the PBL exercise was designed to allow four 'learning outcomes' to be achieved:

- an understanding of how human water resource needs can be met;

- an understanding of the positive and negative aspects of key solutions to human water needs;

- an appreciation of how to manage information sources effectively; and

> *Equipping students with the skills to manage knowledge effectively, rather than just assimilating it, is seen as key to successful study and future employment*

- an appreciation of the need for effective group based research work and presentational skills in communicating information

The article proceeds to outline the PBL approach adopted to promote an understanding of how human water resource needs can be met, and how the professional and educational validity of the approach was ascertained. Finally, the teaching approach developed and implemented is reflected upon, with subsequent modifications being suggested for future use.

Methodology

In order to facilitate an understanding of how human water needs can be met, by a group of 40 students, the students were asked to split themselves into groups of five. They were then handed a copy of the 'trigger' developed to initiate the PBL exercise (see Figure 1). They were then requested to identify and discuss five solutions to how current and future water needs can be met. They were then given a week to research their answers, before presenting their answers, via a ten minute PowerPoint presentation, to the class a whole. Following the student

Figure 1 – Problem Based Learning Exercise Trigger

'One flush of a toilet in the developed world uses as much water as the average person in the developing world uses for a whole day's washing, cleaning, cooking and drinking.'

(United Nations International Year of Freshwater, 2003)

presentations, the key issues they were expected to focus on were discussed to help ensure parity of understanding. All group presentations were then disseminated to members of the cohort undertaking the module via study-net; the University of Hertfordshire's e-learning environment for students.

Assessing Professional and Educational Validity

To demonstrate the professional and educational validity of the teaching approach developed, linkages with the core knowledge and professional values of the Higher Education Academy were identified. In particular, linkages were looked for in relation to the following areas of core knowledge (THEA, 2005):

K1 the subject material you will be teaching;

K2 appropriate methods for teaching and learning in the subject area and at the level of the academic programme;

K3 models of how students learn, both generically and in their subject;

K4 the use of learning technologies appropriate to the context in which you teach;

K5 methods for monitoring and evaluating your own teaching; and

K6 the implications of quality assurance for practice.

Linkages were also looked for in relation to Higher Education Academy's professional values (THEA, 2005):

V1 a commitment to scholarship in teaching, both generally and within your own discipline;

V2 respect for individual learners and for their development and empowerment;

V3 a commitment to the development of learning communities, including students, teachers and all those engaged in learning support;

V4 a commitment to encourage participation in higher education and to equality of educational opportunity; and

V5 a commitment to continued reflection and evaluation and consequent improvement of your own practice.

Linkages between each of the core knowledge areas and professional values were then identified in the case of the teaching approach developed. The specific details of the linkages identified are detailed in Tables 1 and 2 (overleaf) .

On the basis of the information contained in Tables 1 and 2, the learning approach adopted can be assessed as being professionally and educationally valid.

Reflections and Modifications

In general, the learning activity progressed well, the students managed to identify many of the key approaches used to meet human water resources needs. A good awareness was also demonstrated of the positive and negative aspects of varying approaches used to meet human water needs. However, it became apparent from the student presentations that students confused two quite separate issues. In particular, they did not solely concentrate on how human water needs could be met in purely physical engineering terms, which the PBL was designed to

Table 1.

Linkage to Higher Education Academy Core Knowledge and Values

K1   The activity requires the lecturer to have a good understanding of the both the relevant subject material and the skills required to structure the PBL 'trigger' in such a way as to promote effective learning.

K2   The activity would appear to be appropriate for second year students as it assumes a certain level of independent learning skills and maturity in being able to work effectively in a group situation. It also encourages students to draw upon a variety of information sources second year students are expected to increasingly consult and interpret.

K3   This kind of learning activity is likely to result in deep learning rather than surface learning, as the students are actively engaged in determining the extent of their learning for they have to determine what is of relevance and what is not (Gibbs, 1992; Ramsden; 1991; Savin-Baden, 2001; Lee, 2001; Biggs, 2003).

K4   This activity requires the use the library catalogue to identify suitable resources held by the library, for example, books, journals, reports etc...), and the use of the internet to identify reports written by government agencies and various Non-Governmental Organisations. The activity also requires the students to make use of PowerPoint to help them effectively present back the findings of their research.

K5   The session was monitored and evaluated via the group presentations the students were asked to undertake. This session not only allowed the student understanding of the issue to be checked, but also allowed students to ask questions of each other and become aware of differing approaches to how the issue could have been approached. This presentation and discussion process was carried out to enable improvement of teaching and ensure the session was effective.

K6   The provision of lecture feedback at the end of the presentations and subsequent discussion helped to ensure equality and parity of answers students were expected to develop in relation to the PBL trigger. The process of assessing knowledge via the group presentations also helped to assess understanding. The student presentations were checked for accuracy before being up-loaded to study-net; the University of Hertfordshire's e-learning environment for students. This process was designed to ensure the basic quality of the presentations produced by students which would be used for future learning / revision purposes.

Table 2.

Linkage to Higher Education Academy Professional Values

V1   The use and development of this learning approach demonstrates a commitment to scholarship by identifying and developing alternative ways of learning and teaching.

V2   The approach chosen helps to empower the learner via the granting of autonomy during the learning process.

V3   The learning activity encourages the development of learning communities via the active formation of groups. The feedback opportunity also enables the development of learning communities that are inclusive of students and teachers.

V4   The learning activity encourages equality amongst the student group as it creates a situation whereby students of differing levels of skills and experience work together

V5   The encouragement of student discussion and dialogue via the presentations helped to ensure that the learning activity is continually improved and reflected upon.

encourage. Instead, they also focused on methods adopted to ensure the control of water usage, and the policy role played international agencies, for example, the United Nations.

The PBL exercise was designed to encourage the students to solely focus on how human water needs could be met in 'physical terms'. For example, students were expected to discuss the development of dams / reservoirs, desalination plants, usage of groundwater, the use of 'grey' water. It also became apparent from the presentation that students struggled to adequately structure their presentation in a logical and clear manner, with generally poor usage being made of the available resources. More often than not, students failed to provide an adequate introduction and conclusion to their presentations, which failed to indicate how current and future water resource needs, could be met. In this respect, the summing-up discussion held towards the end of the session was central to crystallising and ensuring student understanding.

Following the initial usage of the above learning technique, the PBL exercise was given to colleagues to discuss. From that discussion, it was observed that colleagues made the same decisions as the students in relation to issues to discuss i.e. colleagues focused on methods adopted to ensure the control of water usage, and the policy role played international agencies, for example, the United Nations, in addition to identifying more 'physical' engineering approaches developed to meeting human water needs. Upon discussing this similarity of judgement and the wider problems to emerge from the student presentations the following suggestions were forwarded to allow the PBL to run more effectively next time it was used.

> *the summing-up discussion held towards the end of the session was central to crystallising and ensuring student understanding*

i) Clearly indicate to the students that they are expected to identify five engineering based approaches to how human water resource needs can be met.

ii) 'Brainstorm' with the module cohort as whole in relation the resources they should draw upon. This should allow key resources to be identified by the students but as part of a wider group exercise that allows for tutor feedback to be given at a stage crucial to the development of effective research. In particular, it was suggested that students be encourage to identify and consult international and national government agency web sites and reports (e.g. United Nations, International Water Association, WaterAid, and European Union Environment Commission). Use should also be made of core texts that have been recommended to the students during previous lectures and workshops, which should also help to guide the students to the appropriate sources of up to date and relevant information.

iii) Provide greater guidance on how the students are expected to structure and conclude their presentations.

Conclusions

The exercise was generally successful in allowing students to manage the development of their understanding of how human water resource needs can be met. However, following the student presentations and a review of the PBL with colleagues, it was found that more guidance should be given the students in relation to the resources they should consult, how they should structure their presentations, and what 'aspect' i.e. more physical engineering based solutions, they should aim to understand and discuss in their presentations. Assessment of the developed teaching approach in the context of the core knowledge and professional values of the Higher Education Academy allowed the educational and professional validity of approach to be ascertained prior to use. Subsequent discussion of the PBL exercise with colleagues proved extremely useful in reviewing and improving the learning approach for future student cohorts. It was subsequently suggested that PBL exercises are discussed and reviewed with colleagues so as to allow PBL exercises to become as effective as possible.

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