THE ROLE OF SELF AND PEER APPRAISAL IN CONSTRUCTION EDUCATION AND ITS CONTRIBUTION TO THE CONCEPT OF LIFE LONG LEARNING

Andrew Knight and Paul Watson

School of Construction, Sheffield Hallam University, City Campus, Sheffield, S1 1WB, UK

The importance of life long learning has become a central focus for professional bodies in the construction industry. It is recognized that if the traditional professions are to prosper in the new millennium then individuals and organizations must be flexible and proactive in their approach to learning. In response to this cultural shift universities are offering CPD programmes and higher degrees which are specifically aimed at professionals currently employed in the construction industry.

A research project undertaken at Sheffield Hallam University over two years has established that innovative teaching and assessment methods are particularly suited to improve the quality of learning for construction industry professionals reading for postgraduate qualifications. The process has resulted in the production of reflective practitioners who are most capable of making a valued contribution to their host organizations.

This paper examines the challenges of teaching academic based subjects to a diverse postgraduate population. Cognitive psychology is used to model how students learn whilst qualitative and quantitative methods of data collection are employed to evaluate the teaching techniques. If students are to add value to their companies the need for a strong semantic knowledge is important. This is in contrast to the temporal-contextual knowledge often associated with traditional teaching and examination revision. A practical two stage model of learning is investigated that includes Computer-based Learning, self and peer appraisal.

Keywords: computer-based learning, semantic knowledge, rehearsal, peer appraisal, self appraisal, economics.

INTRODUCTION

The concept of life long learning has been advocated by the current government. This fact is corroborated by Dr Kim Howell being appointed the Minister for Life Long Learning. Within the construction industry personnel should be confident and capable of learning from previous experiences and transferring this experience into practice. Thus, the industry requires reflective practitioners. However, the provision of reflective practitioners is dependent upon the educational processes they are subjected to. Only by escaping from previous modes of temporary knowledge attainment and employing a more enlightened approach via deeper understanding can a truly reflective practitioner be produced. This research is illustrated using students studying construction economics. The subject area is concerned with efficient resource use within the built environment and has become increasingly important to managers associated with the construction industry owing to the focus on sustainability.

Owing to the complex and abstract nature of academic subjects, students of economics may adopt a superficial method of memorizing subject matter in order to pass examinations and coursework assessments. This method of learning is not helpful when students are faced with a more challenging question at masters level. More importantly, they may have difficulty in applying taught material to practical work related situations. Tulving (1983) made a distinction between two different types of knowledge; semantic and episodic.

The model in Figure 1 helps us to make sense of our own personal experiences. However, there must be some interaction between these knowledge sets; they are not mutually exclusive. How many personal experiences of leopards do you need before it becomes permanent knowledge that they have spots? Some models such as HAM (Human Associative Memory) are able to represent the interplay between the episodic and semantic while other models make no attempt to deal with the episodic. How do these models assist in the teaching of construction economics and what role can self and peer appraisal play?

Many students in the study group admitted to forgetting their previous knowledge of economics almost immediately after completing their undergraduate course. This demonstrates the use of an episodic knowledge base. The authors also have experience of groups of students ‘learning’ pages of similar models by the shapes of the line rather than the actual meaning. Within days of taking the examination the knowledge is usually forgotten. This leads to the conclusion that the knowledge was episodic and, therefore, implies the course was not meeting its learning outcomes in the long term.

So how can we assist students in utilizing semantic knowledge in their learning? As discussed by Cohen (1991) and Spencer (1991) personal experience and repetition of activities assist in making knowledge permanent.

The Dual Memory Model (Figure 2) has been important in directing research over the past three decades. It recognizes the importance of the short term memory for calculation and material that is only required in the immediate future. However, the model also demonstrates how the short-term memory allows access to the long-term...
memory via a process called rehearsal. The major disadvantage of text books and traditional teaching is that they do not allow dynamic modelling or regular feedback with large numbers of students. Therefore, the trial and error of learning is removed and there is a lack of rehearsal of the subject material.

**METHODOLOGY**

The first stage of this study examines the use of computer-based learning (CBL) in formative assessment as a tool for increasing deeper semantic understanding and knowledge rehearsal. The study sample consists of students enrolled at Sheffield Hallam University undertaking the construction economics unit \( n=25 \). During arranged sessions students worked through a selected tutorial program at their own pace. A brief introduction to the software was given by the lecturer. Although test results were recorded for diagnostic purposes the evaluation of the session focused on informal discussion with individual students. At the end of the semester a focus group method was employed as described by Krueger (1988). This qualitative approach allowed the students the share their experience of CBL in a semi-structured manner.

The second part of the study attempted to design and implement a summative assessment influenced by the cognitive models described in the literature. A peer assessment exercise was designed and the results were analysed. The detail of the method used is included in the following sections. The student and lecturer grades were correlated and compared to previous studies. The difference in the mean grades were tested for statistical significance.

**COMPUTER-BASED LEARNING**

With computer-based learning, models can be presented to students as dynamic variables. For example, students could change the discount rate and see the effect on the economic life of a building. Students could also alter the value of the next best alternative use and again examine the effect. Once the students are confident with the basic variables more experiments could follow. What would happen if the building was ‘listed’? How could the model reflect the need for government intervention due
to the imperfect market? CBL would take students away from the short term memorizing of stationary graphs and allow them to experience fluid models enabling them to understand, adapt and evaluate the model. This rehearsal should assist in developing the knowledge in the long-term semantic category.

To evaluate CBL, a program called Winecon was used with a group of MSc construction students studying construction economics.

**Winecon**

Winecon is a CBL programme designed by a group of universities with funding from the government. The quality of the product reflects the high cost of development. A variety of tools are available for the student, these include a glossary of economic terms and a calculator. The format allows flexible learning depending on the students previous knowledge. A good example of this is the ‘More’ and ‘Advanced’ buttons which are often displayed and provide further information. Tutorials are the primary source of learning. They often take approximately 30 minutes to complete although this varies with the student and the subject matter. Material is presented in a short concise manner and graphs and examples appear dynamically with the text. There are a number of subjects to choose from and these can be grouped by the lecturer for various courses. After the completion of a unit, students can test their ability using ‘Tests’. These cover the same topic areas as the tutorials. Examinations can only be set by the lecturer.

**Winecon in Use**

Welfare Economics is concerned with the socially efficient allocation of resources. These theories underpin areas such as planning law, market failure and Cost Benefit Analysis. However, students often get confused by theories such as ‘Pareto’ owing to the abstract nature of the material. The tutorial displays information for students to read but more importantly it is distinguished from a book by the amount of interaction available. For example, students are asked questions and advised if they are correct or incorrect with further explanation assisting the less able students. Also, each individual can work at their own pace. The tutorial was described as ‘excellent’ by the majority of the students. The evidence of success was displayed in the examination when several students distinguished between Pareto improvements, Pareto optimal and Pareto non-comparable allocations of goods.

Students enjoy using IT and research has shown this can increase the motivation to learn (Sell 1996). Many of the students returned to Winecon before the examination and the authors believe this had a positive effect on the learning experience. Almost 80% of the students agreed that the software had improved their understanding. One of the most praised advantages was the confidence boost provided by instant feedback in the tutorial test; something traditional assessments fail to provide.

The use of CBL has obvious advantages for increasing the depth of knowledge allowing personal rehearsal and instant formative feedback mechanisms. However, to maximize successful learning the compulsory summative assignments also need to be designed within the semantic knowledge model.

**SUMMATIVE ASSESSMENT OPTIONS**

When considering the various assessment options a useful model of the key processes required for successful learning is proposed by Race (1994). The key factors in learning being;
• The importance of wanting to learn;
• The fact that most learning is achieved by ‘doing’;
• The importance of receiving feedback from other people;
• The need to make sense of what has been learned; to digest.

It is evident that there are conflicts between this model of learning and various types of assessment. Examinations are often used as a primary form of assessment, although many authors in the area of assessment doubt them as a means to promote learning. For example, the only form of feedback given following an examination is the final mark. How can students effectively learn from this? There is also little chance of students having time to digest and consider examination results because examinations are almost always used at the end of a unit. However, the need to pass examinations can act as a powerful motivation to learning in the revision period. The sample unit also includes a continuous assessment (CA) element which provides a degree of flexibility for ensuring the summative element is focused on improving semantic knowledge.

Various methods of assessment were considered for the unit and included; standard essays, role plays, note form essays, open book tests, etc. Gibbs and Habershaw (1993) provide a useful overview of methods, however, the authors were not convinced that any of these methods were the best option. There are several factors to consider when evaluating how useful an assessment strategy could be.

• Will the learners ‘want’ to do the assessment?
• Will the learners enjoy the assessment once they have started working through it?
• Have the part-time students got the available time and access to the resources to complete the tasks?
• Will the full time students with less industrial experience be disadvantaged?
• How can the feedback be structured to ensure maximum learning from the experience?
• Will the marking criteria be clear and fair?
• How do I ensure reliability and validity?
• Can the students demonstrate M (Master’s) level?
• Can the timing of the assignment be structured to allow enough time to digest and reflect?

Whilst evaluating the above issues a reference in The Assessment Handbook (1997) to a keynote lecture delivered at Sheffield Hallam University 1996, was considered:

*Selecting the right method of assessment is clearly important. If we want students to read widely we could ask them to produce annotated bibliographies rather than write yet another lengthy essay which may or may not have the required extensive research.*

This quotation clearly addressed one of the main concerns at M level. Because many of the students are working 40 or 50 hours per week in industry many may produce work which suffers from a lack of research in the preparation. There is also often a lack of incentive to achieve a higher mark because the MSc is un-graded. If these two
effects combine then the end result may not reflect the M level characteristics required. Therefore, the use of an annotated bibliography may provide a solution.

The result was to set two coursework assignments, both on the same topic area but requiring different skills. Students were asked to consider the effect on the construction industry of implementing a national minimum wage. Based on this area two assignments were set, A and B. Assignment A was to produce an Annotated Bibliography. Students would need to research and evaluate sources of information. These may include newspapers, academic journals, trade journals, government publications, text books, Internet, CD-ROM etc. Because this is an individual piece of work it should ensure students research the area to an adequate depth. The activities of evaluation and research which are a fundamental part of the work reflect the nature of the M level aims specifically stated in the course document. This work was then handed-in and feedback provided to highlight areas of strengths and weaknesses before Assignment B was completed. A 20% weighting was applied to Assignment A to ensure the emphasis was on constructive feedback rather than judgement. Assignment B was a report on the effect of the minimum wage on the construction industry. From the feedback provided on the bibliography, and the wide range of reading completed, the report should stand a greater chance of displaying the desired learning outcomes.

A key issue highlighted by students, and our own self-reflection, was the quality and timing of feedback. This is a central feature of assessment and is also fundamental in Race’s (1994) model of learning.

PEER AND SELF ASSESSMENT AS A VEHICLE FOR SUCCESSFUL LEARNING

Planning Peer Assessment

Peer assessment is the process whereby groups of individuals rate their peers. Obviously this requires an element of maturity and evaluation skills, and therefore appears to be well matched to the needs of postgraduate students. It is broadly accepted that the assessment demands placed on students, influence the type of learning which takes place (Laurilard 1984) and devolving some responsibility to students is often seen as a means of enhancing the learning process (Boud 1989). Common to the success of peer assessment is making clear and explicit marking criteria (Falchikov 1995).

Most studies of peer assessment tend to be in areas of group work and practical assessment. However, there is no obvious reason why peer assessment cannot be used to evaluate Assignment A (Annotated Bibliography).

The advantages of using peer assessment to evaluate the Annotated Bibliography are:

• Learners critically evaluate each others work;
• Learners can critically reflect on their own performance after judging others;
• Feedback is very fast;
• Assessment is seen as more explicit when students take ownership of the criteria;
• The grading can be more reliable because there are more judges.

All these advantages match well with the psychological models previously noted. Falchikov (1995) provides some useful guidance on Peer Assessment. Her work is
useful because it highlights some of the problems which may occur and how to minimize these during assessment planning.

**Implementation of peer assessment exercise**

The session progressed as follows:

- Each group elected a Chair to time manage the group;
- Each group discussed the criteria;
- The class then pooled their views over the criteria to ensure equity across groups;
- Each student was provided with five criteria mark forms;
- The students were briefed on the importance of giving good quality feedback. The aim was to facilitate learning and areas of both strength and weakness were included;
- Each student in a group then assessed each piece of work for five minutes. Notes were made using the criteria forms and learners worked individually with Chairs ensuring time management;
- After approximately twenty five minutes the groups discussed each piece of work;
- The final feedback was agreed and written on a standard school assignment cover sheet and a grade was awarded;
- The collection of all work and the checking of the references was made before students left the room.
- Informal feedback on the session was given;
- The work was moderated over the following week adding more feedback and adjusting marks as necessary.
- Work was handed back and students were asked to discuss on an individual basis with tutors how they thought they had performed (self assessment). Further written feedback was provided with verbal guidance for assignment B.

**REFLECTION ON THE USE OF PEER AND SELF ASSESSMENT**

Immediately following the session, informal evaluation of the exercise was carried out. A high proportion of the students felt the experience had been beneficial by enabling them to reflect on their own work. These opinions are similar to those found by Falchikov (1995) where the overwhelming view was that peer assessment was perceived to be useful, reliable and a valid exercise.

To assess the reliability of the peer marking, the marks were moderated and correlated. The correlation coefficient was computed at R=0.4298. An analysis of the scatter-graph indicates that in general students tended to over-mark work which confirms earlier studies in this areas (Stefani 1994). The student mean was calculated as 63 and the tutor mean 59. However, using the ‘t’ test for related samples the difference is not statistically significant ($p > 0.05$). The scatter-graph is also useful for identifying outliers, these are results that do not follow the trend. In the scatter graphs there are two outliers which were then revisited. In both cases the peer assessment had not recognized the quality of the work. This is a good illustration of the potential failure of peer appraisal if not properly monitored. In the case of one outlier, the
students had graded the work at 60% although it was worth 80%. In the feedback session the marks were discussed with both the appraisal group and the student who submitted the work. The appraisers had failed to see that the work evaluated many sources of information and that the evaluation was very detailed and valid. Tutor feedback helped both the appraisers and the individual student. A less able group may not give credit for the best work because those who apprised did not have the ability/knowledge to recognize the quality. This finding again confirms research by Stefani (1994) where high achievers were under-marked.

There was a significant difference between the accuracy of marks between groups of appraisers. Correlations varied from R=0.97 in the best group to R=0.11 in the worst group. Again this additional information allowed the targeting of feedback regarding the session when speaking to individual students. It must be emphasized that the correlation coefficient values only relate to agreement with the lecturers marks not the ‘correct’ marks, which obviously cannot exist. For this reason the quantitative measures of group performance were not given to students although it was a useful aid in identifying those who had a lack of understanding.

**CONCLUSION**

From both personal observation and academic research there appears to be a general problem with student understanding in the area of economics, particularly for those who are studying economics as a minor part of their programme. This may be due to the abstract nature of the subject and the level of background philosophy required to understand the theories. To cope with this situation many students appear to adopt a superficial and mechanical method of rote learning with the principal aim of passing the assessment. The result is that the knowledge gained is only temporarily stored and soon forgotten following the examination.

As an aid to learning, IT has a positive and important role in education. By experimenting with a group of MSc students it appears that the ability to use variables and model in a dynamic way increases the understanding above the level traditionally acquired through textbooks. This process of doing and discovery closely follows Piagetian theory which promotes the ‘active classroom’ (Piaget 1971) where the goals
of education are to create ‘critical, creative and inventive discoverers’. A second key attribute of CBL is the instant feedback available to students. According to the group, this increased student confidence and assisted in the rehearsal process necessary for deeper understanding. The individual nature of the computer programme allows students of different standards to work outside timetabled tutorials to obtain the necessary base knowledge for applied discussion of theory. The central storage of marks provides a useful diagnostic indicator for the tutor who needs to direct time effectively. After the implementation of CBL both the sample group and the authors believe it to be a useful tool to enhance student learning.

To improve the learning potential of summative assessments a two stage assignment was designed to include self and peer appraisal. An implementation model was designed in accordance with previous research. The peer appraisal sessions appeared to develop a student’s ability to reflect on the wider issues surrounding the material and its assessment. Although there were statistical differences in the marking accuracy, most students agreed that the sessions provided a valuable learning opportunity which, importantly, could be acted upon in the second assignment. In conclusion the use of CBL, peer and self appraisal provided a useful framework for enhancing student learning in the sample.

REFERENCES


