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Teaching Hashtables for Data Structures

Richard Shipman rcs@aber.ac.uk

April 28, 2006

Abstract

In teaching data structures I have observed that students have had difficulty engaging with some of the more abstract topics. To this end I chose to set an assignment for the course on a particular topic which I would not cover in lectures until after the assignment was due in, I will measure the success of this technique by examining the results of examination questions on that topic.

1 Introduction

Data Structures and Algorithms is a course that is fundamental to a computing degree scheme, there is a lot of theory written about the area, and students sometimes find it difficult to engage with the succession of data structures that are presented to them. While students can usually understand the relevance of the more straightforward data structures, the more abstract ones often fail to have relevance to them.

In the degree scheme at Aberystwyth, Data Structures and Algorithm Analysis is presented to second year students as a 20 credit module, that is compulsory to all schemes involving programming, and is run across 2 semesters, with a large assignment in each semester and a two hour examination at the end of the second semester.

My intention is to choose one of the less well understood Data Structures, in this case the Hashtable, and set the students a piece of assessed work to implement a solution to a problem using a Hashtable. Only after the assignment is handed in, will I present the lectures on the theory of hashtables.

I hope that this will encourage some of the students to attempt to read around a subject a little before a lecture on a topic.

I will measure the effectiveness of this technique by comparing the examination performance on the hashtables question compared to a similar question set the previous year.

I will examine the results of this research looking at learning styles and which forms of learning style suit this type of practical material.

2 The assignment as set

The assignment that was set involved the combination of 2 data structures — graphs, which had been presented in lectures, and hashtables, which had not, and the students were informed of the fact that they would have to research and implement a program involving hashtables in order to complete the assignment.
The assignment brief included various types of sources, including textbooks, on-line documentation, and code examples to attempt to satisfy students who would learn from different styles of information.

3 Results

Some of the responses in the student questionnaires complained about the fact that I had set an assignment that involved material that had not yet been covered. As the questionnaires were anonymous, I could not correlate this against attendance at lectures to ascertain if the students complaining had missed the lecture where I explained the reasoning.

The hash table lectures were given immediately after the assignment was handed in, and the level of attention and questioning from the students was definitely more than in previous lectures, both for previous years on the same topic, and from previous lectures given to the current group on other topics.

The performance on the hashtables question in the examination was certainly better than in previous years, more students attempted it, and the level of understanding of the topic demonstrated in the answers was much more impressive than in previous years - there was a 10 to 20% increase in the results on the hashtables question over the previous year.

4 Implications

I believe that the technique improved student understanding of the Hashtable data structure. The students appreciated the problems that can be solved by using a Hashtable, and were better able to contextualize the information that was being delivered in the lectures after the assignment hand-in.

There is a lot of research on learning styles and teaching programming to undergraduates, and the Kolb Learning Style Model may be useful here to attempt to understand why computing students at Aberystwyth appear to perform better given the previously stated circumstances. Kolb indicates that active experimental learners, should benefit from being about to experiment with the material in and learn through application of the theory. In this case, however, rather than present the theory and allow the students to apply it to a situation, I have taken it one step further, and instructed them to find the theory, using the supplied sources in a way they were most comfortable with, and apply that theory to produce a result.

The fact that students do not appear to be motivated to read and do work unless they are being assessed on that work is a big issue. There is a growing number of students that are in Higher Education not to learn, but to obtain the certificate, and it is those students I am attempting to encourage to read about a subject.

5 Conclusions

The improvement of the students understanding of the area was noticed in the answers given to the relevant examination question. Students performed between 10 and 20% better on the same question than in the previous year.
I have not been able to repeat exactly the same practice this year with the same module as the timetable has been re-arranged so as to not allow it to be done easily. I have, however, managed to use a similar idea of using assignment work to encourage background reading in more subtle ways, and I believe that this has met with less resistance and should result in less negative feedback from students than last year.

Plans for future years include more use of worksheets to assist those students who are more active learners as characterised by Kolb type 3 and 4, rather than the reflective learners.

Datastructures is a subject that requires an amount of practical work in order to demonstrate the requirement for studying it.