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Attitudes of Students to Independent Learning

S. Kenneth Houston
University of Ulster

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S. Kenneth Houston
School of Computing and Mathematics, University of Ulster
Jordanstown, Northern Ireland

INTRODUCTION

First year undergraduate degree students and second year undergraduate diploma students of mathematics at the University of Ulster take a one semester course which is called "Mathematical Modelling" that embraces not just mathematical modelling but also a study of some mathematical models and relevant mathematical methods. It is a second semester module and they will have taken courses in algebra, calculus, statistics, and computing beforehand.

The mathematical methods studied largely relate to the algebraic solution of first- and second-order ordinary differential equations such as are found in most courses of this nature and are covered in chapters ten and eleven of James (1992). The mathematical models studied make use of these differential equations and include such topics as population dynamics, projectile motion, and oscillations. (See, for example, Burghes and Borrie, 1981.)

Students are introduced to the process of mathematical modelling through problem-solving modelling activities carried out in small groups (usually of size four). They are taught, and encouraged to develop, communication skills through the group work and through written reports and oral and poster presentations (Berry and Houston, 1994) and comprehension tests (Houston 1993). They engage, from day one, in the group modelling activities; this continues as a regular weekly activity throughout the semester.

In the past, the methods and models parts of the curriculum have been taught via traditional lectures and tutorial classes. In 1992-93 and 1993-94, the methods part of the curriculum has been studied by "independent learning" with peer-tutor support.

There were several reasons for making this change. There was the desire to respond to pressure to be "doing more with less" i.e. to try to remove the teacher from the classroom for at least some of the time. More importantly there was the belief that students should be encouraged from an early age to take more responsibility for their own learning and to develop peer support groups to help one another learn. There was the belief that students should be encouraged to engage in "active learning", to seek out information for themselves and to convert it to knowledge in order to achieve personal understanding. (See, for example, Denicolo et al., 1992, Entwistle and Tait, 1992.) There was the belief that the requirement to tutor someone in a topic enhances learning by the tutor - "To teach is to learn twice". The learning resource most readily available to students is their peer group, and it was considered desirable to set up structures to encourage students to use one another in this way. There was the belief that students who engage in self and peer assessment are better prepared for tutor assessment.

"What we need are mathematicians who enjoy their work and not think it's a drag, pain or bore!"

Then the subject matter of the methods curriculum lends itself to learning by independent study. The material is fairly standard and is well presented in many textbooks. (The textbook chosen as the "reader" for this course was James, 1992.) Explanation is supported by worked examples and test questions (with answers).

METHODOLOGY

On day one students were assigned to groups of three or four. These groups were to function both as task groups for the mathematical modelling strand of the course and as peer tutoring groups for the methods strand. These strands and the "study of models" strand ran more or less in parallel through the semester with one two-hour slot per week being assigned to each. It was intended that the lecturer would not be present during the independent learning sessions, but

would deal with questions at other sessions, and that some senior students would be available from time to time to act as tutors and to answer questions. After four weeks the groups were allowed to self-select into new groups. Some stayed the same.

A suggested schedule of readings from the reader was published together with a list of learning objectives - "Having studied this section you should be able to ...". Students were instructed to read the explanation, study the worked examples and attempt a solution of the test questions. They were encouraged to talk to one another in their group about the work and to discuss their solutions to the test questions. A computer algebra package was available to them to use to check answers (which were sometimes wrong at the back of the book). It was suggested that they should attempt

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to construct their own examples of the different differential equations, to write out solutions, and to give them to one another to try. Progress through the independent learning strand was not monitored by the lecturer. Students had been requested to be responsible for their own learning and to use all available resources. The following two paragraphs are extracted from a course handout:

"But this module is about more than just three Ms of Mathematics. It is also about growing up, about cutting apron strings or umbilical cords. It is about becoming independent where previously you were dependent and paradoxically, it is about becoming dependent where previously you were independent."

"Previously your teacher was your sole source of knowledge and wisdom. You depended on her to tell you exactly what to learn and how to learn it, and to prepare you for the big tests of life such as GCSE and A-Level. Now the lecturer is just one of many sources of knowledge and wisdom which you will have to access. The lecturer is a scarce resource and you must learn to make best use of the time that she can afford to give to you. Other resources available to you are books and yourselves - yes, yourselves, one another, your peers in this class. You must learn how to use books and how to help each other to learn. Assessment is an important part of learning. Not just the "big test" at the end, but all the little tests as you go along. You must learn how to assess your own work and how to help each other to assess your own work by assessing each others' work."

Furthermore, students were told that they should keep up with the scheduled readings so that they would be in a better state to understand the lectures on models. They were advised that the methods and models strands would be summatively assessed by written examinations at the end of the semester. The modelling strand was summatively assessed by written reports and oral and poster presentations. There was also a comprehension test.

EVALUATION

During the first session (1992-93) our primary interest was in assessing student attitudes to the peer tutoring/peer learning aspects of the programme. This has been reported elsewhere by Houston and Lazenbatt (1994). The students readily accepted the need to work in groups and to support one another in the group project work on the modelling tasks. However, they did not so readily accept the ideas associated with peer support and peer assessment of the independent learning activity. They found the textbook hard to understand, and they preferred to work at their own pace and not to have to meet weekly deadlines. They did not appreciate the value of setting their own questions. The found it difficult to support one another because they themselves had an inadequate knowledge of the subject matter.

A majority of students had an overall negative attitude to the scheme. These students were mostly in the diploma class and this attitude may be understood by recognising that they were coming up to their final examinations, that they had had a fairly "dependent" style of education up to now and consequently were anxious that this new style might prejudice their ability to obtain a good grade.

Having learnt this during 1992-93, it was decided to persevere with the independent learning scheme through 1993-94 but to try to improve it.

Better written support materials were prepared which set clearer and less ambitious goals for each week's learning. It was decided to try to impress upon

students the idea of taking responsibility for their own learning and how this and the peer tutoring aspects of the programme would benefit them.

The outcome of the 1993-94 evaluation indicates that students were very much aware of the benefits of being able to learn independently and of peer support and they were aware of the need to work consistently through the semester. However, while the spirit was willing, the flesh was weak and many students confessed to not keeping up with the weekly reading, to leaving it all to the last minute, and to not being sufficiently well prepared to ask sensible questions of the seniors and the lecturer. It was observed by us that many were not properly prepared to solve the problems arising in the models strand of the course, nor to produce analytic solutions to compare with the numerical solutions to differential equations that they met in a parallel module on Numerical Methods.

There was the belief that the requirement to tutor someone in a topic enhances learning by the tutor– "To teach is to learn twice".

The method used to determine student attitudes in 1993-94 was to include an essay question in the end-of-semester written examination. The question was:

Write an essay of about 1000 words which discusses the statement "Independent learning only gives you a pain in the brain."

This question was one of eight, with the other seven dealing with the methods and models studied during the semester. (Essay questions have been set in the past.) Students had to answer five questions and so were not required to write the essay. However 15 students out of 20 in the diploma class and 16 students out of 23 in the degree class did attempt the essay question. Marks, of course, were awarded for the quality of the essay, and not just for their views (or for telling me what they thought I wanted to hear).

Scores ranged from 5 to 20 out of 20. Of the 31 students who wrote the essay, 19 scored a mark which was greater than 20% of their total mark for the paper (which suggests that it is easier to score marks writing essays on independent learning than it is to answer questions about what should have been learnt independently).

Of those who attempted the essay question and failed the examination (i.e. scored less than 40%), (10 students) the essay marks ranged from 5 to 15. All but one of these students indicated in their essays that they recognised the benefits of independent learning and 6 of them confessed to not having kept up with their reading schedule. In the whole class, of the students who wrote the essay (31 students), all but 3 recognised the benefits of the scheme and 10 confessed to not paying enough attention to it (4 of these students did pass the examination).

The student who scored 20 on the essay obtained only a total of 40%.

The scores obtained on the essay question were not particularly well correlated with the total scores ($r = 0.5$). A more detailed analysis follows in the "Evidence" section below.

THE ESSAY

"Independent learning only gives you a pain in the brain."

The key words in this title are "learning", "independent", "only", and "pain", and answers should have referred to these. Given the discussions we had during the semester and the experiences of the students, I expected answers to define and describe independent learning with reference to how we had arranged it and their own experiences of it. The description should have discussed reading the reader, doing the exercises and checking the solutions, setting test questions, and how independent learning is different from traditional lectures. Comment on the peer support and senior student tutorials should have been included.

There should have been reference to assessment, the reasons for it (feedback, part of learning, etc.) and the methods available (using the answers in the book, each other, tutors, lecturers).

The "pain" in the title should have inspired comment on hard work, self-discipline and time management, and the "only" was intended to evoke a discussion on

the reasons for independent learning (economic, pedagogical, socio-psychological) and the benefits of it (becoming independent, etc).

The marks awarded were determined not only by the breadth of the topics covered but also on the quality of the answers.

EVIDENCE FOR THE CONCLUSIONS

Realising the Benefits

31 students wrote the essay and all but 3 recognised the benefits of the scheme. Of the 10 students who failed the written examination, all but 1 recognised the benefits. Typical comments are:

Personal Understanding

"This gives them a better understanding of the subject in the long run as the student teaches him/her self in a way that they understand."

Peer Interaction

"It is a very important part of learning to be able to listen to other people's points of view and above all be able to give your point of view and back it up with reasons."

Peer Assessment

"Students may, in their peer support group, get together and make up a test for the other members of the group. Tests may be swapped and done by the students. This helps give an understanding as students have to make up questions and so must understand the theory first."

Self Discipline

"Not coming to class prepared with the background reading meant that much of the lecture did not make sense. It is therefore a matter of sitting down and conditioning yourself to do these independent learning sessions, for in the long run it is only yourself that loses out."

Becoming Independent

"The whole reason for the drama of independent learning was to "untie us from the apron strings" of days gone by."

Confessing to Weakness

10 students, including 6 who failed the examination, confessed to not having kept up with the schedule. Perhaps the most telling comment (by a student with poor spelling) was:

"The dangers of independant cannot be over stressed, as I unfortunately can testify. The great hazard is becoming lazy, and avoiding nessicary work through lack of self discipline. This tragic situation of sitting back and letting the chapters pass by you has many unfortunate consequencies, many felt only when it is too late."

Other students commented:

"All the classes I am in I don't seem to want to bother doing any more work for than is necessary."

"So you think, "I think I will just leave that until the exam", well, it isn't going to help my coursework any. So that's it, end of discussion, well that is until a week or two before your exam when you run around the class photocopying notes, and this is the time you realise your mistake."

"We looked back on them [the readings and exercises] as something that didn't have to be done just yet."

OTHER INTERESTING INSIGHTS

Students' responses brought to light a number of interesting points.

We have seen above that some students confessed to not working through their independent learning programme as intended. Laziness was mentioned as a possible cause, but there would appear to be others.

There are a lot of other interesting things to do at University and so students are distracted from their studies to too great an extent.

"The topic of independent learning is a sore one for many students. Having to go off on your own and work is not an appealing idea to most, especially when there are other distractions about."

There is peer pressure to conform and if there is a lazy attitude in at least a section of the class, then it is all too easy to be infected by this.

"Students are under extreme pressure from their

peer group to enjoy themselves and not to seem to worry or even to do any work."

A number of students commented on the lack of motivation and interest in the subject. This was disappointing given that they choose to enroll for a mathematics course, and, it seemed to me, there were lots of interesting things for them to do.

"If I was set the task to independently learn about new fashion or music, the task would not be a pain in the brain. I would find the subject of the learning interesting and would be enthusiastic about the task. The subject again is all important and the motivation behind how it is learnt" but "it is the student's choice to be in that class."

"When it comes to group work...when the lecturer leaves so do many of the students. It is very hard to motivate people outside class time and sometimes in it."

"What we need are mathematicians who enjoy their work and not think it's a drag, pain or bore!"

The whole concept of becoming independent learners was new to them and it frightened them. There had been too much of a dependency culture at school or college.

"This [independent learning] is made harder by coming from a school background when the work is set and it must be done."

"Coming from a Further Education College, which some of us did, we had grown accustomed to being "spoon fed"."

"We all came from schools where the teachers set us work which we had to do or else get punished." Some students, particularly those in the diploma class (who were in the final year of their studies) were reluctant to get involved with peer-support. They were in a competitive situation with their peers because final rank order had a bearing on how successful they would be at the next stage, whether it is admission to year 2 of the degree course, or employment.

"It is not possible for all of us to get places [on the degree], so we are all trying to do better than everybody else. This means that in our independent learning if somebody could understand something they kept it to themselves rather than enlighten the rest of us."

The students freely gave me advice on how to improve the scheme in future - have regular, frequent, tutor-supervised assessment of the learning programme. They were just too unsure of themselves and needed authoritative reassurance that they were doing things correctly. Because there were mistakes in some answers at the back of the book, they lost confidence in this as a source of reassurance. They did not make use of the computer algebra package even though it was available, they had used it before, and it was suggested that they should.

"I felt that there was not enough checks on us. Maybe if a test had been introduced at the end of each session it would have been beneficial. I know each group had to set each other a test. But when a model project was also underway, there wasn't time."

"It is a good idea as long as it is supervised, i.e. you work towards a test or questions."

"Many people like myself need to be put under pressure to finish things."

"So instead of being the odd one out the general average person wouldn't carry out independent learning sessions unless they were forced to by a higher authority. And we therefore come back to the teacher."

"So maybe they would have been less of a pain in the brain if the book had been easier to follow and had been correct all the time."

CONCLUSIONS

This paper has described the context in which two groups of undergraduate students were introduced to the concept and practice of independent learning. It discussed their approach and attitudes to it and the methodology by which these data were collected (an end of semester essay question).

The students were well aware of the likely benefits to them of developing skills of independent learning and of cooperative learning, including peer assessment.

However, it is a curious trait of human nature that

"The good that I would I do not; but the evil I would not, that I do."
(Paul, c56)

Unless they are very self-disciplined and able to manage their time to good effect, many students put off doing their learning, sometimes until it was too late. They would have liked the tutor to keep them under pressure to do the work. They would also have liked the reassurance of tutor feedback regularly and frequently.

Some disliked the independence culture, first, because they were not used to it, and secondly, because they were unwilling to take so much responsibility for their own learning. Their previous educational experiences had not exposed them to ambiguity or independence.

Some felt (rightly) that they were in a competitive situation with their peers and so were reluctant to share their learning with them. This is an unfortunate consequence of the present economic climate where employment and study opportunities are limited. The name of the game is to get ahead of the other person, rather than for all to move forward together.

It was also disappointing to find that quite a few students were not really fired up with curiosity and enthusiasm for mathematics. Their goal in life was to get a degree as painlessly as possible.

Some valuable lessons for next year's teaching have been learned.

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